Identifying industrial clusters for competitiveness: Policy implications for economic development in the North West Province of South Africa

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DEDICATION

I dedicate this work to my husband, Pedro and my daughter, Caitlin. Thank you for the sacrifices you had to make throughout my studies and to my late father Oscar Wilfred Sithole, for always being a source of encouragement.

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ABSTRACT

Firm competitiveness is no longer an industry-specific or regional phenomenon, but it has evolved to have global impacts. The increase in intensity of regional and international competition, ineffectiveness of regional development policies and models has led to the focus on regional economic development. In particular, a focus on industrial cluster promotion, both in developed and developing countries has proliferated owing to their increased success as a sustainable source of economic growth and development. Industrial clusters are a geographically proximate group of inter-connected companies and associated institutions in a particular field, linked by commonalities and complementarities. In addition to industrial cluster formation, firms can also maintain competitiveness through internationalisation. Internationalisation ensures that firms are able to serve many markets from existing manufacturing bases without having to establish production plants in other markets. It reduces the over dependence on domestic markets and business risks associated with dependence on one market.

This study identified industrial clusters for the North West Province (NWP) of South Africa using the Structural Path Analysis (SPA) method, as a strategy to enhance firm competitiveness. It contributes to the methods to identify industrial clusters by applying the Power of Pull (PoP) method to prioritise the number of clusters for the NWP. The ten identified industrial clusters and their respective PoP rankings were (i) communication; (ii) real estate; (iii) grain mill, bakery and animal feed products; (iv) building and other construction; (v) basic metal products; (vi) other food products; (vii) agriculture; (viii) non-metallic mineral products; (ix) trade; and (x) dairy products. This study identified the most important centres, in terms of the most contributions to output, employment and profit at the local municipal level across all the ten identified clusters. These centres were Madibeng, Rustenburg, City of Matlosana, Mafikeng and Ditsobotla. This indicates that efforts to stimulate cluster formation in this sector should be focused in these regions.

This study also determined whether any association exists between the identified industrial clusters‟ products and services and the realistic export opportunities according to the DSM for products and the DSM for services. Four of the six product clusters were found to have REOs according to the DSM for products, namely grain mill, bakery and animal feeds products, agriculture, non-metallic mineral products and the basic metal products clusters. In terms of services, only two service clusters, namely communication and building and other construction services clusters, were found to have with REOs according to the DSM for services.

This study further demonstrated the effects of industrial cluster formation on the regional economy, using social accounting matrix (SAM) multipliers. SAM multiplier analysis was used to demonstrate the output, employment, employment income and gross domestic product (GDP) supported by cluster formation for the NWP. The supported activity for the agriculture and trade clusters was less than the actual activity. The following clusters‟ supported activity was greater than the actual activity; communication; real estate; grain mill, bakery and animal feed products; building and other construction; basic metal products; other food products; non-metallic mineral products; and dairy products. The identified industrial clusters‟ REOs were explored further to provide more details on the products or services identified as having REOs. In addition, the countries to which the identified REOs (products and services) can be exported were discussed. In terms of product clusters identified to have REOs, the export potential values, cell classifications and market accessibility index scores were discussed. In terms of the service clusters identified as having REOs, countries, market access, market openness, import demand and cell classifications were discussed.

KEYWORDS: Industrial clusters, firm competitiveness, regional economic development, internationalisation, decision support model, realistic export opportunities

OPSOMMING

Ondernemingsmededingendheid is nie meer ŉ industrie-spesifieke of streeksfenomeen nie, maar het ontwikkel om wêreldwye impakte te hê. Die toename in intensiteit van streeks- en internasionale kompetisie, die oneffektiwiteit van streeksontwikkelingsbeleide en -modelle het gelei tot die fokus op streeksekonomiese ontwikkeling. Spesifiek het ŉ fokus op industriële bondelbevordering, in beide ontwikkelde en ontwikkelende lande vinnig toegeneem vanweë hul verhoogde sukses as ŉ volhoubare bron van ekonomiese groei en ontwikkeling. Industriële bondels is ŉ geografies-nabye groep onderling verbinde maatskappye en geassosieerde instellings in ŉ spesifieke veld, verbind deur gemeenskaplikhede en komplementêre aspekte. Addisioneel tot industriële bondelformasie kan ondernemings ook mededingendheid handhaaf deur middel van internasionalisering. Internasionalisering verseker dat ondernemings so veel markte moontlik kan diens vanuit bestaande vervaardigingsbasisse sonder dat dit nodig is om produksie-aanlegte in ander markte te vestig. Dit verminder die oormatige afhanklikheid van plaaslike markte en besigheidsrisiko‟s wat met afhanklikheid van een mark geassosieer word.

Hierdie studie het die potensiële industriële bondels vir die Noordwes Provinsie (NWP) van Suid-Afrika geïdentifiseer deur gebruik te maak van die Strukturele Roete-analise-metode [Structural Path Analysis (SPA)] as strategie om ondernemings se mededingendheid te verbeter. Dit dra by tot die metodes om industriële bondels te identifiseer deur die „Power of Pull‟ (PoP)-metode toe te pas om die aantal bondels vir die NWP te prioriseer. Die tien geïdentifiseerde industriële bondels en hul onderskeie PoP-rangordes was: (i) kommunikasie; (ii) eiendom; (iii) graanmeule, bakkery en dierevoerprodukte; (iv) bou en ander konstruksie; (v) basiese metaalprodukte; (vi) ander voedselprodukte; (vii) landbou; (viii) nie-metaal minerale produkte; (ix) handel; en (x) suiwelprodukte. Hierdie studie het die belangrikste sentra, ten opsigte van die meeste kontribusies tot uitset, werksgeleenthede en wins op plaaslike munisipale vlak regoor al tien geïdentifiseerde bondels, geïdentifiseer. Hierdie sentra was Madibeng, Rustenburg, City of Matlosana, Mafikeng en Ditsobotla. Hierdie is ŉ aanduiding daarvan dat pogings om bondelformasie in hierdie sektor te stimuleer, in hierdie streke gefokus behoort te word.

Hierdie studie het ook bepaal of enige assosiasie tussen die geïdentifiseerde potensiële industriële bondels se produkte en dienste en die realistiese uitvoergeleenthede volgens die DSM vir produkte en die DSM vir dienste bestaan. Vier van die ses produkbondels het realistiese uitvoergeleenthede volgens die DSM vir produkte getoon, naamlik graanmeule, bakkery en dierevoerprodukte-, landbou-, nie-metaal minerale produkte- en die basiese metaalprodukte-bondels. Ten opsigte van dienste is slegs twee dienstebondels, naamlik kommunikasie en bou en ander konstruksiedienste-bondels gevind wat realistiese uitvoergeleenthede het volgens die DSM vir dienste.

Hierdie studie demonstreer voorts die effekte van industriële bondelformasie op die streeksekonomie deur van Sosiale Rekeningkundige Matriks [Social Accounting Matrix (SAM)]-vermenigvuldigers gebruik te maak. SAM-vermenigvuldiger-analise is gebruik om die uitset, werksgeleenthede, indiensnemingsinkomste en bruto binnelandse produk (BBP), ondersteun deur die bondelformasie van die NWP, te demonstreer. Die ondersteunde aktiwiteit vir die landbou- en handelsbondels was minder as die werklike aktiwiteit. Die volgende bondels se ondersteunde aktiwiteit was meer as die werklike aktiwiteit: kommunikasie; eiendom; graanmeule, bakkery en dierevoerprodukte; bou en ander konstruksie; basiese metaalprodukte; ander voedselprodukte; nie-metaal mineraalprodukte; en suiwelprodukte. Die geïdentifiseerde potensiële bondels se realistiese uitvoergeleenthede is verder ondersoek om meer besonderhede oor die produkte en dienste wat realistiese uitvoergeleenthede het, te verskaf. Daarbenewens is die lande wat die geïdentifiseerde REOs (produkte en dienste) uitgevoer kan word bespreek. Ten opsigte van produkbondels wat realistiese uitvoergeleenthede het, is die uitvoerpotensiaalwaardes, selklassifikasies en marktoeganklikheidsindekstellings bespreek. Ten opsigte van die dienstebondels met realistiese uitvoergeleenthede is lande, marktoegang, markoopheid, invoervraag en selklassifikasies bespreek.

SLEUTELWOORDE: Industriële bondels, ondernemingsmededingendheid, streeksekonomiese ontwikkeling, internasionalisering, besluitondersteuningsmodel, realistiese uitvoergeleenthede

LIST OF ABBREVIATIONS

AHP	Analytic Hierarchy Process
CBM	Community Based Business Model
CPC	Central Product Classification
CSPS	Community, Social and Personal Services
DBSA	Development Bank Southern Africa
DSM	Decision Support Model
DTI	Department of Trade and Industry
EBOPS	Extended Balance of Payments Services
EG	Ellison-Glaeser
GATS	Global Agreement on Trade in Services
GIS	Geographical Information System
GOS	Gross Operating Surplus
GVA	Gross Value Added
HS	Harmonised System
I-O	Input Output
LC	Locational Correlation
LDC	Less Developing Countries
LQ	Location Quotient
NAICS	North American Industry Classification System
NWP	North West Province
PCA	Principle Components Analysis
PoP	Power of Pull
R	South African Rands
REOs	Realistic Export Opportunities
SAM	Social Accounting Matrix
SIC	Standard Industrial Classification
SME	Small and Medium-sized Enterprises
SPA	Structural Path Analysis
SWOT	Strengths, Weaknesses, Opportunities and Threats

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CHAPTER 1: INTRODUCTION

1.1 Background and motivation

Today, the globalised business environment is characterised by liberalisation and extensive organisational, institutional and technological changes (Reardon & Barrett, 2000). Economic globalisation now maps the characteristics of the world economy. Prominent features of economic globalisation include reduced transport and communication costs, liberalisation of financial and production activities, increased availability and access to information and technology, as well as the reduction in policy barriers to trade and investment by the public sector (Craft, 2004; Rodrick, 1997; Frankel, 2000; Khor, 2000). The process of globalisation is not a new phenomenon; it has been in effect for several centuries. According to Steger (2003) and MacGillivray (2006), the current trend of globalisation has been in effect for approximately the last two and a half decades, although its magnitude differs substantially from past trends.

A systematic search of economic literature identified a number of studies presenting various models on the effects of globalisation on economic growth and development (Craft, 2004; Awuah, 2009; Van Laere & Heene, 2003; Alvarez & Vergara, 2006; Audretsch, 2003; Awuah, 2009). Contention on the different views and the associated variables in the analysis of the effects of globalisation on economic growth and development dates back to the mid-20th century. During the latter period, one of the early views on the subject was the Prebisch-Singer thesis. This view was pessimistic about the notion of opening up the economy and competing based on comparative advantage. This scepticism over openness to trade was supported by other views, such as Bhagwati‟s (1958) immiserising growth theory. The immiserising growth theory states that an economy with high levels of distortions would initially become more productive with globalisation and openness to trade. However, this increased productivity would subsequently be offset by declining export prices relative to import prices as a result of increased competition in the world market (Dinopoulos, 2005; Sawada, 2009). Ultimately, a deterioration of the terms of trade would occur, especially in the primary sector and would result in reduced welfare (Bhagwati, 1958). In other words, globalisation and exposure to trade would leave the country worse off. Several studies have found that the positive benefits derived from trade outweigh the possible loss in welfare proposed by Bhagwati (Krugman & Obstfeld, 2003; Crafts & Venables, 2001; Boltho & Toniolo, 1999; Bleaney & Nishiyama, 2002; Bhagwati, 2004; Craft, 2004). Furthermore, an empirical evaluation of the immiserising growth theory by Sawada (2009) showed overall positive welfare effects in the world economy over the last fifteen years and only twenty-six cases of immiserising growth in the post-World War II world economy. Gerschenkron (1962) proposed an alternate optimistic view on the effects of globalisation. Gerschenkron (1962) asserted that a country could "escape from backwardness" if the government played a proactive role in correcting market failures. This would result in the reduction or even elimination of factors that make investment in that country unattractive. Government has the ability to create a favourable business environment in which the country‟s benefits from globalisation can be maximised. The government can create a favourable business environment by allocating capital efficiently and supporting emerging industries.

Similarly, North (1990) proposed the new institutional economic history view, in which the government also played a pivotal role in the development of the economy. This economic history tradition stressed the existence of institutions and the associated incentive structures as fundamental pull factors in investment and innovation decision-making (North, 1990). A country can benefit from globalisation by putting in place a rule of law; in particular property rights, enforceable contracts and having a conscientious government. These factors are perceived to be the preconditions for the formation of capital markets, which are crucial to finance the advancement of the economy (Craft, 2004). However, it is important to note that state intervention has been shown to yield less success in growth and development compared to private initiatives. Instead, free trade and less substantial government involvement in the form of ensuring institutional quality have been shown to achieve higher growth rates and development (Craft, 2004).

The Lucas paradox proposes an alternative viewpoint on the effects of globalisation. It states that the 21^{st} century will see the reversal of income inequality internationally (Lucas, 2000). According to this paradox, globalisation will allow all countries to have equal access to the same technology and institutions. Furthermore, all countries will more easily adopt market economic policies and allow capital to be fully mobile across national borders. With this world-wide restructuring of economies, "economic catch-up and convergence" would occur as capital moves freely from rich countries to poor countries. This would lead to the reversal of income inequality internationally (Lucas, 2000). Evidence of "economic catch-up and convergence" has been shown in trends of the Gini-coefficient, which peaked in the 1970s and has since declined with the advent of globalisation (Dollar & Kraay, 2000).

Contrary to this view of steady transition, the new economic geography school proposes that the process of development will be a swift shift; however, not for all countries, but for a few in favoured locations (Henderson *et al*., 2001). Globalisation results in lower "transaction costs associated with overcoming space", which, in turn, encourages agglomeration of economic activity in favoured locations (Friedman, 2007). Henderson *et al.* (2001) cited the East Asian Tigers as empirical examples of such a phenomenon. Grounded in the new economic geography view, economic development efforts in more recent times are now focusing more on regional economic development policies. These regional development policies are aimed at improving regional production systems and promoting emerging and/or existing industrial clusters. These efforts enhance firm, regional and national competitiveness and achieve growth and development (NGA, 2002; Shields, Barkley & Emery, 2010). The following section provides a brief background on industrial cluster formation as a strategy to enhance competitiveness and achieve growth and development.

1.2. Industrial cluster formation as a strategy to enhance competitiveness, growth and development

Research findings in recent years have been increasingly pointing to how industrial clustering can be applied as a growth and development strategy, especially for developing countries. This follows the success of several regions in the developed world. Examples of these success stories include Italian small and medium enterprise (SME) clusters, auto-industries clustered around Detroit, Silicon Valley in San Francisco and around Boston in the USA as well as the Dublin high-tech firms cluster in Europe (Piore & Sabel, 1984; Strøjer Madsen, 2002). Porter"s diamond model of competitiveness is one of the most cited models in industrial cluster literature. Porter (2000) defines industrial clusters as "a geographically proximate group of inter-connected companies and associated institutions in a particular field, linked by commonalities and complementarities". Porter‟s model demonstrates that focusing on specific industries concentrated in specific locations is a vital step to industrialisation, internationalisation and wealth creation for a country (Weijland, 1999). Under Porter‟s diamond of competitiveness, firm competency is enhanced through four factors. These factors are factor conditions; local demand conditions; related and supporting industries; and firm strategy, structure and rivalry (Porter, 1998). Chance events and government influence these four factors, although they do not enhance the competitiveness of firms.

Cluster genesis begins with the formation of firms and an industry. Firms are formed to take advantage of the four factors of competitive advantage in a region. This, in turn, leads to the establishment of an industry and an industrial cluster comprising competitive firms. The attributes shaping or creating a competitive environment are the main stimulants of industrial cluster formation and creation of a national advantage (Porter, 1989). Any of the four factors of Porter‟s diamond create a sustained competitive advantage for firms, creating knowledge-intensive industries and advanced industries in turn. This is referred to as dynamic value creation in industrial clusters. This is of particular importance for a developing country such as South Africa. Industrial cluster formation can enhance the competitiveness of South African firms by enhancing technology use and innovation, reducing transport and transactional costs and other benefits discussed in section 2.5. In an age of liberalisation and globalisation, few firms can compete on their own. Firms in South Africa can take advantage of this interdependence between enterprises in industrial clusters to become more competitive (Schmitz, 1999). Resultantly, industrial cluster formation can generate inclusive economic growth and create employment. Industrial cluster formation creates inclusive economic growth and employment through the inclusion of various firms in different industries or sectors across all regions in the country.

The interdependence between firms in an industrial cluster creates several associated benefits. Firstly, clusters incubate innovation. Increased innovation in the cluster enables firms to experience productivity growth as a result of enhanced technical and technological capabilities (Porter, 1998; Neven & Droge, 2001). Clusters reduce and spread the risks associated with investment over a large number of firms (Schmitz, 1997). Additionally, resources are mobilised and used more efficiently in industrial clusters in comparison with individual competing firms

(Schmitz & Nadvi, 1999). This collaboration can effectively empower firms in the industrial cluster to become more competitive and to survive in the globalised world economy. In developing countries, small and medium-sized enterprises (SMEs) account for a substantial proportion of employment in labour intensive sectors. By forming industrial clusters, SMEs in developing countries can provide sustainable employment and income for the working poor (Schmitz, 1997). This is an important role that an industrial cluster promotion strategy can play in addressing unemployment and poverty, which are among the South African government‟s key challenges. The following section provides a brief background on the importance of internationalisation and the prioritisation of exports as a strategy to enhance competitiveness.

1.3 The identification of realistic export opportunities

Firm competitiveness is no longer an industry-specific or regional phenomenon, but it has evolved to have global impacts. Firms are faced with competition not only from local firms, but also from international firms. The increased intensity of regional and international competition, as well as the ineffectiveness of regional development policies and models leaves firms vulnerable to competition and the threat of being driven out of business. Van Laere and Heene (2003) suggest that firms, particularly SMEs, can survive and remain competitive in an environment of increased global integration and competition by enhancing three firm capabilities, namely innovation, learning and internationalisation. Awuah and Amal (2009) found that firms in less developed countries (LDCs) can cope with the challenges of globalisation and take advantage of the opportunities it presents by forming industrial clusters and internationalising.

Internationalisation ensures that firms are able to serve many markets from existing manufacturing bases without having to establish production plants in other markets (Czinkota & Ronkainen, 2007; Doole & Lowe, 2004). The competitiveness of firms that rely on the domestic market can be threatened by shifts in consumer preferences, new competitors or economic downturn. These shifts lead to decreased sales volumes, profits and growth prospects (Trimeche, 2002; Leonidou *et al*., 2007). Internationalisation reduces over dependence on domestic markets and business risks associated with dependence on one market. This is achieved by taking advantage of the differences in market share growth, the different stages and the intensities in different countries‟ business and product cycles (Albaum, Strandscov & Duerr, 2004; Trimeche, 2002; Czinkota, 2002).

The continuously changing international environment creates an urgent need for governments to provide effective export promotion to ensure international competitiveness (Cuyvers & Viviers, 2012). Ideally, development efforts should be holistic; that is, they should not exclude any products, sectors or regions. In reality, however, governments have limited resources that must be used efficiently in order to achieve results. One of the main challenges for all governments is the task of identifying and justifying which products, sectors, industries or regions to promote. The South African government, through the Department of Trade and Industry (the dti), has taken steps to achieve international competitiveness through export success. The dti incorporates the results of scientific models into the national export strategy to prioritise export sectors (DTI, 2010). These models are the Decision Support Model (DSM) for products and the gravity model. This stance by the dti is an effort to increase the probability of success for exporting firms, to maximise the efficiency of government‟s export promotion programmes and to enhance South Africa‟s international trade position.

The DSM for products is a tool that decision-makers can use to identify smaller sub-sets of products with realistic export opportunities (REOs) that can be promoted and can achieve export success. The South African DSM for products was adapted from a DSM for products developed for Belgium and Thailand (Cuyvers *et al*., 1995; Cuyvers, 2004) to suit the characteristics and data for South Africa (Cuyvers & Viviers, 2012; Steenkamp; 2011). The DSM for products involves a sequential filtering process with four filters that identify products and markets with the most REOs for export success (Cuyvers *et al*., 1995). The DSM for products can therefore be used to justify the allocation of public resources to promote products with the highest export potential (Cuyvers & Viviers, 2012).

The DSM for products only analyses export opportunities for products with no consideration for the service sector. A DSM for services was developed to identify export opportunities for the South African economy in the service sector (Grater, 2011). The DSM for services uses the first two filters of the DSM for products as the basis on which countries and products are eliminated, respectively (Grater & Viviers, 2012). The same assumptions of the DSM for products are made in the DSM for services. That is, for any particular country, all countries in the world are considered as potential markets. However, not all the filters of the DSM for products could be applied for services. The DSM for services methodology had to be adjusted by changing Filters 3 and 4, owing to limited data availability for trade in services (Grater, 2011). The DSM for products and the DSM for services can therefore be used to justify the allocation of public resources to promote products and services with the highest export potential (Cuyvers & Viviers, 2012). This study explores whether these models can be used together with an industrial cluster promotion strategy. The aim is to explore whether firm competitiveness can further be enhanced not only in the local market, but also internationally through the internationalisation of the industrial clusters‟ products and services (REOs).

This study aims to identify industrial clusters and to evaluate the impact of industrial cluster formation in the North West Province (NWP) of South Africa as a strategy to enhance firm competitiveness. This study also investigates whether any of the identified industrial clusters‟ products and services have REOs according to the DSM for products and DSM for services. In addition, policy recommendations for the promotion of industrial cluster formation and exports are provided.

1.4 Problem statement

Successful economies comprise successful firms. Industrial clusters are incubators of firm, regional and national competitiveness (Porter, 1998). In order to enhance South Africa‟s growth and competitive position, this study investigates whether industrial cluster formation can enhance the competitiveness of firms in the NWP of South Africa. Furthermore, this study investigates whether any of the identified industrial clusters products and services have REOs according to the DSM. This study also illustrates the impacts of industrial cluster formation and explores the export potential of the identified industrial clusters. Finally, policy recommendations for the promotion of industrial clusters and exports in the NWP are provided.

1.5 Research questions

This study addresses the following research questions based on the above-mentioned description of the research problem:

i. Are there industrial clusters in the NWP?
ii. Do any of the identified industrial clusters" products and services have the REOs according to the DSM"s?
iii. What are the impacts of industrial cluster formation on the NWP economy and what is the export potential of the identified clusters" products and services? and
iv. What policies should the government implement to enhance industrial cluster formation and the promotion of these clusters" exports?

1.6 Objectives

1.6.1 Primary objectives

The primary objectives of this study are to:

i. investigate the existence of industrial clusters in the NWP to enhance firm competitiveness;
ii. investigate whether any of the identified industrial clusters" products and services have REOs according to the DSM;
iii. demonstrate the effects of industrial cluster formation on the NWP economy using SAM multiplier analysis; and
iv. demonstrate the export potential of the industrial clusters" products and services for the NWP.

1.6.2 Secondary objectives

The secondary objectives of this study are to:

i. provide a theoretical background and understanding of industrial clusters by discussing the definitions, genesis and evolutionary processes, measurable characteristics, advantages as well as the shortcomings of industrial cluster formation;
ii. provide a discussion on the different cluster taxonomies and conditions necessary for industrial cluster formation;
iii. provide a discussion on the role of government in industrial cluster formation;
iv. provide a discussion on the strategies, instruments and policies to promote industrial cluster formation;
v. provide an assessment of the quantitative and qualitative tools available to investigate the existence of industrial clusters;
vi. provide a sector-based spatial overview of the economy of the NWP of South Africa;
vii. apply the structural path analysis (SPA) method to a social accounting matrix (SAM) for the NWP;
viii. identify industrial clusters in the NWP;
ix. prioritise the identified industrial clusters using the Power of Pull (PoP) method;
x. determine whether any of the identified industrial clusters‟ products and services have REOs according to the DSM;
xi. quantify the intermediate and final demand linkages identified in the NWP cluster map in a SAM;
xii. measure the strength of interaction among the clusters and the related sectors and determine the level of integration (i.e. how much the sectors in a cluster are reliant on each other‟s value added and final demands);
xiii. demonstrate the effects of industrial cluster formation on the regional economy using SAM multiplier analysis;
xiv. demonstrate the export potential of the industrial clusters‟ products and services for the NWP; and
xv. recommend policies and/or instruments to promote the formation of industrial clusters and exports in the NWP.

1.7 Research method

In order to achieve the research objectives outlined in section 1.6, in-depth literature reviews as well as an empirical analysis were conducted. The literature review conducted in this study was twofold. Firstly, the literature review provided a theoretical background on industrial clustering. This theoretic background is significant because it provides an understanding of how industrial clusters enhance firm competitiveness as well as growth and development in a region. Secondly, the literature review provided an assessment of the quantitative and qualitative tools available to investigate the existence of industrial clusters and highlighting the strengths and weaknesses of the various methods. This review of the different methods to identify clusters also highlighted the strengths and weaknesses of the method applied in this study, namely the structural path analysis.

The empirical analysis involved an analysis of data on ten sectors for the NWP to provide a background on the structure of the NWP economy. This also highlighted sectors on which the provincial economy is dependant and revealed where production in the different sectors is localised. The following step in the empirical analysis involved applying the SPA method to a SAM for the NWP in order to identify industrial clusters. The identified industrial clusters were prioritised using the Power of Pull (PoP) method. The identified industrial clusters and the DSM"s REOs were compared to determine whether any of the clusters" products and services have REOs. Furthermore, this study quantified the intermediate and final demand linkages identified in the NWP cluster map using a SAM. This study also measured the strength of interaction among the clusters and the related sectors and determined the level of integration (i.e. how much the sectors in a cluster are reliant on each other"s value added and final demands). In addition, the effects of industrial cluster formation on the regional economy were demonstrated using SAM multiplier analysis. Finally, this study demonstrated the export of the industrial clusters" products and services for the NWP. Thereafter, the recommendations for the promotion of industrial cluster formation and exports in the NWP were provided.

1.8 Outline of chapters

Following this introductory chapter, Chapter 2 provides a theoretical background and understanding of industrial cluster phenomenon by discussing the definitions, genesis and evolutionary processes, measurable characteristics, benefits and disadvantages, classifications, conditions necessary for industrial clusters formation, the role of government in industrial cluster formation and the strategies, instruments and policies to promote industrial cluster formation.

Chapter 3 provides an overview of the literature on the quantitative as well as qualitative tools available to investigate the existence of industrial clusters. In this chapter, the types of data used in the investigation of the existence of industrial clusters are also discussed.

Chapter 4 provides a sector-based spatial overview of the NWP economy.

Chapter 5 presents the results and discussion of the SPA and PoP methods to identify industrial clusters in the NWP of South Africa. Additionally, brief descriptions of the methodology of the DSM and the results of investigating the association between the identified industrial clusters‟ products and services and the DSM‟s REOs are presented.

Chapter 6 focuses on the use of the NWP SAM to quantify the intermediate and final demand linkages identified in the NWP cluster map. It also measures the strength of interaction among the clusters and the related sectors and determined the level of integration (i.e. how much the sectors in a cluster are reliant on each other‟s value added and final demands). Lastly, Chapter 6 demonstrates the effects industrial cluster formation on the regional economy using SAM multiplier analysis to compare the cluster‟s actual activity to the supported activity; as well as demonstrating the export potential of the industrial clusters‟ products and services for the NWP.

Chapter 7 provides a summary, recommendations and conclusion of this study.

CHAPTER 2: ELUCIDATING THE INDUSTRIAL CLUSTER PHENOMENON

2.1 Introduction

The increased intensity of regional and international competition, as well as the ineffectiveness of regional development policies and models has led to the focus on regional economic development. In particular, the focus on industrial cluster promotion, both in developed and developing countries has proliferated owing to their increased role as a sustainable source of economic growth and development (Enright, 2003; Goetez, Deller & Hariss, 2010). This chapter attempts to elucidate and provide an in-depth background on the industrial clustering. This is achieved by providing an overview of the various definitions of industrial clusters in section 2.2, followed by some viewpoints on the genesis and evolutionary process of industrial clusters in section 2.3. The factors used in empirical analysis to identify industrial clusters are provided in section 2.4. Section 2.5 explains the advantages, micro- as well as macro-level, derived from industrial clustering, while section 2.6 discusses some of the disadvantages associated with industrial cluster formation. Section 2.7 describes the different types of clusters cited in the literature. In section 2.8, the necessary conditions for the formation of industrial clusters will be highlighted, while the role of government in industrial cluster formation is discussed in section 2.9. The strategies, instruments and policies to promote industrial cluster formation are discussed in section 2.10, and finally, section 2.11 concludes the chapter.

2.2 Defining industrial clusters

2.2.1 Definitions

Studies on the industrial agglomeration of firms date back to the 1920s. For example, Marshall (1920) and Weber (1929) described the development of localised firms in the same industry and the conceptualisation and impact of clusters on a region, respectively. Definitions of clusters vary among authors. These definitions encompass different aspects, ranging from the geographical proximity of firms, networks and relationships, the production of complementary goods and the provision of services, research institutions, infrastructure and communication networks, technology, social capital, integration and active channels of business transactions, among other aspects (Enright, 1998; Porter, 1990; Redman, 1994; Jacobs & De Man, 1996; Rosenfeld, 1997; Chiaroni & Chiesa, 2006; Boschma, 1999; Morosini, 2004).

The simplest definition of clusters by Prevezer (1997: 255) delineates clusters as „*groups of firms within one industry based in one geographical area*".

One of the most commonly quoted definitions of an industrial cluster is by Porter (1990: 3), i.e. "*geographic cooperative group that includes suppliers, consumers, peripheral industries, governments and supporting institutions such as universities*".

Redman"s (1994) definition of industrial clusters also extends beyond the geographic concentration of production chains to include linked institutions, such as educational institutions, which enhance firms" competitiveness.

The definition of clusters is characterised by the dimensions that make this form of regional cooperation unique. Jacobs and De Man (1996) distinguished clusters from other forms of cooperation and agglomeration by identifying key dimensions unique to clusters. These are geographic or spatial concentration, integration (both vertical and horizontal; see section 6.4), equal access and use of common technology, strong inter-firm networks and the presence of a lead firm (either a large firm or a research institution; see section 2.8.3).

Rosenfeld (1997: 12) characterised an industry cluster as "*a geographically bounded concentration of similar, related or complementary businesses, with active channels for business transactions, communication and dialogue; that share specialised infrastructure, labour markets and services, and that are faced with common opportunities and threats*".

Enright (1998: 191) pointed out that an industry cluster is "*a group of business enterprises and non-business organisations for whom membership within the group is an important element of each member firm's individual competitiveness*".

Boschma"s (1999) definition of clusters elucidates the concept of clusters as comprising firms from a variety of industries, but using similar or supporting technologies, institutions and social relationships to promote the competitiveness and interests of the cluster.

The industrial cluster phenomenon is relevant in a number of related and unrelated fields, spanning from business management, economics, and politics to public and social policy. The socio-economic perspective envisions clusters as: "*an entity characterised by a social community of people and a population of economic agents localised in close proximity in a specific geographic region*" (Morosini, 2004: 307). Within this realm of industrial clusters, social and economic agents cooperate in economic activities through new product development, technology use and information sharing.

According to Morosini (2004: 307), the cooperation of social and economic agents creates inter-linkages between members in the cluster based on the following industrial characteristics:

- "*common customers (both firms and individuals);*
- *common suppliers and service providers;*
- *common infrastructure such as transportation,*
- *communications and utilities;*
- *common pool of human talent such as skilled professionals or specialised labour;*
- *common educational, training and coaching facilities and approaches for workers;*
- *common university, research centre and technology institute specialisations; and*
- *common risk capital markets*" (see section 2.4).

Chiaroni and Chiesa (2006: 1065) identify clusters as "*a geographical concentration of actors in vertical and horizontal relationships, showing a clear tendency of co-operating and of sharing their competences, all involved in a localised infrastructure of support*".

A uniform feature of most of these definitions is the geographic concentration of firms. One group of definitions of clusters mainly concentrated on the geographic proximity and networks in clusters with little or no focus on the use of and access to technology (Prevezer, 1997; Porter, 1990; Redman, 1994; Rosenfeld, 1997; Morosini, 2004). In contrast, other definitions cover access to technology, interaction with research institutions and access to specialised infrastructure (Rosenfeld, 1997; Jacobs & De Man, 1996; Chiaroni & Chiesa, 2006). The definition of a cluster and the elements included in the particular definition provide a basis for deriving the measurable characteristics of clusters (see section 2.4) as well as the taxonomy for the different types of clusters (see section 2.7). Furthermore, the factors and methods used to investigate the existence of industrial clusters are derived from the definitions and delimitations of the concept (see section 2.4 and section 3.2).

2.2.2 Examples of industrial clusters

The main drive for the promotion of industrial clusters in the early 1970s was mainly the success of small firm enterprises, for example in Italy, in generating inclusive economic growth and employment (Albu, 1997; see section 5.3.2). Sectoral agglomeration in Italy was mainly in the clothing, footwear, ceramics and light engineering sectors and was mainly localised in northern Italy. These small firms successfully developed sustainable production systems and greatly enhanced their technological capabilities. Resultantly, these clusters defied the pessimistic view (see section 1.1) of that time that small firms generally failed to be competitive and therefore to survive. The pessimistic view was based on the premises that small firms lack competitiveness and have little or no capability to create and adopt new technologies into their production systems, thereby making their operations less competitive (Albu, 1997; see section 2.5.1).

Clusters are found in both developed and developing countries (Humphrey & Schmitz, 1996; see section 2.7). Some of the most popular clusters in developed countries include the Silicon Valley in San Francisco; Route 128 in Detroit; the Geneva luxury watch industry; fashion industries in Paris, New York and Milan; creative industries in Hollywood, Los Angeles and the auto industries in Japan (see section 2.7.1). In developing countries, the most popular clusters include the wine making industry and the clothing clusters in Cape Town and Witwatersrand, respectively, in South Africa; the automotive, garment and clothing sectors in the Mathare Valley, Kenya and the surgical instruments cluster in Sialkot, Pakistan (see section 2.7.2). The genesis and evolution of industrial clusters are discussed in the following section.

2.3 The genesis and evolution of industrial clusters

The conception and development stages of clusters vary from region to region and from industry to industry owing to the differences in the drivers of cluster formation. Cluster genesis and evolution can be stimulated or induced by public sector policies (see section 2.9). Alternatively, cluster formation can be induced by initiatives in the private sector. It is important to note that most successful and sustainable clusters were formed as a result of private sector initiatives. The rate, speed of development and maturity of clusters vary across countries, depending on the business environment in which the clusters are born. This section provides an overview of some of the prominent views on cluster genesis and evolution.

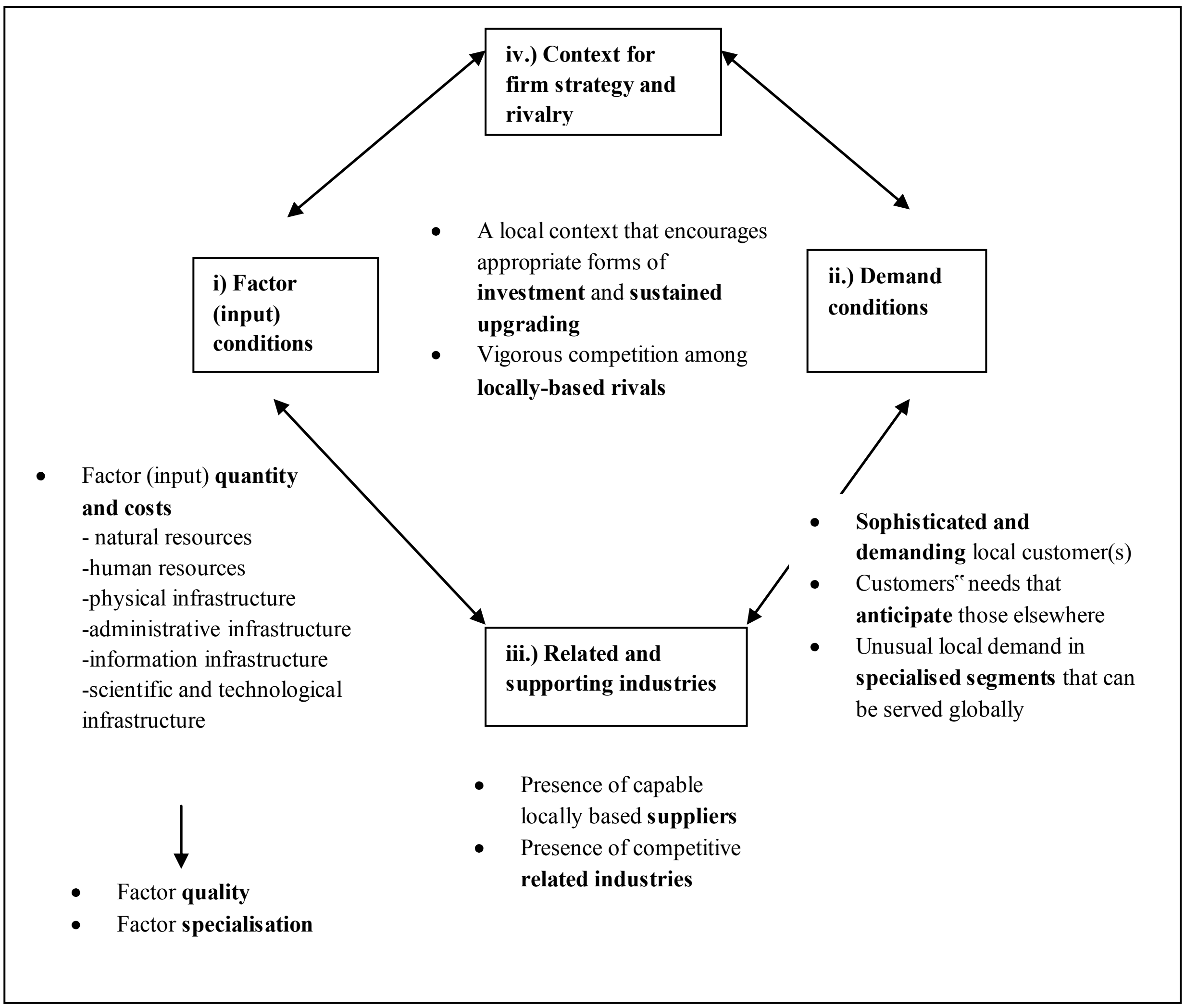
2.3.1 Porter's diamond of competitiveness

One of the most widely quoted authors in the literature on the topic of industrial clustering is Michael Porter for his work on the diamond of competitiveness. According to Porter (1998), the competitiveness of nations and of their firms is based on the existence of a mix of clusters of industries that are connected by vertical and horizontal linkages. Under this approach, cluster formation is dependent on underlying factors that endow firms in that country with a competitive advantage. The four key factors determining the national competitive advantage in any industry are (i) factor conditions, (ii) demand conditions, (iii) related and supporting industries; and (iv) firm strategy, structure and rivalry, and are presented in Figure 2.1 and will be discussed below.

(i) *Factor conditions or factors of production*. This factor relates to the factor endowment theory; whereby production and trade are determined by the abundant availability of factors of production (Heckscher & Ohlin, 1991). *Factor conditions* can either be basic in the form of natural resources, climate, location, unskilled and semi-skilled labour and debt capital. Alternatively, factor conditions can be advanced, such as modern digital data communications infrastructure, highly educated personnel or universities and research institutions (Porter, 2002). Firms with advanced factor conditions have competitive advantages in differentiated products and proprietary production technology, although this requires sustained investment in order to maintain a competitive advantage.

(ii) *Demand conditions*. This relates to the nature of buyer needs, especially in the domestic market. *Demand conditions* determine the way in which firms perceive, interpret and respond to buyer needs. A competitive advantage will be established if buyers clearly communicate their needs to the firm and if the firm can maintain or keep that advantage over their rivals (Porter, 2002; see Figure 2.1).

Figure 2.1: Porter‟s diamond of competitiveness



Source: Porter, 2002

(iii) *Related and supporting industries*. Supporting industries refer to related industries that produce widely used inputs and that are important for the innovation and internationalisation of firms (see sections 2.5.1 to 2.5.3). Supporting industries help firms to perceive new methods and opportunities and to apply new technologies, thereby creating an innovative environment (Porter, 2002). This factor accelerates the pace of innovation across all industries and the free flow of information through close proximity to managerial and technical personnel (Porter, 2008). All this is possible only if the related and supporting industries are internationally competitive. Related industries or complimentary products are ones with which firms can coordinate or share activities in the value chain when competing. These shared activities can be in technology development, manufacturing, distribution marketing or information flow. Close proximity with related industries enhances firm performance (see section 2.8.8).

(iv) *Firm strategy, structure and rivalry*. This factor refers to the context of firm creation, organisation, management and the nature of domestic rivalry. A competitive advantage is derived under this factor, when a match exists between the (a) choices of goals, strategies and industry organisation of firms, and the (b) sources of competitive advantage in an industry (Porter, 2002). Management practices and approaches refer to the provision of training, the type and use of decision-making tools and the strength of individual initiative. Firm structures refer to attitudes towards authority, norms of interpersonal interaction and professional standards. A strong correlation was found to exist between vigorous domestic competition and the creation and persistence of competitive advantages (Porter, 2008). This implies that competition is vital to maintain innovative pressures that maintain a firm‟s competitive advantage (see section 2.5.1). Rivalry encompasses price competitiveness, technology use, market share, people (customers and employees) and technical breakthroughs. Rivalry encourages internationalisation as well as greater efficiency and profitability.

Porter also identified two other factors, namely chance events and government that also influence competitive advantages, although they are not determinants. Chance events are exogenous to both the firm and government (national and regional). Chance events include breakthroughs in basic technology, wars, major technological discontinuities, pure inventions or major developments in the global markets or exchange rates shifts (Porter, 2008). Chance events shift existing or established competitive advantages for some firms and create new opportunities. This can also alter the conditions in the diamond, thereby shifting a country‟s competitive advantage. It is noteworthy that government influences the four determinants in the diamond and *vice versa*.

This bi-directional relationship can either be positive or negative through the use of subsidies, policies affecting capital markets, education-related policies, the establishment of local product regulations, standards influencing buyer needs or the role of government as a consumer of defence and telecommunications equipment (Porter, 2002).

The establishment of firms in response to the availability of factors of competitiveness in a region leads to the establishment of a competitive industry. The success of an industry makes it a sophisticated buyer of products and services. Both domestic and foreign suppliers will be attracted to establish in close proximity to this competitive industry to provide goods and services. This stimulates the creation of new industries in a mutually reinforcing process (see section 2.5.8). Downstream industries are also drawn to this location to enhance transmission of information to suppliers about their needs. The success of the industry is enhanced by vertical and horizontal linkages and these relationships will continue to mutate until a cluster is born and all industries become mutually supporting. Growth and competitiveness of the cluster are accelerated by rivalry across all industries. Rivalry maintains the momentum for firms to be innovative and remain competitive. New entrants in the cluster stimulate upgrading and diversity in research and development as well as the development of new strategies and skills.

The facilitation of information and innovation flows among firms in clusters as a result of the agglomeration of suppliers and buyers in one geographical location enhances learning among the various firms in the cluster (see section 2.5.1). The cluster becomes a means of diversifying and enhancing competitiveness in the industry and in the country as a whole. The creation and modification of factors of competitiveness in the cluster will be enhanced by investments in technology, the availability of information, infrastructure and human resources from the group of interconnected industries (Porter, 2008). As the cluster grows, it acts as a magnet for the resources in the economy as economic agents move resources from less efficient sectors and industries to the efficient cluster (see section 2.6.6). Competitive nations are made up of various clusters with differing characteristics and sources of competitive advantages. The subsequent section presents an alternative view on the cluster genesis and evolution; emphasising the role of entrepreneurs in the industrial cluster formation process. The entrepreneurs and industrial cluster formation view will be discussed in the proceeding section.

2.3.2 Entrepreneurs and industrial cluster formation

Clusters evolve in different stages depending on the nature of the industry and its stages of development. Feldman, Francis and Bercovits (2005) describe the evolution of clusters to be characterised by three phases, namely emergent, self-organising and maturation phases (see Figure 2.2). Firstly, the *emergent phase* is characterised by the exogenous stimulation of entrepreneurial activity. This results from various stimuli such as the availability of human and physical capital or from the need to commercialise research inventions from an academic or research institute. Cluster formation and entrepreneurial stimulation occur simultaneously in the emergent phase of Feldman *et al.'s* (2005) view. This is because the new entrepreneur interacts with other firms and institutions that support its business operations. Relationships start to develop and lay the foundation for learning and knowledge creation in the cluster (see sections 2.5.1 and 2.5.2).

Figure 2.2: Stages of cluster evolution

Source: Feldman *et al*., 2005

Once the *emergent stage* is established, entrepreneurial activity increases as the initial start-up and spin-off companies[1] succeed. The success of the cluster also attracts capital (human and physical) and supporting institutions (private and public) (Arthur, 1990; see section 2.6.6). Increased gains from locating in an industrial cluster attract more firms to locate in the cluster and reinforce the process of positive feedback and establishment as the cluster becomes more instituted. This signals the start of the *self-organising phase*. Competitiveness becomes a key driver of operations igniting self-reinforcing feedback and self-organisation. The cluster formation process at this stage is steered by the players in the cluster‟s need to collaborate and have a shared vision in order to improve competitiveness.

The final stage of cluster formation is the *maturation phase*. In this phase, the industry matures into a well-functioning, innovative and adaptive entrepreneurial system. The success and establishment of the cluster is indicative of the cluster‟s business potential and reduction in risk. The government at this stage recognises the potential in the cluster and puts in place policies to attract investment and encourage more start-up and spin-off companies. Venture capitalists also relocate to the cluster to be involved in the lucrative cluster. Subsequently, the cluster becomes dynamic, self-sustaining and reinforcing. This view highlights a cyclical pattern in the development of industrial clusters characterised by different stages. A similar approach is the classic product lifecycle approach, which is discussed in the subsequent section, and which describes cluster formation to occur in evolutionary logic.

2.3.3 The classic product lifecycle approach

Similar to the approach discussed above, Feldman and Braunerhjelm (2006) illustrated that the defining developmental stages in cluster genesis are based on the assumptions of the classic product lifecycle model. They highlighted that cluster formation occurs in stages characterised by evolutionary logic. The first stage is characterised by the spark of entrepreneurial activity from seeding events. Seeding events include chance, factor conditions (see section 2.3.1) or an individual or a group of individuals that drive entrepreneurial activity. Factor conditions such as

[1] Start-ups are new companies that are formed in the cluster and do not have any formal association with existing industrial or scientific institutions in the cluster. Spin-offs are companies that are formed to take commercial advantage of a business idea generated by research entities in the cluster (Chiarino & Chiesa, 2006; see section 2.8.1 and Figure 2.2).

location and suitable climatic conditions in the winter sparked entrepreneurial activity in the motion picture industry in Hollywood, Southern California (Scott, 2006). Seeding events present lucrative business opportunities prompting entrepreneurs to engage in business. In response, firms adapt available resources, local networks and relationships with people working in the same industry to create solutions that ensure success over challenges in the initial stages of business formation. Solutions that are found to work are diffused, repeated and fine-tuned until they are established as accepted routines and standard operating procedure.

Stage two in cluster genesis is initiated by the success of a particular location, comprising various successful entrepreneurs, relative to other locations. The success of existing firms together with the development of working solutions or standard working procedures provides advantages to firms in the region. Again, this success can be attributed to pure random processes or the availability of a unique resource in the region. Experienced entrepreneurs move to the region from other parts of the country to take advantage of the business opportunities nested in the region (see section 2.6.6). The intensifying competitive advantages and consolidated market shares of the industry in the cluster location signal the emergence of phase three of cluster evolution. The presence of networks, spatial density and inter-organisational networks will foster innovation, thereby creating the social infrastructure necessary to create sustainable industrial clusters (see section 2.7.8). Other locations reach comparative stagnation or decay, while the cluster location maintains superior command of its competitive advantages and continues to experience increasing returns effects (see section 2.6.6).

Once stage three has been reached, the clusters can either continue to grow, or decline and eventually die. Sustained growth transforms the cluster into a national or international leader in a particular sector or technology. Immaturity or weak growth leads to economic and social decline and subsequent migration outflows from the region, mass unemployment and regional stagnation (Maggioni, 2006; see section 2.6.2). Stage three puts in place conditions for major technological innovations setting the pace for a process of creative destruction. New clusters will emerge to take advantage of new opportunities created by advances in technology or shifts or discontinuities in the business environment. These shifts result in changes in sources of competitive advantages (see section 2.3.1) for existing clusters. Old clusters that fail to innovate and „keep up" will become less competitive and eventually die out. This implies that regions dependent on clusters can be more vulnerable (see section 2.6.2). In cases where cluster formation results from physical and technological spill-overs, cluster formation is grounded in regional competitive advantages (see section 2.3.4). Clusters develop to enhance the competitiveness of firms that exist in a region to take advantage of existing competitive advantages.

2.3.4 Physical and technological spill-over approach

Drawing from the work of Marshall (1920) and Weber (1929), Enright (2003) provided an alternative view of the evolution of clusters. This view begins with the establishment of an industry owing to the existence of competitive advantages, such as the availability of natural, financial or capital resources or the existence of a pool of labour (Enright, 1991, 1998; see section 2.3.1). The emergence of the industry activity in the Silicon Valley was spurred by pools of skilled labour in the San Francisco Bay area. The stone working industry in Carrara, Italy, was stimulated by marble deposits in the area and the packaging machinery industry in Bologna, Germany, by specialised demand conditions. With the establishment of the industry, new firms and suppliers emerge to take advantage of the existing opportunities in the region. As the industry continues to grow new industries, downstream and upstream industries are formed to take advantage of physical and intellectual spill-overs. The economic activity in this particular geographic area characterises the cluster. The final step in cluster formation is the establishment of relationships and networks among the various players in the region. This facilitates the transfer of knowledge and other resources among firms and forms the foundation of a cluster (see section 2.5.3). This, in turn, creates advantages for the cluster that supersede the initial stimulants to industry and cluster formation (see section 2.5).

The evolution of clusters is not strictly uniform. It differs by industry, the country"s stage of development and the various seeding events that create comparative and/or competitive advantages for specific industries. Seeding events that spark entrepreneurial activity vary and may be exogenous to the firm. However, this section only provides a partial view from existing literature of cluster evolution. More detailed analysis is needed to understand the evolution of clusters, especially from a developing country perspective. This is mainly attributed to the fact that most of the existing literature on cluster evolution focuses on innovative clusters, such as bio-technology clusters and high-technology clusters in developed countries. This type of cluster is more widely researched compared to other types of clusters in recent literature. In addition, innovative clusters and high-technology clusters are mostly formed in developed countries that meet the institutional requirements and social as well as economic characteristics necessary for their establishment (see section 2.7.1). The following section provides an overview of the factors that characterise industrial clusters in empirical studies.

2.4 Characteristics of industrial clusters

Porter (1998) emphasised that cluster boundaries are marked by the extent of linkages and complementarities between the different firms and industries that constitute the cluster. The geographic coverage or dispersion of firms in a cluster ranges from a single city or region to a country or even a network of regions in neighbouring countries. The leading European biotechnology cluster, Medicon Valley"s geographic coverage spans over two countries i.e. Northern Denmark and Southern Sweden (Braunerhjelm & Helgesson, 2003). Enright (2003), in a study of 160 regional clusters in different countries, found that 36% of the clusters covered a city and the periphery, 25% covered most of the sub-national region and 14% covered only a small part in a city. Resultantly, cluster size varies depending on the cluster depth[2], level of aggregation of firms in the cluster as well as the policies implemented by government for the development of clusters (Lee, 2006).

Porter (1998) further stressed that clusters do not necessarily conform to Standard Industrial Classification (SIC) systems due to the nature of their networks and external linkages that sometimes make them difficult to identify. An example is the Massachusetts medical device cluster, which comprises firms from different industries. For many years, the cluster remained latent (see section 2.7.2), because the North American Industry Classification System (NAICS) and SIC codes under which sectors are classified and measured were unable to historically track the firms or account for the boundary of the cluster (Best, 2006; Porter, 1998). Enright (1998,

[2] Cluster depth refers to the range of vertically integrated industries that make up the supply chain of a cluster, taking into account how many elements in the supply chain a cluster accounts for (Enright, 2003).

2003) emphasised that clusters are characterised by both competition and cooperation among firms through vertical and horizontal relationships. He clarified that vertical relationships exist between buyers and suppliers and are characterised by information sharing, new product and process development and better coordination. In contrast, horizontal relationships exist between rival firms in the industry and are characterised by collective lobbying, foreign market research, joint export promotion and investment in industry-specific infrastructure. However, certain aspects of business are kept separate to retain competitiveness, for example production and company-specific marketing. Horizontal relationships generate benefits such as sharing of complementary assets, increased power to lobby, and increased collective competitiveness against outsider competitors.

2.4.1 Functional and spatial linkages of industrial clusters

Industrial clusters are characterised by functional and spatial linkages. According to Yingming (2010), functional linkages are the exchange of goods and services and are the technical economic linkages or ties among industries. Functional linkages (input-output links; see sections 3.4 and 6.4) are the material bases on which industrial clusters are formed and develop (Yingming, 2010). Functional linkages exist in three forms; (i) links of products and services, (ii) productive technological links, and (iii) price links (Yingming, 2010). Links of products and services are the most basic form of linkages between firms in a cluster. The ratio of products and services exchanged between industries in the cluster determined the stability, functionality, efficiency and enhancement capabilities of the cluster (Yingming, 2010; see section 6.4).

Productive technological links relate to how the supply and demand of products and services among industries are linked by the manufacturing techniques and operating technologies. Firms in the cluster do not passively accept the products and services of related industries. Instead, they have specific requirements according to manufacturing techniques and operating technologies. Productive technological links develop in order for intermediary firms to facilitate exchange and structural relations among industries in the cluster. The third form of functional linkages is price links. Price links are the medium through which the significance of the links of products and services (value of goods and services exchanged between industries) are expressed. Price links are the foundation for the identification of industrial clusters using I-O tables (see section 3.4).

The second characteristic of clusters is spatial linkages. These are the external agglomeration economies firms derive from locating in the same region (Yingming, 2010). Spatial linkages are derived from path dependencies among industries that operate in a socio-economic environment. An interesting aspect of industrial clusters to both policy-makers and firms is the conditions under which they are formed and the path that the development of the cluster takes (see sections 2.3 and 2.8). For policy-makers, these aspects are important to inform policy formulation and to select the instruments that will best support the creation of sustainable and competitive clusters. For firms, this information is necessary to equip firms with information on the prerequisites and possible benefits of cooperation with other firms. Empirical studies seek to measure characteristics of clusters for a number of reasons. These include identifying industrial clusters or measuring the efficiency of industrial clusters, among other reasons. The measurable characteristics of industrial clusters are discussed in the following section.

2.4.2 Measurable characteristics of industrial clusters

Table 2.1 shows some characteristics of industrial clusters, descriptions of the characteristics and the typical measures. *Geographic proximity* is a main characteristic that distinguishes industrial clusters from other forms of cooperation (see section 2.2). This factor entails the proximity of firms to primary and secondary suppliers. *Geographic proximity* enables members of the cluster to have access to materials and services that minimise transaction costs (see section 2.5.12) and maximise profits (see section 2.5.10). This factor can be investigated through input-output (I-O) analysis to reveal potential first-, second- and third-tier buyers. Surveys can also be conducted to reveal the actual locality of suppliers for firms in the cluster.

Table 2.1: Factors that can be measured and/or analysed to identify industrial clusters

Factor	Description	Typical measures/proxies
Innovation	New and enhanced technologies and products that are conceived, developed, and adopted or brought to market; Dispersion of innovations to other local firms	Patents and copyrights; Dollar investments in new technologies; New product lines started
Entrepreneurship	Continual formation of new business ventures by workers and managers within the cluster based on new, complementary, or competitive products or on core competences	Number of new start-ups generated by cluster; Number attracted to cluster
Workforce skills and availability	Degree to which labour force skills are tailored to the cluster‟s needs (i.e. technical skills, general knowledge of the industry, and entrepreneurial skills)	Number of enrolment in relevant programs; Graduates hired by cluster; Number of local mid-skilled labour force
Networks	Frequency of formal cooperation among cluster members in, for example joint ventures, production, marketing, training, or problem solving	Number of joint ventures, skills alliances, marketing consortia, etc.
External connections	Joint ventures, contracts, alliances with firms, contacts/communications with experts in other regions; Knowledge of international benchmark practices	Study or benchmarking tours, travel to trade shows; Alliances that include external members
Social capital (connections and intermediaries)	Scale and degree of activity among local business and civic associations in the region; Frequency of interaction; Informal activity; Survey of connections	Number of professional, business, and trade associations; Membership in each, level of networks of personal business-related contacts
Geographic concern (Proximity to suppliers)	Nearby sources of primary and secondary suppliers, materials, and services that minimise transaction costs and maximise interaction	I-O analysis of supply chains; Number of potential first-, second-, and third-tier suppliers; Survey of actual suppliers
Specialised services	Public-sector services, such as technology extension services, technology centres, export assistance, or small business centres and private-sector services provided by designers, engineering consultants, accountants and lawyers that have special knowledge of the cluster	Number of consultants who specialise in the cluster; Services that employ specialists from clusters; Dollar value of local outsourced services
R&D capacity	Institute of public or private research in areas related to cluster‟s products or processes; Expert individual researchers that are available or accessible	R&D expenditures from government and private sources that involve cluster members, products, or processes

Source: NGA, 2002

Innovation is a key factor that provides insight into the existence of clusters, particularly innovative or high technology clusters (see section 2.7.1). *Innovation* refers to the application of new technologies, new product development and the dispersion of new technology to other firms (Audretsch, 2000; see section 2.5.1). This is important as it demonstrates the firms in the cluster‟s ability to develop new products and processes and to diffuse knowledge to other members of the cluster (see sections 2.5.1; 2.5.2; 2.5.3). *Innovation* can be measured by the number of patents and copyrights obtained by firms in the cluster, the expenditure on new technologies and the introduction of new product lines. *Entrepreneurship* is a main stimulant of cluster formation (see section 2.3). As such, it is one of the factors that can be investigated to determine the existence of clusters. *Entrepreneurship* is chiefly characterised by the continual formation of new business, complementary or competitive, in the cluster. It can be measured by analysing the number of new start-ups in the cluster (see Table 2.1).

Workforce skills and availability pertains to the number of people with specialised skills required in the cluster. Proxies for this factor are the number of graduates employed in the cluster, enrolment rates in specialised programmes and the number of semi-skilled workers. *Network*s form the social capital that is essential for the successful competitive cooperation of firms in clusters (see section 2.8.7). *Networks* refer to the formal cooperation among cluster members in joint ventures, production, marketing, training or problem-solving. It can be measured by the number of joint ventures, skills alliances or marketing consortia.

External connections in industrial clusters are similar to networks, but extend to include communication with experts in other regions and the cluster‟s knowledge of international benchmarks (see section 2.5.4). Typical proxies for *external connections* of industrial clusters are studies or benchmarking tours, travel to trade shows, and alliances that include external members. *Social capital* is a very important foundation for the long-term sustainable exchange of resources in the cluster (see section 2.5.4). It is the basis on which interaction between local business and civic associations in the region occurs. *Social capital* enhances the frequency of interaction and informal activity among cluster members and other firms in the region. It can be measured by observing the number of associations (professional, business and trade) associated with the cluster and the membership, level of networks of personal business-related contacts in each association.

One of the supporting services in a cluster is the provision of *specialised services*. This can be in the form of public-sector services, such as technology extension services, technology centres and export assistance. Alternatively, *specialised services* can be small business centres and private-sector services provided by designers, engineering consultants, accountants and lawyers that have special knowledge of the cluster (see section 2.5.16). This characteristic of industrial clusters can be measured by the number of consultants who specialise in the cluster, services that employ specialists from clusters or the dollar value of local outsourced services.

Technology and innovation are the drivers of new product development and competence of firms in clusters (Doeringera & Terkla, 1995; Lee, 200; see sections 2.5.1 and 2.5.3). *Research and development* capacity in a cluster is supported and enhanced through the establishment of an institute of public or private research in areas related to the cluster"s products or processes and the availability of expert individual researchers that are available or accessible (see Table 2.1). *Research and development* can be measured through expenditures from government and private sources that involve cluster members" products, or processes. The following section explains the benefits associated with industrial clustering.

2.5 Benefits associated with industrial cluster formation

Lorenzoni and Ornati (1988) stated that firms do not prosper sustainably in isolation, but through interaction with other firms and institutions as well as taking advantage of the supporting structures linked with these interactions. New firms find it difficult to survive in the markets owing to difficulties in securing resources. Stinchcombe (1965) termed this the „liability of newness" and attributed the high rate of failure among young firms to it. Schutjens and Stam (2003) found empirical evidence suggesting that business relationships between firms are localised in specific locations. Business relationships include sales, supplier, outsourcing, and cooperative relationships. Vast empirical and theoretical evidence supports the formation of industrial clusters as a way to provide access to support structures and resources for new as well as existing firms. As a result, the benefits associated with industrial cluster formation are interrelated. Some benefits arise as a result of the existence of other benefits. This is illustrated by the cross referencing across the different benefits associated with industrial clusters in this section.

Empirical evidence supports the notion that firms in clusters possess higher levels of knowledge integration, innovation, global competence, growth, adaptability to changes in the external environment and have more sustainable development (Morosini, 2004; Porter, 1998). The documentation of the benefits derived from clusters dates back to the 1920s from the work of Marshall (1920) and Weber (1929). The benefits associated with industrial cluster formation include reductions in transaction and transport costs and enhanced economic performance, and will be discussed in more detail in this section. The subsequent section discusses the research and development capability, innovation and imitation benefits.

2.5.1 Research and development capability, innovation and imitation

Small firms often find it difficult to create and adopt new technologies into their production systems, thereby making their operations less competitive (Albu, 1997). According to Feldman *et al*. (2005), systems of innovation in clusters are not formed as a result of systematic linear processes, but as a result of adaptation and self-organisation of behaviour by entrepreneurs (see sections 2.3.2 and 2.5.3). Industrial clusters are repositories of specialised and flexible labour markets, capital and research, and development of firms (Doeringera & Terkla, 1995; Lee, 2006). This provides small firms with access to the skills, knowledge and research and development findings of other firms in the cluster.

Small firms often incubate very little, if any, research and development activities, owing to limited resources and capacity. Innovation depends on several factors, namely investment, availability of incentives for innovation, the state of intellectual property protection, effective appropriation of gains from innovation mechanisms and technological opportunities (Enright, 2003). Small firms often do not have access to these research and development activities. However, access to research and development enables small firms in clusters to develop new products and process technologies. Audretsch (1998, 2000) found that innovation activities tend to be localised in specific locations, resulting in a few countries accounting for the vast majority of commercially viable new products. In addition to this, a few locations in these countries are major sources of innovation, conducting a majority of the research and development efforts in those countries. New technology and innovations in the cluster are made available through turnkey projects or sale in the cluster marketplace. A turnkey project involves bidding activities for the procurement of a project. The winning contractor designs, constructs and equips a finished product or service such as a manufacturing plant or business service and will only deliver it as a completed product ready for operation to the customer (Brady, Davis & Gann, 2005). Small firms, therefore, can buy technology licenses or form strategic alliances with lead firms in the cluster as ways to get access to new technology which would have been impossible outside the cluster (Lee, 2006). A more common phenomenon for the spread of innovations in clusters is through the lead foreign firm in the cluster first adopting the new technology and then small companies imitating or reverse engineering the technology (see section 2.8.3).

Later definitions of industrial clusters differ from earlier ones by including research institutions as players in the cluster (Rosenfeld, 1997; Jacobs & De Man, 1996; Chiaroni & Chiesa, 2006; see section 2.2). Innovation advantages in these clusters are enhanced by the existence of and close proximity to research institutions and centres. The proximity to research institutes or centres enhances firms‟ critical mass in research and development. This is made easier by the existence of a qualified labour market in the cluster (Chiaroni & Chiesa, 2006). The existence of strong relationships and dense networks in clusters facilitates the diffusion of knowledge on markets and technology. Additionally, geographical proximity of buyers, suppliers, and firms in clusters creates short feedback loops for ideas and innovations, thereby making knowledge diffusion faster and more effective (Enright, 2003). Porter (1989) highlights the ability to innovate as a source of long-term sustainable advantage for a firm or a region.

2.5.2 Technology and learning in clusters

Competition among firms in some sectors is not entirely driven by price, but also by innovation, technology and the development and improvement of products. Technology, according to Smillie

(1991), “is the science and art of getting things done through the application of skills and knowledge”. Technology enhances a firm‟s competency by improving the tools used in executing tasks and the know-how that is the knowledge skills and routines that are vested in people. Technology is physically demonstrated through the use of machinery (Albu, 1997). The presence of multiple suppliers and institutions in clusters facilitates knowledge creation (Porter, 2002). Small firms acquire different types of technological capabilities, which enhance competency, by being part of a cluster. These capabilities are summarised in Table 2.2.

Table 2.2: Technological capabilities of small firms that can be enhanced by clusters

Capability	**Effect**
Technological	Acquisition of dynamic resources encompassing skills, knowledge and routines involved in generating and managing technical change
Human	Acquisition of knowledge and routines involved in generating and managing technical change
Institutional resources	Enhancement of production activities, investment activities or relations with other firms
Innovative and adaptive capabilities (learning mechanisms)	Improvement of skills and knowledge resources that facilitate assimilation of change and creation of technology
Investment capabilities	Expansion of workshop facilities; Improvements in procurement, installation of standard equipment and improvements in evaluation and selection of technology
Production	Improvements in skills, knowledge and resources and enhancement of existing plant and processes efficiency
Supporting activities	Improvements in investment activities; Procurement of capital goods; supply of raw materials; distribution channels of finished goods.

Sources: Lall, 1992; Biggs Shah and Srivastava, 1995; Romijn, 1996

The development of capabilities illustrated in Table 2.2 is a gradual and cumulative process. It involves learning, assimilation and finally implementation of the acquired knowledge into the firm‟s operations (Lall, 1992). The evolution of firms in acquiring the different capabilities is not uniform. Some processes and capabilities can be bought and as such reduce the time the firm would need to learn, assimilate and implement the new capability. In today‟s fast-paced, everchanging global economy, outsourcing[3], in particular global outsourcing, has gained increased popularity as firms strive to maintain competitiveness and survival (Quinn & Hilmer, 1994).

According to Bell and Pavitt (1993), capabilities are acquired in various stages in the technological learning process in a firm. These stages are illustrated in Figure 2.3. In the first stage, the firm acquires *technological capabilities* through *technological learning*. At this stage, the firm acquires dynamic resources (skills, knowledge and routines) involved in generating and managing technical change. These feed into the *technological capabilities* of the firm (stage two). The technological capabilities of the firm are the resources needed to generate change within the firm. Technological capabilities can be in the form of institutional resources or human capabilities (see Table 2.2). *Human capabilities* include the knowledge and routines involved in generating and managing technical change. *Production capabilities* concern production activities, investment activities or relations with other firms.

Once technological capabilities have been enhanced, *technical change* follows. This is in the form of *innovative and adaptive or investment capabilities*. Innovative capabilities are also known as learning mechanisms; they improve skills and knowledge resources that facilitate the assimilation of change and the creation of technology (see Table 2.2 and Figure 2.3). *Investment capabilities* involve the expansion of workshop facilities, improvements in the procurement and installation of standard equipment as well as improvements in the evaluation and selection of technology. *Technical change* allows for improvements in the procurement and installation of standard equipment and the learning mechanisms in the firm (Bell *et al.,* 1993; see Table 2.2). These are all pre-conditions for the final stage, enhancement of the *production capacity*, in the process of technological learning (see Table 2.2 and Figure 2.3). In the final stage, the learning process enhances the resources needed to produce goods efficiently. In addition, learning enhances the supporting activities. Supporting activities‟ capabilities encompass improvements in investment activities, procurement of capital goods, supply of raw materials and the distribution channels of finished goods (Bell *et al.,* 1993; see Table 2.2).

[3] Outsourcing is characterised by utilisation of external suppliers, investments, innovations, and specialised professional capabilities that would be prohibitively expensive or even impossible to duplicate internally.

Figure 2.3: The process of technical learning

Technological learning	TECHNOLOGICAL CAPABILITY	Technical change	PRODUCTION CAPACITY
	Resources needed to generate change		Resources needed to produce goods
The acquisition of technological capabilities	Knowledge, skills and experience of change; institutional resources	Incremental adaptation and improvements.	Fixed capital operating skills and know how
	Structures and linkages	Introduction of new machines	Production procedures

Source: Bell & Pavitt, 1993

2.5.3 Intellectual spill-overs

Firms in a cluster will specialise in areas in which their competitive advantage lies. This results in the firms in the cluster outsourcing specialised tasks from other firms in the cluster. Firms are therefore able to specialise in activities they are more efficient in, therefore enabling them to be more productive and efficient (Madsen, Smith & Dilling-Hensen, 2004). The small distance between firms in clusters (geographic proximity) enhances the diffusion of knowledge and localised learning from one firm to the other (Tallman *et al*., 2004; Morgan, 1997; Maskell & Malmberg, 1999; see section 2.8.8). Geographic proximity enables specialists to move easily between the different firms and engage in personal communication with the people being trained (see section 2.8.8). Furthermore, clusters create a local research environment that is a stimulus for innovation and best practice through collaboration (Madsen *et al.,* 2004; see section 2.5.2). A cluster composed of firms from different industries creates an environment that promotes innovation. The differences in technology and production methods create an opportunity for innovation (Jacobs, 1969). This is particularly the case for high technology clusters that are not always industry specific.

Firms located in a cluster are expected to receive more help from other firms and institutions in the networks than firms outside the cluster (Becattini, 2002). Small firms in particular benefit from being located in a cluster by having access to resources and networks that will enhance their competitiveness and survival. Geographical proximity of firms in clusters provides access to a specialised and flexible labour market (see section 2.8.8). As a result of agglomeration, an abundant pool of labour is created, where both firms require specific skills and workers supplying those skills meet (Marshall, 1890). This reduces or eliminates the costs of hiring and firing for both firms and workers (see section 2.8.8). Clusters provide a joint pool of resources that are procured, developed and utilised by all members (Hoang & Antoncic, 2003).

2.5.4 Informal networks/contacts

The importance of collective learning and networks in knowledge diffusion dates back to Allen‟s (1983) study on the blast furnace industry in Cleveland in the UK. Empirical evidence has continued to grow since Allen‟s study with other authors such as Russo (1985), McGaw (1987), Saxenian, (1994) as well as Lamoreaux and Sokoloff (2000) investigating the hypothesis of increased productivity as a result of collective invention. Dahl and Pedersen (2004) delineate collective invention in clusters as having high knowledge accumulation through the disclosure of information through networks between competing agents. High levels of technical knowledge and skill as well as reputation are key determinants of collective invention (Dahl *et al.*, 2004). The various firms in a cluster contribute to technical knowledge and skills, thereby building the collective efficiency of the cluster (see section 2.5.5). Resultantly, the intensity of personal networks is higher among the employees responsible for transferring knowledge in the cluster. Furthermore, a good reputation spurs the willingness to share information among firms as it ensures reciprocity from other firms. Clusters encourage the establishment of informal relationships that extends beyond entrepreneur to entrepreneur to include regional institutions. Regional institutions provide network services that range from arranging trade fairs, conferences and seminars, to social activities for individuals, co-workers, competitors, former co-workers, suppliers and customers.

2.5.5 Collective efficiency

Clustering opens up efficiency gains known as collective efficiency, which individual small firms were unlikely to obtain while operating individually. Collective efficiency refers to the advantages that accrue indirectly to firms owing to "external economies[4] and joint action" (Schmitz, 1995, 1997; Schmitz & Nadvi, 1999). Benefits of external economies from agglomeration have been recorded as early as 1890. Marshall (1890, 1920) identified three types of „externalities" accruing to firms that locate in close geographic proximity, namely access to a specialised and flexible labour market (see sections 2.5.13 and 2.5.14), knowledge spill-overs (see section 2.5.3) and close proximity to suppliers and customers (see section 2.8.8). According to Marshall (1920), knowledge spill-overs enhance learning from other firms in the cluster (see section 2.5.2). Close proximity to suppliers and customers facilitates the development of specialised upstream and downstream firms. Similarly, Krugman (1991) documented three classical externalities of agglomeration, i.e. economies of specialisation, economies of labour pooling and externalities or knowledge spill-overs.

Clustering increases the likelihood of the division of labour and specialisation among firms that were likely to be fierce local rivals in the absence of the cluster (see section 2.5.3; Schmitz, 1995). Division of labour and specialisation among firms results in low transaction costs associated with clusters (see section 2.5.12). This enables firms to utilise specialised machinery and achieve higher utilisation rates (Marshal, 1920). Additionally, the division of labour allows firms in the cluster to specialise in a limited range of production services, which allows them to be save both working as well as fixed capital and also allows firms to procure materials and parts more flexibly (see section 2.5.2; Ruan & Zhang, 2009). External economies in low-income economies accrue to firms in clusters if market conditions, technology and organisational form remain constant (Han, 2009). These are mainly related to labour, collective marketing, technological spill-overs (see sections 2.5.2, 2.5.13 and 2.5.16) and improved market accessibility (McCormick, 1999). Collective marketing in clusters stems from the good reputation of the cluster location. This enables firms to utilise various joint marketing mechanisms such as trade fairs, trade magazines, marketing delegations and company referrals

[4] External economies are the benefits that accrue to a firm as a result of locating in a specific area. These can include access to natural resources, skilled labour and specialised infrastructure.

(Porter, 1998). Furthermore, complementarities or externalities make buying from a cluster more attractive as customers have different options all in the same location. This reduces buying risk and enables customers to switch suppliers if need be (Porter, 1998).

Krugman (1991) differentiates two types of externalities, namely pecuniary and non-pecuniary externalities. Pecuniary or monetary externalities operate through market mechanisms such as supplier and customer linkages. In contrast, non-pecuniary or non-monetary externalities, such as knowledge spill-overs, arise through personal interactions between the employees or managers of different firms. Non-pecuniary externalities are not mediated through markets. Nadvi (1996) further highlights the existence of passive and active interdependencies between clustering firms. Passive interdependencies are incidental benefits accruing to clustering firms and are similar to Marshal"s external economies. Active interdependencies can be in the form of vertical or horizontal relationships. Vertical relationships can exist between producers of certain components and their users, that is, between component parts producers and the firms using these component parts as intermediate inputs (Schmitz, 1999). Such relationships can either be hands-off or obligatory (Sako, 1992). Horizontal interdependency includes sharing orders and equipment.

Clusters foster efficient access to specialised inputs and services, which improves the efficiency of the firms operating within the cluster. Empirical evidence from Italy showed that industrial district provinces performed better owing to external economies as compared to large firms (Becattini & Ottati, 2006). Clusters simplify coordination and transactions between firms, thereby availing more time to productive processes and allowing for faster diffusion of knowledge, best practices and other resources between firms (Porter, 2002). Firms in clusters gain from co-operative and collaborative relations between the various types of institutions that exist in the cluster.

2.5.6 Employment creation

Clusters stimulate the expansion of existing businesses and the establishment of new firms (see section 2.3). The expansion of existing business or establishment of new firms stimulated by clusters creates new jobs to meet the demand for a larger workforce in the cluster (Sonobe, Higuchi & Otsuka, 2013). Delgado, Porter and Stern (2011) found that firms in industries that are part of a cluster experience higher employment and wage growth than firms that were not part of clusters. They also found that the existence of a strong cluster in a region improves growth prospects for other industries and clusters. This implies that firms in clusters create more employment opportunities than firms that are not part of a cluster. Additionally, it implies that clusters can improve the growth prospects, including employment growth, for other industries that are not part of the cluster.

Drawing on the Enright"s (2003) viewpoint of cluster evolution, entrepreneurial activity and industry formation are the first steps to cluster genesis. The availability of a large pool of labour is a catalyst for industry and cluster formation (see section 2.3.4). Krugman (1991) identified economies of labour pooling externalities that can be derived from clustering (see section 2.5.13). This available pool of labour, skilled or otherwise, attracts business activities, which in turn enhance labour market efficiency through employment creation for the labour force in that area. Marshal (1920) pointed out that clusters facilitate the matching between job seekers with special skills and employers (see section 2.5.3). In addition, an existing pool of skilled labour allows for specialisation in knowledge and skills of the workers as well as increases in efficiency (see section 2.5.3; Enright, 2003). Empirical evidence from the Silicon Valley showed that this region was the third largest high technology centre in the US in 2010. Silicon Valley provided high technology employment to 225 300 people and ranked first in terms of the concentration of high technology workers, that is, 285.9 out of every 1 000 private-sector workers compared to any other metropolitan area in the US (Pimentel, 2011).

2.5.7 Agglomeration economies

Vast literature exists on agglomeration economies and the benefits that firms and the region derive. The earliest work on agglomeration economies dates back to Marshall (1920). Advances have been made in the agglomeration economies literature to include additional features that Marshall did not analyse. Harrison (1996) elucidated the existence of static and dynamic agglomeration economies. He characterised static agglomeration economies as having a local concentration of downstream firms or customers. Static agglomeration economies enable firms in a cluster to achieve economies of scale. Producers are able to achieve economies of scale as a result of increased demand from the large pool of upstream firms. This allows the firm to reduce costs when producing or distributing larger volumes of output.

Static agglomeration economies accrue from specialised infrastructure investments that will be made in the area by the local government as well as from the specialised division of labour. The economies of specialisation are derived from a pool of specialised suppliers that are attracted to the cluster. Economies of labour pooling are derived from an existing pool of labour in the region where the cluster is formed, which, in turn, creates more specialised labour in the cluster (see section 2.5.6). Dynamic agglomeration economies are characterised by technological learning and improvement (Harisson, 1996). Porter (1998) similarly identified innovation advantages from agglomeration that are derived from clusters containing knowledge centres (research entities and universities) from which firms can adopt new technology. Technological spill-overs are derived from an easier and more efficient flow of information among players who are in close proximity in the cluster (Porter, 1998; see sections 2.5.2 and 2.8.8). Innovation advantages also generate business advantages or new business ideas as a result of a better flow of information that enables the communication of market opportunities and potential (Porter, 1998; see section 2.5.1). Porter (1998) stated that firms in clusters benefit from increased productivity as a result of better access and use of specialised inputs due to agglomeration. Krugman (1991) also identified static agglomeration externalities that accrue to firms, namely economies of specialisation and economies of labour pooling.

2.5.8 Facilitation of commercialisation and new business formation

Clusters create opportunities for new companies and new lines of business. This is stimulated by the presence of commercial relationships and concentrated demand (Porter, 2002). These features in clusters spread the risk of new business start-ups and make the successful set-up of businesses more probable. Additionally, the processes of commercialisation of new products and the formation of new companies are safeguarded by the existence of available skills and reliable suppliers in the cluster (Porter, 2002). Lower barriers of entry exist in clusters are attributed to the existent assets, inputs, infrastructure, skilled labour and easy access to finance. Access to financial resources is at a lower premium and this is facilitated by existing trust between financial institutions and the existent players in the cluster (see section 2.5.13; Caves & Porter, 1977). The prerequisites for the formation of clusters, namely the pre-existence of a number of firms, a favourable business environment and the existence of a research centre, stimulate entrepreneurship and present new business opportunities (Chiaroni & Chiesa, 2006; see section 2.8). Research centres provide new and unexploited business opportunities from research findings. Networks and relationships in the cluster facilitate face-to-face communication of suppliers or consumers" unmet needs. This indicates gaps in product or service provision and consequently new business opportunities (see section 2.5.4; Porter, 2003).

2.5.9 Trust

New and small firms do not have undisputed credibility to gain trust, and to establish relationships and networks (Singh *et al.,* 1986). Networks and strong relationships are essential for improved and sustained information flows between firms, which improves the firm"s competitiveness (Hoang & Antoncic, 2003). Dense networks and relationships provide a source of validatory support for small and new firms (Lechner *et al.,* 2006). Clusters provide access to dense networks, which improves the firm"s competitiveness and ability to meet consumer expectations. Clusters build institution-based trust for firms by establishing schemes or centres that promote, assure and certify quality, further enhancing firm competency and customer satisfaction. An example of this is the Quality Assurance Centre of Gosheim in Baden Württemberg, Germany. This centre serves a cluster of 400 independent small metal-turning firms (Semlinger, 1995). It provides certification for firms in the cluster"s products and consequently ensures trust in the market. Trust among players in a cluster facilitates the creation of an institutional environment characterised by enforceable contracts, secure property rights and other institutional improvements. An institutional environment enhances the sustained competitiveness in the cluster by protecting innovative processes (Mokyr, 2005). This institutional environment, in turn, allows firms in the cluster to specialise according to their comparative advantage and fully utilise the benefits of agglomeration.

2.5.10 Enhanced economic performance

One of the primary objectives of industrial cluster formation is to enhance the economic performance of firms (Doeringer & Terkla, 1995; Lee, 2006). Schmitz (1999) and Sonobe and Otsuka (2006) found that clusters enhance the economic performance of industries, especially in developing countries. This is because a cluster provides access to technology (see section 2.5.2). Technology enables the firms in the cluster to improve their product from a low quality imitation of competing imported goods in the domestic market, to a higher quality product. This is facilitated by access to better materials, capital machinery, skilled labour and networks in the cluster enabling the firm to produce and market a better product and to earn higher profits.

Economic performance is also improved by the extensive learning experienced between firms in the cluster. Firms in clusters have access to new technology that enables them to conceive and develop new and state-of-the-art technologies and products and successfully launch them in the market. This is particularly the case for small firms that otherwise would not have the capability or resources to venture into research and development. Additionally, being part of a cluster avails access to several resources, i.e. skilled labour (see section 2.5.13), infrastructure (see section 2.5.17), collective bargaining (see section 2.5.5), capital (see section 2.5.15), and specialised services (see section 2.5.15), all of which improve the firms" productivity and efficiency, thereby making them more competitive and profitable. In addition, firms in a cluster experience lower transport and transaction costs (see sections 2.5.11 and 2.5.12), which reduce the operational costs and enhance firm profitability.

2.5.11 Reduction in transportation costs

The core-periphery model, a subset of the new economic geography literature, explains that the associated reductions in transport costs derived from clustering do not occur in isolation, but in conjunction with the collective efficiency gains (Yoshino, 2011; see section 2.5.5). According to this view, transport costs are a determining factor in the formation of industrial clusters. The reduction of transport costs enables firms to enjoy agglomeration externalities (see section 2.5.7). This is because *a priori* high transport costs result in the dispersal of business activity as it is cheaper for the firms to be in close proximity to consumers (Yoshino, 2011). The reduction of transport costs as a single factor is not a sufficient stimulant for agglomeration of economic activity. This is because if transport costs are low or zero then firms can still remain dispersed as a specific location does not create any productivity gains (the productivity differential). Firms in clusters enjoy transport cost reductions when the cluster is characterised by product differentiation and specialisation (see section 2.5.5). Product differentiation encourages the development of inter-firm linkages between intermediate input suppliers and buyers. Relationships forged, in turn, result in the intermediate input suppliers committing to firm-to-firm shipping of materials, thereby reducing transport costs for the firms (Yoshino, 2011).

Eifert, Gelb and Ramachandran (2008) pointed out that physical transport costs are high due to the shortage or the poor state of infrastructure, especially in low-income countries. Clusters reduce transport costs by eliminating the need to use infrastructure as the various firms are within close proximity (Sonobe, Higuchi & Otsuka, 2013). If a cluster significantly reduces transportation costs, this will expand economically viable geographic space and will increase the size of the market. The expansion of an economically viable geographic space will, in turn, attract new businesses (see section 2.5.8). Co-location brings together a pool of specialised and flexible labour, capital and research and development to firms (Doeringera & Terkla, 1995; Lee, 2006). This reduces or eliminates the transportation costs of raw materials and other resources incurred by firms, resultantly enhancing access to other members in the cluster (Takeda *et al.,* 2008*)*. This is attributed to the distinguishing vertical and horizontal linkages of clusters that bring together suppliers, consumers, peripheral industries, governments, and supporting institutions, such as universities, to a geographical region (Porter, 1990). This frees up the working capital of firms and enhances their profit margin.

2.5.12 Reduction in transaction costs

Government failures such as excessively strict licensing and regulatory regimes are contributing factors to the high costs of doing business (Yoshino, 2011). The productivity and efficiency of firms in clusters are enhanced by the reduction in transaction costs (Chiaroni & Chiesa, 2006). Transactions costs are reduced as a result of different factors. Firstly, clusters build and ensure institutional-based trust (see section 2.5.9) among member firms, which enables the formation of strong relationships and dense networks (see sections 2.5.4; 2.8.7 and 2.8.5). Resultantly, institutional based trust reduces the contractual costs associated with business (Singh *et al.,* 1986; Hoang & Antonic, 2003; Enright, 2003; Lechner *et al*., 2006; Chiaroni & Chiesa, 2006; see sections 2.5.12). Furthermore, clustering facilitates joint purchasing services and equal access to facilities. Joint purchases of inputs and equipment, usually by a central actor in the cluster; enhance the bargaining power of firms, thereby ensuring quantity discounts on high quality purchases as opposed to individual firm purchases.

Moreover, transaction costs are reduced in clusters through the sharing of specialised infrastructure and other facilities usually offered by a lead firm or research institutions in the cluster (Chiaroni & Chiesa, 2006; see section 2.8.3). This helps to reduce the fixed costs of investment and ensures sustained growth for both new and existing firms in the cluster. Clusters reduce transaction costs by attracting a highly qualified labour force, which increases the flexibility of the labour market and reduces the costs of searching and recruiting qualified personnel (see section 2.5.13). Clusters also attract specialised suppliers to the cluster, which substantially reduces firms‟ transaction costs such as the need for inventory, the need to import inputs, the risk of overpricing and communication costs (Porter, 1998; see section 2.5.3).

The risk of overpriced inputs is eliminated by the existing networks and relationships in clusters. Transaction costs are reduced as a result of the reduction in search costs to identify buyers and sellers because of the strong knowledge-sharing environment created from trust and relationships (Yoshino, 2011). For developing countries‟ clusters, the reduction in transaction costs is one of the major benefits to firms in the cluster. As mentioned in section 1.2.1, developing country clusters have been shown to lack a dynamic and interactive learning environment as well as highly skilled labour resulting in little or no knowledge transfer (Schmitz & Nadvi, 1999). Instead, clusters in developing countries have been shown to mainly achieve cost reduction for the firms as opposed to value creation in the developed country clusters (Neven & Droge, 2001; see sections 2.6.4 and 2.7.2).

2.5.13 Availability of a skilled workforce

Clusters attract a relatively large pool of labour with higher skills. Clusters also provide possibilities for training and further education (Lee, 2006). This is attributed to the fact that once a cluster is formed, workers move to the cluster regions as they provide greater job and growth opportunities (both personal and firm level) and job security. Evidence of this has been observed in Taiwanese Science-based Parks. Most of the science parks are located in the bigger cities such as Taipei and Hinschu. As a result, the cluster and the city provide incentives that draw workers to the location (Lee, 2006). In addition, geographical areas containing clusters have been found to be labour markets for specialised workers. Combes and Duranton (2006) found that workers are more likely to look for a new job in the same location than to move to another location in order to avoid the cost of moving. This creates a pool of labour within the cluster as the risk for workers moving outside the area is low.

Large pools of skilled labour are associated with concentrations of enterprises engaged in the same or similar industries. Workers with the relevant skills to the cluster are attracted by the existing pool of labour. Examples of clusters with large pools of workers with specialised skills and a flexible labour market include the creative industries cluster in Hollywood, California; the Sialkot surgical instruments cluster in Pakistan; the Gamarra garment cluster in Lima, Peru; the Agra footwear cluster in India; and the Suame magazine cluster in Kumasi, Ghana (Rosenfeld, 2002; Yoshino, 2011).

2.5.14 Education and training

Industrial clusters offer education and training for employees to enhance the competence of firms that adopt technology (see section 2.5.2) and learn from the lead firm (see section 2.8.3). Training and education are essential to ensure that the employees have the knowledge and skills to effectively execute tasks while utilising new technology. Training and education facilitate the learning (see section 2.5.2) and the transfer of technological spill-over benefits associated with industrial clusters (Rosenfeld, 2002; see sections 2.5.3 and 2.5.17). Taiwanese Science Parks offer professional training services such as lectures, workshops, and seminars annually (Lee, 2006). In cases where government is involved in cluster development, government assistance can be in the form of provision of infrastructure and education and training. Investments of this nature by government are aimed at providing industry-specific infrastructure, specific skills training and capability enhancement to boost the growth and sustainability of the cluster (Enright, 2003).

In some cases, clusters attract unskilled labour if the supply of specialised skilled labour is insufficient (Yoshino, 2011). The skills upgrading benefit associated with education and training in clusters is particularly important in such instances. This is because it prevents the labour disabling effect. The labour disabling effect is common among some Sub-Saharan African clusters and it occurs when the new pool of labour drawn to a cluster does not possess the specialised skills required by the cluster (McCormick, 1999). This results in the stagnation of cluster growth as the labour is not able to upgrade the cluster. McCormick (1999) reassured that education and training of the workforce will ensure that their skills are upgraded thereby supporting cluster growth and survival from external competition.

2.5.15 Capital availability

Some banks and other financial institutions align their functions with government policy to achieve national industrial development. Resultantly, these institutions allow easier investment and provide capital to firms in a cluster. Commercial loans are issued at very low interest rates for infrastructure development, such as erecting a plant and purchase of machinery. This assistance is aimed at encouraging the development and reducing the burdens on firms in the cluster. In small communities, business may be willing to invest in strategies designed to achieve economic growth such as industrial cluster formation by providing capital to clusters (see section 3.2.1.6). An example of this is the hosiery technology centre in Italy. This centre received funding in the form of loans and research and development support from the rural co-operative bank in Castle Goffredo, Italy (Rosenfeld, 2002).

Ramachandra, Gelb and Shah (2009) found that the main constraints to productivity for indigenous SMEs in Africa were the education levels of managers and access to finance. Clusters facilitate access to finance for firms through informal social networks; especially in environments where market institutions are weak (see section 2.5.4). Informal social networks enhance the flow of information among firms in the cluster reducing search costs associated with finding buyers and sellers. This, in turn, develops trust and relationships; leading to reductions in transaction costs (see sections 2.5.12, 2.8.5 and 2.8.7) and may ultimately facilitate access to finance (Yoshino, 2011). Clusters also enhance the physical capital intensity of production for firms either by providing access to capital thereby enhancing the firms‟ ability to invest and obtain physical capital or by the firm having access to specialised machinery in the cluster (Yoshino, 2011). The cluster provides access to specialised infrastructure and machinery, which in turn enhances the firm‟s use of physical capital (such as specialised machinery) relative to labour. Ultimately, this increases cluster firms‟ productivity and product quality (Yoshino, 2011).

2.5.16 Specialised services

Government‟s role in facilitating cluster formation may be the provision of specialised services to firms in the cluster to enhance the advantages of clustering (Chiaroni & Chiesa, 2006). Specialised services are public sector services provided to firms by related experts who have specialised knowledge of the cluster (Lee, 2006). Specialised services include technology extension services, technology centres, export assistance, small business centres, and private sector services. These services are provided by specialists such as designers, engineering consultants, accountants and lawyers, among others. The only drawback is that these technology extension services do not achieve economies of scale and therefore result in high administration costs. Industrial clusters in Taiwan offer convenient services, such as bureaus for tariff duties to handle import as well as export affairs, logistic centres for customs-related issues, or one-stop services that offer employment information. In addition, the authorities also provide preferential loans, tax relief, and long-term financing, among others.

2.5.17 Physical spill-overs

Physical spill-overs emerge among buyers and suppliers (vertically related firms) and among competitors (horizontal relationship) (Madsen *et al.,* 2004). This occurs when investments are made in specialised industry-specific infrastructure, either by local government or by private sector agents taking advantage of business opportunities that exist in the cluster (Harrison, 1996).

Physical spill-overs reduce transportation costs in the cluster. Investments in physical infrastructure enable firms to jointly transport and distribute cluster goods enabling them to share costs (see section 2.5.11). The following section discusses some of the disadvantages associated with industrial cluster formation.

2.6 Disadvantages associated with industrial cluster formation

2.6.1 Regions will have difficulty picking winners

In cases were cluster formation is not a result of spontaneous firm cooperation (spontaneous clusters), cluster formation can be induced by the public sector (see sections 2.7 and 2.9). In such cases, successful cluster formation should be facilitated in sectors where the region‟s comparative advantage lies. This requires the identification of a region‟s competitive advantage. Competitive advantage can be based on the characteristics of the labour force, local endowments, quality and availability of private and public infrastructure, and proximity to input and product markets (see section 2.3; Rosenfeld, 1992). The identification of a region‟s comparative advantage is important and ensures the design of an effective industry cluster promotion programme. The cluster formation process will likely succeed if the clusters are in sectors in which a competitive advantage exists (see section 2.9). However, competitive advantages change over time as a result of changes in technology, customer tastes and preferences as well as changes in institutions (Cunningham, 1995). For small regions, this problem is worsened by the fact that little effort and few resources are dedicated to understand the composition and evolution of the economy (Porter *et al.,* 2004). More effort and resources are usually utilised in order to understand the economies of large regions as compared to small regions (Shields, Barkley & Emery, 2010).

The accurate assessment of the regional comparative advantage is the public sector‟s responsibility. Barkley and Henry (1997: 318) pointed out that “many regional scientists are sceptical regarding the availability of public officials to identify regional competitive advantage, select “good” industries/firms to target, or design programs to assist specific sectors”. The accuracy of the identification of competitive regions is hampered by the fact that industry-wide growth prospects cannot always be accurately measured. Additionally, growth prospects change over time and an industry can experience employment and sales trends that are different to the industry-level trends (Courant, 1995). Storper and Scott (1992) also highlighted that comparative advantage analysis is likely to reveal past trends as historic data are used in the analysis. This may lead to the use of past trends for a particular location and may not provide insight into current resource endowments. Furthermore, the process of identifying industrial clusters by the public sector is usually inclusive instead of selective (Peck & McGuiness, 2003). This implies that the available resources for cluster promotion are shared among a variety of options, thereby achieving sub-optimal outcomes in order to meet policy objectives.

2.6.2 Areas dependant on clusters are more vulnerable

Regions in which industrial clusters are established are more vulnerable to changes arising from short-term economic stability or long-term economic decline (Feser, 1998; Harrison, 1992; Kaufman *et al.,* 1994). Feser (1998) pointed out that there is a lack of sufficient *a priori* evidence to prove that clustering will remain beneficial and continue to grow and provide economic as well as geographic benefits. He highlighted that social, cultural or even political changes can lead to a loss of the relationships between firms in a cluster. This reduces or even eliminates the positive synergies of clusters. Furthermore, Feser (1998) pointed out that regions in which clusters are formed are more vulnerable to the spatial dispersal of firms in the cluster as a result of improvements in transport and communication infrastructure (see section 2.5.11). The gains from spatial agglomeration are eroded by efficient transport and communication infrastructure. Efficient transport and communication infrastructure erodes agglomeration gains as firms are able to enhance their competitiveness by making individual investments. Furthermore, firms are able to maintain individual as opposed to collective competitiveness in the cluster (see section 2.5.11).

2.6.3 Latecomers may not be competitive

The main benefits of industrial cluster formation are positive feedback (see section 2.3.2), shorter feedback loops for innovation (see sections 2.5.1 to 2.5.3) and entry of new firms in the cluster. However, these benefits diminish as the cluster becomes larger and grows older (Boari, 2001). The oldest clusters in a region benefit the most from localisation. The benefits of agglomeration such as institutional support, specialised infrastructure investments and localisation economies may not be available to the clusters that are formed later (Scott, 1993; Rauch, 1993; Barkley & Henry, 1997). Intra-cluster networks and relationships are formed over time from experiences of contracting, formal and informal deal making, and sharing infrastructure and support services (Harrison, 1992; see sections 2.5.9 and 2.8.5). Latecomer clusters are more likely to struggle to form networks and relationships, which are vital for cluster growth and survival. Scott (1993) pointed out that latecomers can enhance their competitiveness and overcome this limitation by either utilising a unique local resource or characteristic of the region that other firms in the cluster are not, thereby creating new and operating an activity in the cluster‟s industrial structure (see section 2.8.1). Alternatively, latecomers can enhance their competitiveness by developing and implementing a more competitive wage policy relative to other players in the cluster, or utilising locally-provided subsidies to enhance the firm‟s competences (Scott, 1993; Hansen, 1990; Rauch, 1993).

2.6.4 Supportive institutions are not easily established

Hirst and Zeitlin (1992) pointed out that the prerequisites in the cluster formation process that ensure that antagonistic competition is discouraged are political, economic and institutional changes. These changes are necessary to discourage opportunistic behaviour and to ensure the development of trust; cooperation, coordination, flexibility and collective action (see sections 2.5.5 and 2.5.9). Cluster formation requires a supportive institutional environment to support and nurture the process (Barkley *et al.,* 1997; see section 2.8.1). Proponents of new institutional economics caution that the cluster formation process is likely to be impeded by the likelihood of failure to establish cooperative behaviour among firms and to conduct beneficial market exchange. This is likely to be as a result of incomplete information, bounded rationality, opportunistic behaviour and asset fixity and specificity (Libecap, 1996). Camagni (1995) pointed out that the difficulty in creating supportive institutional environments is one of the major limitations in the cluster formation process.

Other limiting factors that impede the establishment of a favourable environment for cluster formation are cultural and demographic diversity. Camagni (1995) and Harrison (1992) found that successful industrial districts were usually racially and culturally homogeneous. This indicates that the more culturally and demographically diverse a region is, the more difficult it will be to establish the institutional environment required to form clusters successfully. In an investigation of the viability of industrial cluster formation in rural agricultural regions in the USA, Harrison (1993) found that "historical and cultural vestiges that contribute to the evolution of a supportive industrial environment are more likely to be absent in rural agricultural areas". Barkley *et al.* (1997) suggested that these shortcomings can be addressed by leadership training programmes, community-level consensus building. Additionally, this shortcoming can be addressed by strategic planning and the use of brokers to facilitate the stimulation of collective services and buyer-seller networks.

2.6.5 Supply side disadvantages

Locating in a dense cluster may imply monetary disadvantages for firms. This is because congestion and competition in the input market will arise as more firms locate in the cluster (Barkley *et al.*, 1997). Increased demand is met with increases in input prices to retain equilibrium (Beaudry & Breschi, 2003). This congestion effect is likely to be reflected in the increased costs of real estate and/or labour in the cluster (Beaudry & Breschi, 2003; Yoshino, 2011). Location in a cluster may also result in a slowdown in technical change. If firms experience competitive pressure as a result of congestion in the cluster, they may resolve to an inward-oriented attitude. Subsequent technological lock-ins and resistance to innovations generated by other firms in the cluster occur as firms strive to remain competitive (Suarez-Villa & Walrod, 1997).

2.6.6 Imbalanced economic development

Success and growth in a cluster attract more capital, related and supporting firms, institutions and competitors. This reinforces the process of positive feedback and establishment as the cluster becomes more instituted (Feldman *et al.* 2005; see section 2.3.2). This movement of economic players to the cluster region has adverse effects on the periphery regions losing them. Furthermore, many regions, especially small ones, have clusters in declining industries or no clusters at all. As a result, an industrial cluster promotion strategy would not be relevant for such regions and would result in these regions being excluded. Rosenfeld (2002) suggested that such a situation can be addressed by focusing on promoting connections to clusters in adjacent regions based on similarities in knowledge, innovation or entrepreneurial inter-linkages instead of production-based linkages. Industrial cluster strategies may also bring about imbalanced economic development to regions or segments of the population because they tend not to be „a holistic view" of regional development (Martin & Sunley, 2003). Efforts in industrial cluster promotion strategies (see section 2.9) tend to be focused on creating a favourable environment for cluster formation rather than creating a favourable environment for all businesses to grow and prosper. This creates a scenario in which the regions where clusters are established have a favourable business environment, while periphery regions do not.

This section has demonstrated some of the disadvantages associated with industrial cluster formation. Shields *et al.* (2010) highlighted that the benefits of promoting an industrial cluster strategy can still be realised if the shortcomings associated with the strategy are addressed. Economic development practitioners should therefore identify and address any limitations in order to ensure holistic success for the region and the country. The following section discusses the different types of industrial clusters found in the literature.

2.7 Different types of industrial clusters

An understanding of the different types of clusters provides a better understanding of the nature and the different forms of clusters. Regional and urban economic growth is of prime importance in developing countries (van Dijk & Sverrisson, 2003). An understanding of the different forms in which clusters exist is necessary for effective policy formulation. It is important to distinguish between developed and developing country clusters as the economic and social bases on which they are formed are different. These differences influence the evolutionary path of cluster formation in different economies (see section 2.3). Some clusters are characteristic of developed countries, while others are of developing countries. The cluster taxonomies reported in this section are not exclusive to either developing or developed countries. The type of cluster formed depends on the economic and social characteristics of the country in which they are formed. Therefore, these classifications are not completely distinct, but are nested rather. Developing country cluster forms also exist in developed country clusters and *vice versa*. Schmitz and Nadvi (1999) cautioned that distinguishing clusters in developed countries and developing countries is an oversimplification of the complexities of cluster capabilities. However, this distinction still provides a basis for analysing key features of clusters (see section 2.4). The subsequent section discusses cluster different types of clusters mostly found in developed countries.

2.7.1 Different types of industrial clusters found in developed countries

A distinguishing feature of clusters in developed countries is technology and innovation in product and process designs (see sections 2.5.1 and 2.5.2). This sets clusters in developed countries apart and enables them to become world leaders and standard-setters (Schmitz & Nadvi, 1999). Developed country clusters are also found in developing countries that have the economic and social bases necessary for the formation of such advanced clusters. In Africa, for example, a notable few examples of advanced clusters have been investigated, namely the Nnewi auto parts cluster in Eastern Nigeria, the clothing producers in Witwatersrand, South Africa and the Lagos clusters (Oyelaran-Oyeyinka, 1997, 2006; Rogerson, 2000).

Table 2.3 shows the types of clusters found in developed countries. It also provides the authors citing each cluster type, the characteristics of the clusters and examples of each cluster type. *Marshalian industrial districts* were one of the first forms of clusters to be documented in the 1920s. The main characteristic of this type of cluster is product specialisation at industry level. This type of cluster is made up of firms producing the same product and becomes a competitive force in that industry. Labour specialisation throughout the production chain is also a key feature of this type of cluster. Firms specialise in tasks in which they are competitive and efficient and leave tasks where they are less competitive and efficient to other firms in the cluster. As a result, the cluster has strong interdependence and cooperation. Interdependence and cooperation in *Marshalian industrial districts* are enhanced by cultural and family ties, at various levels in the value chain. This type of cluster maintains competitive and cooperative relationships, which drive firms to be efficient in order to survive (Markusen, 1996; see Table 2.3).

Table 2.3: Types of industrial clusters found in developed countries

Cluster	**Authors citing cluster**	**Characteristics of cluster**	**Examples**
Marshalian industrial districts	Marshall, 1920 Markusen, 1996	Product specialisation at industry level; labour specialisation throughout the production chain; dependence and cooperation; competitive and cooperative relationships; cultural and family ties	Textile and metal working districts of England, Germany, and France; Information technology cluster of New York
Industrial districts	Becatinni, 1990	Firm-level vertical disintegration of production; cooperative competition; socio-cultural identity; support from private and public institutions	Industrial districts of Sweden, Germany; Italy and India
High technology	Enright, 2003; Amin, 1994; Madsen *et al*., 2004	Span over several technologically unrelated industries	Silicon Valley, USA; Route 128, USA; M4 area Tokyo;
Diversified industrial	Pedersen, 1997; McCormick, 1998	Individual firm vertical specialisation; vertical diversity; broad sectoral specialisation; efficiency gains from collaboration	The clothing cluster Cape Town, South Africa; Fishing and fish processing Lake Victoria, Kenya
Sub-contractor	Pedersen, 1998; Amin, 1994.	Narrow vertical and horizontal specialisation; collective efficiency from reduced transaction costs; sub-contraction of economic activities; interaction of large and small firms	Mechanical industrial district, Pordenone Italy; furniture cluster Pampanga, Philippines
Public-induced/ policy-driven/ constructed	Mytelka & Farinelli, 2000; Chiaroni & Chiesa, 2006	Policy initiatives trigger cluster formation; use of either industry restructuring or industry development policies	Uppsala, bio-technology cluster Sweden; Grenopole, Paris-Evry clusters, France
Spontaneous	Chiaroni & Chiesa, 2006; Mytelka & Farinelli, 2000; Zucker, 1998; Feldman *et al*., 2001; Prevezer, 2001	Strong scientific/ industrial base; build on local knowledge; technology transfer mechanisms; strong entrepreneurial culture; availability of innovative finance; strong legal framework	Cambridge bio-technology cluster, UK; Bay area bio-technology cluster, USA
Organised	Ottati, 1994; Schmitz, 1995	High levels of inter-firm linkages; relatively greater networking within and outside their national borders	Nnewi Nigeria; the surgical instruments cluster in Sialkot, Pakistan

Dynamic/ innovative	Nadvi & Schmitz, 1994; Schmitz, 1995; Oyelaran-Oyeyinka, 2003	Specialisation in high value niches; strong competition; dynamic and high levels of innovation	Pharmaceuticals cluster, Dewas, Madhya Pradesh, India
Hybrid	Chiaroni & Chiesa, 2006	Combination of spontaneous formation and government initiatives	San Diego ICT cluster; bio-technology cluster, Milano, Italy, Uppsala, bio-technology cluster

Source: Compiled by author

Industrial districts are formed where strong inter-firm divisions of labour and inter-connectedness of the local community exist (Schmitz, 1995). The terms industrial districts and clusters are sometimes used interchangeably. Clusters, however, extend beyond the scope of industrial districts to include the geographical concentration of firms. Becatinni‟s (1990) industrial districts are similar to Marshall‟s (1920) industrial district, but further incorporate support for the cluster from both private as well as public institutions. *High technology clusters* are highly innovative and span over several technologically unrelated industries (Enright, 2003; Amin, 1994; Madsen *et al.*, 2004). This empowers the cluster with innovative capabilities as the technologies of one industry can be adopted to develop new products and new processes in another (Madsen *et al.*, 2004; see section 2.5.2). For example, the Massachusetts medical device cluster comprises firms from different industries spanning from electrical equipment, computer components and medical devices to plastic products (Porter, 1998).

Individual vertical specialisation among firms in *diversified clusters* creates vertical diversity (Pedersen, 1997). This type of cluster is characterised by broad sectoral specialisation and resultantly earns efficiency gains from collaboration (Pedersen, 1997; McCormick, 1998). Examples of diversified clusters are the clothing, footwear, ceramics and furniture sectors in the Emilia-Romagna, Tuscany and other regions of the Third Italy[5]. In contrast, *subcontractor clusters* are characterised by narrow vertical and horizontal specialisation among firms.

[5] The Third Italy includes the regions Tuscany, Umbria, Marche, Emilia-Romagna, Veneto, Friuli, and Trentino-Alto Adige/Südtirol. Industrial clusters were formed in these regions (comprising small firms and workshops) in the 1970s and 1980s in the post-Fordist (mass production) era. These clusters became well known for producing high quality products and employing highly skilled and well-paid workers (Kumar, 1995).

However, the cluster achieves collective efficiency from reduced transaction costs (Amin, 1994; see sections 2.5.5 and 2.5.12). Firms in this type of cluster subcontract activities that the firm cannot perform efficiently. Sub-contraction is usually between large and small firms in the cluster (Pedersen, 1998; Amin, 1994).

Public-induced, policy-driven or constructed clusters are formed as a result of policy initiatives by government to trigger cluster formation (Mytelka & Farinelli, 2000; see sections 2.9 and 2.10). In most cases, these clusters will possess little or no critical mass or the competencies for cluster formation to occur organically (Enright, 2003). Government uses either industry restructuring or public policy to enhance cluster formation. Industry restructuring occurs where a once competitive industry experiencing a crisis is supported by government initiatives to create jobs for the redundant workers. Alternatively, public policies can be aimed at industry development. Public policies are usually aimed at initiating development in a particular sector where some favourable conditions exist (Chiaroni & Chiesa, 2006; see section 2.10). Examples of this form of cluster are the Uppsala, bio-technology cluster in Sweden and the Grenopole, Paris-Evry, cluster in France.

Spontaneous clusters are formed as a result of the existence of a strong scientific and/or industrial base (Chiaroni & Chiesa, 2006; Mytelka & Farinelli, 2000: see section 2.8.1). This facilitates technology transfer mechanisms. A strong entrepreneurial culture initiates the commercialisation of scientific findings and business ideas and ignites the cluster genesis process (Mytelka & Farinelli, 2000; see sections 2.3 and 2.8.12). The availability of innovative finance and a strong legal framework also provides an impetus for entrepreneurial and subsequent cluster success (see sections 2.8.6). *Organised clusters* have high levels of inter-firm linkages and relatively greater networking within and outside their national borders. Examples of this type of cluster include the Nnewi cluster in Nigeria and the surgical instruments cluster in Sialkot, Pakistan.

Dynamic or innovative clusters bear similar characteristics to high technology clusters. Specialisation in high value niches, strong competition, as well as dynamic and high levels of innovation characterise this form of cluster (Nadvi & Schmitz, 1994; Schmitz, 1995; Oyelaran-

Oyeyinka, 2003). *Innovative clusters* specialise and develop new technology, new products or new production processes using locally available resources or an existing competitive advantage (van Dijk & Sverrisson, 2003). Strong competition among firms in the cluster steers the innovative process in order to maintain competitiveness and survival among rival firms. Resultantly, the levels of innovation in this type of cluster are very high (see sections 2.5.1 and 2.5.2). Once the novelty has been developed in innovative clusters, other firms, usually small firms with limited research and development capabilities, then imitate. This is achieved by reverse engineering, subcontracting or forming strategic alliances with the lead firm to adopt the novelty (see sections 2.5.1 and 2.5.2). This type of industrial cluster is not common in developing countries. However, understanding innovative clusters is essential to equip developing country clusters with the necessary preconditions to evolve into innovative clusters.

In some instances, a favourable environment for cluster formation exists but the supporting infrastructure may be lacking. Government initiatives may be put in place to activate the cluster by providing the necessary infrastructure (see section 2.9). In this case, *hybrid clusters* are formed. These are a combination of spontaneous formation and government initiatives. Hybrid clusters are of particular interest for developing countries as government is needed to facilitate the cluster formation process where supporting infrastructure may be lacking (see section 2.9). The different types of industrial clusters found in developing countries will be discussed subsequently.

2.7.2 Different types of industrial clusters found in developing countries

Clusters in developing countries are embedded in a different setting than those in developed countries. This is due to factors such as widespread poverty and surplus unskilled and semi-skilled labour (Schmitz, 1990). Social cohesion and the integrating role of local institutions are less prominent among firms in developing countries. These factors are vital to successful cluster formation. This is mainly due to factors such as high levels of internal segmentation, which strengthen inequalities among firms (Oyelaran-Oyeyinka, 1997). Furthermore, extreme differences exist in bargaining power among firms in developing country clusters. This results in the benefits from collective efficiency to mainly accrue to competitive firms and market agents in the cluster (Schmitz, 1992). Table 2.4 shows the cluster types found in developing countries. It also provides the authors citing each cluster type, as well as the characteristics and examples of the different cluster types. However, these clusters are not strictly restricted to developing countries, as they can also be found in developed countries.

Craft-based industrial clusters are common in developing countries, particularly in traditional and low technology industries (Enright, 2003). A high level of craftsmanship exists in this form of a cluster, resulting in specialisation in labour intensive artisanal sectors (Enright, 2003; Amin, 1994). Another striking feature of this cluster form is that it is a strategy of self-employment in metropolitan areas. Similarly, *informal enterprise* clusters are a self-employment survival strategy in metropolitan areas (McCormick, 1999; Dawson & Oyeyinka, 1993; van Dijk & Rabelloti, 1997). They mainly comprise small and medium-sized enterprises. Examples of informal enterprise clusters include the automotive, garment and clothing sectors in Mathare valley, Kenya; the auto-mechanics cluster in Lagos, Nigeria; and the grain milling cluster in Burkina Faso (see Table 2.4).

Table 2.4: Types of industrial clusters found in developing countries

Cluster	**Authors citing cluster**	**Characteristics of cluster**	**Examples**
Craft-based/ artisanal/ traditional	Enright, 2003; Amin, 1994	High levels of craftsmanship; specialisation in labour intensive artisanal sectors; self-employment in metropolitan areas	Witwatersrand garment making South Africa; Agra footwear cluster, India
Informal enterprise	McCormick,1999; Dawson & Oyeyinka, 1993; van Dijk & Rabelloti, 1997	Self-employment survival strategies; located in metropolitan areas; mainly comprise of small and medium sized enterprises	Automotive, garment and clothing sectors in Mathare valley, Kenya; auto-mechanics in Lagos, Nigeria; Grain milling in Burkina Faso
Policy-driven	Enright, 2003; Chiaroni & Chiesa, 2006	Government support; industry restructuring or industry development; lack favourable conditions for spontaneous formation;	Uppsala pharmaceutical cluster; Grenopole of Paris-Evry.
Latent	Enright, 2004	Critical mass for cluster formation exists; no interactions and information flows;	Medical device cluster, Massachusetts, USA

Low-income	Nadvi & Schmitz, 1994; Schmitz, 1995; McCormick, 1999	Little dynamism in markets; price competitiveness; weak competition; large pool of labour; economies of scale from market conditions; constant technology and organisational form	

Source: Compiled by author

Policy-driven clusters are common in developing countries. This is because developing countries lack the capacity and favourable environment to sustainably support cluster formation (McCormick, 1999). *Latent clusters* exist where critical mass for cluster formation exists, but there is little or no interaction and information flows between firms (Enright, 2003). This means that firms are not aware of the potential benefits of strengthening existing inter-linkages or are not willing to engage in collaborative cooperation. *Low-income clusters* exhibit little dynamism in markets and in price competitiveness (McCormick, 1999). This form of cluster has weak competition, a large pool of labour and experiences economies of scale from market conditions (Nadvi & Schmitz, 1999). Additionally, constant technology and constant organisational form are characteristic of this cluster form indicating that little or no innovation will take place in this cluster (see Table 2.4). Other authors have cited other different types of clusters that are commonly cited in the literature. These are discussed in the following section.

2.7.3 Other types of industrial clusters

Other cluster typologies covered in the literature include *industrial parks,* which are also known as *industrial zones*. These aim to generate economic benefits of clustering by creating a favourable environment for cluster formation and local economic development (Lee, 2006). Another form of clustering is *science parks*. Science parks are formed to set up a basis for the formation and development of high-tech industries. This is achieved by providing for the needs of high-tech development through efficient utilisation of available industry, academia and government resources (Lee, 2006). Lee (2006) also identifies *village-based industrial clusters* consisting of household enterprises and SMEs in the rural areas of Vietnam, especially in the northern region.

Krugman (1991) identified three subsets of clusters. The first subset of clusters is known as the *cohesive cluster (Type A).* This cluster is characterised by groups of firms that initially locate together to reduce costs. Transport costs are assumed to be a function of weight and distance. The aim of agglomeration in this type of cluster is to keep the costs of movement associated with material assembly and subsequent distribution to the market at a minimum. *New industrial districts (Type B)* are the second type of cluster. These clusters tend to be knowledge based, often with a high proportion of companies in high-technology sectors. Research and development is a key driver for the creation of new products. *Innovative milieu (Type C)* is the third subset and is based on the work of researchers who emphasise the importance of social capital to promote innovation.

Markusen"s (1996) seminal work on cluster typology distinguished four cluster taxonomies based on the industrial structure of the cluster. The first are termed *Marshalian clusters*. Marshalian clusters comprise several locally-owned SMEs usually in the information-technology sectors. Marshalian clusters are characterised by strong inter-firm linkages and strong institutional support (Shields *et al.,* 2010; see section 2.7.1- Marshalian industrial districts). This type of cluster is highly dependent on the economies of scale derived from collaboration in the cluster. The second type of cluster is the *hub and spoke*. These clusters comprise one or several large firms with several supporting service firms and small suppliers (see section 2.8.3). The large firms determine the terms of inter-firm linkages with the small suppliers as well the growth prospects of the cluster. *Satellite platforms* are the third category and are composed of medium and large branch plants of large companies. Inter-firm linkages are minimal in this type of cluster as branch plants are self-sufficient (Shields *et al.,* 2010; Markusen, 1996). The fourth category, *state anchored clusters,* comprises either a large firm or a public non-profit entity such as a government office, university or a military base. Related and service firms are also a feature of this type of cluster. Inter-firm linkages are limited to buy-sell relationships. The cluster"s growth prospects are dependent on the availability of public funds to support the facility.

Developing countries" characteristics are different to those in developed countries. Issues such as widespread poverty, surplus unskilled and semi-skilled labour, lack of social cohesion and the absence of local institutional infrastructure are key challenges to cluster formation in developing countries. High levels of internal segmentation strengthen inequalities among firms. This results in extreme differences in bargaining power and the unequal distribution of collective efficiency gains. These factors ultimately impede cluster formation in developing countries. Globalisation also places more pressure and threatens the sustainability of clusters in developing countries. Subcontracting and outsourcing have reduced the magnitude of benefits of close proximity to suppliers. Advances in information technology have also increased the accessibility of the global consumer, likewise reducing the magnitude of the benefits of close proximity to buyers. In some advanced economies, the emergence of virtual clusters further illustrates the dying significance of geographical proximity as a source of competitive advantage.

Cluster failure is also a common feature despite the widespread success of clusters globally. Clusters are increasingly faced with competition from producers in low cost countries. Causes of cluster failure include falling demand for cluster products, for example the detachable collar industry in Troy, New York. Other causes of failure include organisational obsolescence, as well as competitive pressure from similar clusters, for example the Sheffield cutlery cluster (UK) was replaced by the Solingen (Germany) cluster, which was later replaced by the Seki (Japan) cluster. Other causes of cluster failure are the loss of ability to coordinate activities and the loss of internal dynamism (Enright 2003).

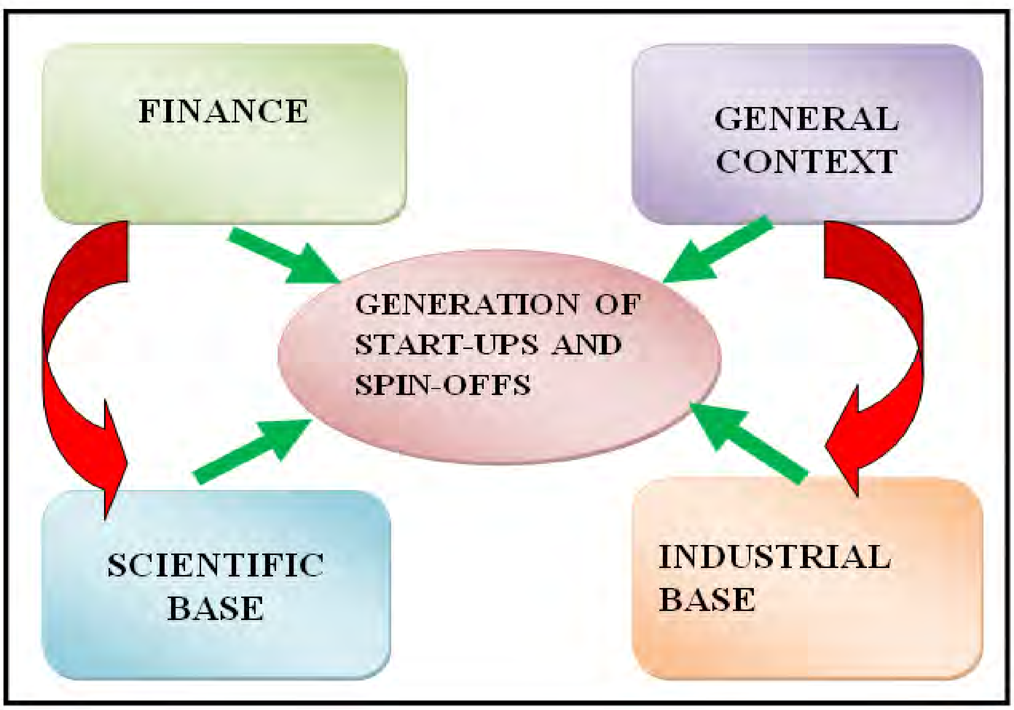
This section provided important insight into the types of industrial clusters found in both developing as well as developed countries. This is a vital part of this study as it provides information on the characteristics of the different types of clusters. Otsuka and Sonobe (2006) stated that understanding the different types of clusters provides vital knowledge that can formulate effective “policies to nurture new industries or to accelerate the development of existing industries” and form industrial clusters. Therefore, the following section provides more insight into the conditions necessary for cluster formation.

2.8 Conditions necessary for industrial clusters formation

2.8.1 A favourable environment

Chiarino and Chiesa (2006) investigated the forms of creation of industrial clusters in biotechnology. They identified a favourable environment as the key driver to industrial cluster formation. A favourable environment is characterised by a *scientific base, finance, general context* and *an industrial base.* These factors stimulate the generation of *start-ups and spin-offs* (see Figure 2.4). Start- ups are new companies that are formed in the cluster and do not have any formal association with existing industrial or scientific institutions in the cluster. On the contrary, spin-offs are companies that are formed to take commercial advantage of a business idea generated in the cluster. Business ideas originate either from research entities (universities and research institutions) or from industry research and development outcomes (Chiarino & Chiesa, 2006).

Figure 2.4: Key factors affecting a favourable environment



Source: Chiarino and Chiesa, 2006

Pre-seed and seed capital is early-stage capital investment from the entrepreneurs‟ personal funds. Alternatively, pre-seed and seed capital can be micro-loan provisions. The new firm requires capital to cover operational costs until the company‟s development is accelerated. Wright *et al.* (2006) attributed differences in capital needs and preferences to the pecking order hypothesis. Under this hypothesis, entrepreneurs prefer internal funding compared to external funding. If this is not available, debt financing is preferable to equity financing and venture capital. Equity financing and venture capital are less preferable because of the associated loss of ownership for entrepreneurs in the event of dissolution of the company (Roberts, 1991; Watson & Wilson, 2002). Roberts (1991) and Smilor *et al*. (1990) found that 70% of US university spin-offs internally provided pre-seed and seed capital. However, most entrepreneurs do not have sufficient financial resources to start up their business ideas. Resultantly, the need for financial institutions and government to make up for this shortfall and avail favourable conditions to provide finance is a vital precondition to cluster success (see section 2.5.15).

The *general context* refers to a strong legal framework, attractiveness of the area and infrastructure. Gerstlberger (2004) emphasised that infrastructure development is a success criterion for the sustainable regional innovation systems. The general context comprises the legal system, general attractiveness of the area and the international promotion of the culture. A legal system provides services ranging from facilitating dispute resolutions to assistance in the formation, funding and expansion of firms in the cluster (McCormick, 1999; see section 2.8.6). A strong *industrial base* facilitates the acceleration of growth of clusters. Munich, Germany is Europe‟s leading high technology region owing to a strong industrial base. The strong industrial base nurtured the success of large companies such as Siemens. Siemens, in turn, co-operates with innovative SMEs to create an innovative cluster (Sternberg & Tamàsy, 1999). The existence of success stories in the industry and in the cluster attracts more companies, skilled labour and research institutes to the site.

A *scientific base* comprises universities or large companies engaging in research and development. In the case of high technology industries such as biotechnology, a scientific base continually provides new ideas and inventions that enhance and maintain the competitive edge of the cluster. Furthermore, the university-industry network fosters a networking culture that drives the sustenance of the cluster. However, the effectiveness of innovations from the scientific base is dependent on the skills and knowledge of scientists and managers (see section 2.5.4), availability of information, and the effectiveness of firms in commercialising new innovations (see section 2.5.4; Enright, 2003).

2.8.2 Unplanned events

In their most basic form, industrial clusters begin in response to unplanned events that foster benefits for co-operation between firms (see section 2.3). The emergence of clusters can be as a result of the availability of resources at certain locations (see section 2.3.1). Clusters can also form as a result of shortages in finances or the workforce in the event of rushed orders (Sandee & Rietveld, 2001). Such situations create the need for collaboration with other firms within the same geographical location. This becomes the first step in the formation of an industrial cluster (see section 2.3). Schmitz (1995) noted that "governments or government-sponsored institutions cannot create an industrial organisation which competes on the basis of collective efficiency". Han (2009), in a study of clusters in low income economies, found that public agencies cannot initiate the concentration of industrial activity and know-how in clusters, but rather can help spontaneously formed clusters to expand and innovate. This highlights the fact that government intervention will not likely create successful clusters. Rather, cluster formation must be spontaneous for it to succeed (see section 2.9). Feldman *et al.* (2005) pointed out that government intervention should rather be focused on creating a favourable environment to incubate innovation, entrepreneurs and clusters. Such a favourable environment is characterised by legal and tax framework, research institutions and social relationships (see section 2.8.1).

2.8.3 The presence of a lead firm

The success of clusters depends on the existence of a lead firm in the cluster. A leader, recognised by all players in the cluster, facilitates the amalgamation of a shared vision that addresses all players" interests in the cluster (Morosini, 2004; see section 2.8.10). This is achieved through establishing mutual cooperation, knowledge sharing, leadership coaching and arbitration of disputes in the cluster (Morosini, 2002). Following the macro-economic shocks of the 1980s and 1990s, leaders in the Guadalajara footwear cluster in Mexico collaborated to design and implement a joint course of action for recovery of the cluster (Rabelloti, 1999). The lead firm can be a multinational firm. Multinational firms enhance the probability of success of a cluster‟s foreign market penetration (Enright, 2003). This can be attributed to the following characteristics of multinational companies; experience in international business, rich human capital base that is active in international professional associations, active personal networks, and established links in foreign markets. Therefore, lead firms make clusters successful because they are part of global networks and are successful in global markets.

Markusen‟s (1996) hub and spoke clusters illustrate the role of the lead firm in a cluster (see section 2.7.2). Markusen‟s hub and spoke industrial clusters are characterised by one or several large firms that are either strongly linked or nucleated. These firms are vertically integrated and can be in the same industry or from different industries. The nucleated cluster contains a large firm that shares agglomeration economies with smaller firms without necessarily having buying or selling relationships. In strongly linked clusters, small firms are dependent on the lead firm for market entry or for suppliers (Markusen, 1996; see section 2.7.2). Lead firms in clusters take responsibility for the collective competitiveness of the cluster by establishing external connections and networks with other players in other regions in order to acquire new technology and knowledge (see sections 2.5.1; 2.5.2 and 2.8.3).

2.8.4 Trade networks

Trade and supplier networks in a cluster create ties among firms from buyer-supplier relationships, common technologies, common buyers, common distribution channels or common labour pools (Whalley & Hertog, 2000). Empirical evidence suggests that trade and supplier networks are an effective and sustainable source of competitiveness for firms in Africa and Asia (Brautigam 1997; Perry, 1999). The inexistence of trade networks and lack of effective incentives reduce the mobility of financial and human resources in the cluster. This will lead to the dilution of the potential benefits of knowledge diffusion, learning and other spill-overs among firms. Clusters with strong links to foreign markets established through traders have been shown to earn higher incomes (Weijland, 1994). In East and Southern Africa, the poor infrastructure and poor distribution networks were identified as the main determinants of poor performance of small-scale producers (Pedersen *et al.*, 1994). High transport and transactional costs arise from poor infrastructure and poor distribution networks. Neither of the firms involved in a business transaction can lower these costs, resulting in the reduced mobility of financial and human resources. This, in turn, inhibits the full realisation of benefits from clustering among firms.

Clusters are unique from other types of cooperation among firms in that the inter-firm linkages form value networks (Lee, 2006). Clusters go beyond simple value chains characterised by cooperation in R&D, demonstration programmes, collective marketing, or purchasing policy. The value networks in clusters also include vertical and/or horizontal linkages between firms. These linkages consist of dissimilar and complementary firms that specialise in the same knowledge base in the value network. Clusters are also characterised by external connections; strong relationships with experts in other regions. External connections are an important source of new technology and knowledge. Clusters can enhance knowledge spill-overs through establishing joint ventures, contracts, alliances, or communication networks with experts in other regions or countries (see section 2.5.2). A limited scope of external connections excludes a cluster from new knowledge and technology and consequently limits the cluster‟s competitive position (Lee, 2006)

Trade networks also ensure the successful internationalisation of firms in a cluster (see section 1.3). Established buyer-seller relationships minimise or eliminate the risks associated with internationalisation. In cases where clusters comprise multinational firms, the probability of success in foreign market penetration is enhanced by (i) the multinationals‟ experience in international business, (ii) highly skilled human capital base, (iii) networks in international professional associations, and (iv) established links in foreign markets (Enright, 2003; see section 2.8.3). Brazil is home to one of the world‟s leading leather shoe export clusters. This cluster‟s output was initially aimed at the home market. In the 1970s and the 1980s, the cluster took advantage of incentives provided by government to promote export-led growth. The cluster took advantage of government export promotion initiatives and established trade networks. This enabled the cluster to move from a home-market-based to an exporting cluster (Schmitz, 1995). Further evidence of the importance of trade networks in enhancing the success of clusters is found in the Sialkot cluster of surgical instrument manufacturers in Pakistan (Schmitz, 1999).

This cluster was estimated to export 20% of total world exports of surgical instruments (Nadvi, 1996). Resultantly, Pakistan ranked second in the world as an exporter of surgical instruments.

2.8.5 Trust

Schmitz (1999) defined trust as "the willingness to expose oneself to the possibility of opportunistic behaviour by others". Cluster formation requires trust. This, in turn, requires the discouragement of free market models and policies to promote competition (Barkley *et al.,* 1997). This is because inter-firm rivalry reduces networking and the provision of collective services such as new product development, marketing information, technology development and transfer and labour training, which are characteristic of the cluster (Barkley *et al.,* 1997). Trust in cluster genesis is a crucial element that facilitates the effective communal use of resources such as machinery; technology and technical know-how by firms in the cluster (see section 2.5.9). Trust is crucial to maximise the cumulative and recurrent collective efficiency gains of firms in a cluster (see section 2.5.5; Schmitz, 1999). The success of firms is endogenous to the cluster and therefore trust is essential to ensure that firms devote their operations to the collective success of the cluster rather than rivalry. Hirst and Zeitlin (1992) highlighted that political, economic and institutional changes are a prerequisite in the cluster formation process. Trust ensures that antagonistic competition is discouraged thereby nurturing trust, cooperation, coordination, flexibility and collective action.

The basis for the development of trust varies among authors. Becattini (1990) attributes the development of trust to be based on socio-cultural ties that develop naturally or through history in an area. Common culture and frequent face-to-face relations are also deemed as sources of trust (Ottati, 1994). Ottati (1994) found a positive correlation between social relations in a community and the economic performance of an enterprise. Schmitz (1999), drawing from Zucker (1986), distinguished between ascribed trust and earned trust. The former refers to trust based on solidarity in existing relationships with certain individuals, families, ethnic groups and local communities. The latter, also known as process-based trust (Zucker, 1986), refers to trust derived from either personal experience or the reputation of doing business with a particular individual, family, ethnic group or local community.

Traditional ethnic networks were found to be a determinant of economic cooperation among firms in East Africa (McCormick, 1999; Mobig, 2005; Han, 2009). Ethnic networks and family bonds were found to influence the flow of information. As a result, the successful development of clusters and the integration of outsiders to a network depend on fitting in with traditional information channels or gaining trust within the traditional ethnic network or family bond (Morfessis, 1994; Han, 2009). The competitive strength and success of an industrial cluster depends on the social embeddedness and social integration of networks that facilitate coordination and cooperation between firms (Gordon & McCann, 2000). Social embeddedness and social integration develop from the norms, institutions and shared assumptions that exist among firms in a cluster (see section 2.8.7). Social embeddedness and social integration also originate from social history or current collective action (Gordon & McCann, 2000). This, in turn, creates and maintains the social capital that strengthens economic decisions in the cluster (Morosini, 2004).

2.8.6 Highly developed legal system

In a study of East African firms, McCormick (1999) found that the survival and sustainability of clusters were greatly influenced by the nature of the legal system. Ensuring observance of or obedience to business collaboration depends on the existence of a highly developed legal system. A highly developed legal system acknowledges and facilitates an economic environment suitable for the formation of industrial clusters (see section 2.8.1). The success of the Silicon Valley in the US was founded by the formation of a highly developed legal system to support the cluster formation process. The cluster attracted experienced litigators and judges housed in local and international law firms. A highly developed legal system provides services ranging from facilitating dispute resolutions, as well as assistance in the formation, funding and expansion of firms in the cluster. A weak legal framework for commercial and industrial activity does not provide any assurance about the enforceability of commercial contracts (McCormick, 1999). Enforceable commercial contracts ensure that firms are accountable through the law. This enables firms in the cluster to explore business relationships with other players in the cluster (Fafchamps, 1996).

2.8.7 Social infrastructure

The success and effectiveness of industrial clusters are in part dependent on the existence of social infrastructure. Social infrastructure can be characterised as the common habits, routines, practices and rules that make up the socio-institutional and cultural setting that is prevailing in an area. It largely influences the cluster"s innovative capacity, as it regulates the interactions between the innovation actors (Johnson, 1992; Gertler, 2004; Edquist, 2005). Consequently, institutional factors such as the dominating patterns of behaviour, the culture of cooperation or also attitudes towards innovation and technological progress are important elements. Social infrastructure is essential for the effective flow of information between firms (see section 2.8.5; Rosenfeld, 1997).

An effective cluster requires social interaction; trust and shared vision between members (see sections 2.8.5 and 2.8.8). Schmitz and Nadvi"s (1999) stylised growth model for the formation of clusters highlights the existence of a trade network (see section 2.8.4) and the existence of social infrastructure as prerequisites to the formation of clusters. Furthermore, when present, these factors are considered to minimise hindrances in the formation of industrial clusters. Social infrastructure creates dynamism within a cluster, which creates interactions and functional relationships (Doeringer & Terkla 1995). According to Krugman"s (1997) categorisation of clusters, under Type C; innovative milieu, clusters result in the establishment of social networks between different firms and within firms (see section 2.7.2). The social network within a cluster promotes innovation and the achievement of medium- and long-term innovative goals between firms.

2.8.8 Geographical proximity

The geographical proximity of firms is another important characteristic of industrial clusters that further distinguishes them from other forms of economic cooperation. Shorter distances between firms in clusters enhance the diffusion of knowledge and localised learning (Maskell & Malmberg, 1999; see sections 2.5.1 and 2.5.2). Geographical proximity enables specialists to move easily between the different firms and to engage in personal communication with the people being trained (Tallman *et al.*, 2004; Morgan, 1997). Proximity of firms in clusters also ensures that firms are close to suppliers of inputs, materials and services. This reduces the transaction and transportation costs associated with obtaining inputs (see sections 2.5.11 and 2.5.12). These reductions in cost consequently foster trade networks and trust among firms, thereby encouraging higher levels of cooperation (see sections 2.58.4 and 2.8.5).

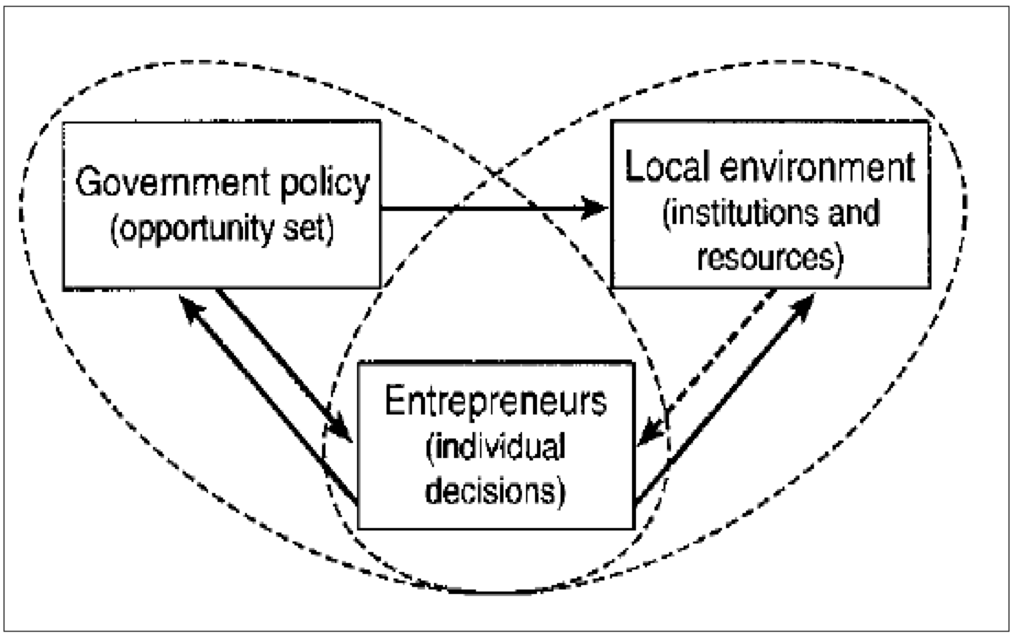
McCormick (1999) highlighted that proximity is of particular importance to developing country clusters. This is because developing countries have poor infrastructure and weak information systems. The clustering of firms in close geographic proximity eliminates the transport and transactional cost associated with poor infrastructure and weak information systems. Furthermore, McCormick (1999) pointed out that proximity is of great importance in industrial cluster formation because cultures in developing countries place great importance on face-to-face communication when establishing trust (see section 2.8.5). Rosenfeld (2002) posited that "proximity accounts for much of the informal learning that occurs in a cluster". Geographic proximity facilitates informal learning, building of trust and the acquisition of know-how through face-to-face interaction in trade, professional or social settings (Rosenfeld, 2002).

2.8.9 Entrepreneurs

Most models of regional economic development do not acknowledge the role of entrepreneurs as change agents in the development of regional economics (Appold, 2000). Little attention has been paid to entrepreneurs in the genesis of patterns of regional economic development. Entrepreneurs act as change agents who are able to attract the required resources and institutions for the success of their business ventures. They achieve this by taking advantage of either the regional or historic competencies of the regions in which their business operates (Feldman *et al.*, 2005; Romanelli & Feldmam, 2004). Consequently, entrepreneurs ignite cluster formation by acting collectively as well as establishing institutions that act to improve the cluster‟s competencies.

High technology clusters in the US can be used to illustrate the role of the local environment and government policy in the successful and sustainable formation of clusters, as depicted in Figure 2.5. In this case, the local environment comprises social and commercial institutions as well as physical and human capital. The formation of the Silicon Valley is attributed to Fredrick Terman, who was the dean of engineering at Stanford University in the 1950s (Kargon *et al.,* 1992). Post-World War 2, an influx of students at universities prompted the formation of a large research institute, namely the Stanford Industrial Park, to create employment for students. The second aim of forming the institute was to encourage students to become entrepreneurs and to be actively involved in corporate research programmes. Fred Terman spearheaded the leasing of Stanford University land and the acquisition of venture capital. Today, several companies from the Silicon Valley, such as Hewlett Packard (HP), are the largest technology corporations in the world.

Figure 2.5: Factors affecting cluster formation



Source: Feldman *et al*. 2005

Similarly, bio-technology companies in the Route 128 cluster in Boston, Massachusetts, are a result of inventions from university research in the area. However, in Route 128, government policy and funding strongly enhanced the growth of the region. In 1991, the government through the Department of Defence and the National Science Foundation accounted for 60% of federal research and development spending in Massachusetts (Saxenian, 1994). Furthermore, government policy such as the Bayh-Dole Act (1980) encouraged universities and other research institutions to develop intellectual property from research funded by the federal government and to commercialise these inventions in order to benefit the public (Wonglimpiyarat, 2006).

2.8.10 Access to information

Impacted information, a form of market failure, occurs when firms do not have access to useful information or it is only available at a prohibitive cost (Enright, 2003). Access to information enhances the effectiveness of operations in two ways. Firstly, networks and relationships established in clusters ensure that customers can effectively communicate their needs in order for firms to produce the products that the customers want. Secondly, firms can communicate their needs to suppliers, or suppliers can communicate new trends or new products that they can provide. This will enable firms to utilise fully existing resources that they may not have been aware of. Cluster formation and competitiveness depend on the existence of social infrastructure (see section 2.8.7) and trust (see section 2.8.5). These elements act as the medium for the exchange of information in clusters (Rosenfeld, 2002). However, it is not just the access to information that enhances the cluster‟s competitiveness, but also access to new information and ideas from other regions.

Furthermore, clusters that comprise a lead firm (see section 2.8.4) are more competitive, especially where the lead firm is part of global networks, is exposed to global market opportunities and employs members of international professional associations and networks. Such clusters overcome the problem of regional insularity and lock in. Access to information can also be enhanced by employing a diverse workforce, as well as accessing benchmark practices, innovations and markets. Access to benchmark practices, innovations and new markets can be achieved by conducting periodic cluster benchmark studies and compiling status reports (Rosenfeld, 2002). Institutional structures are another channel through which clusters can access information and other services. Rosenfeld (2002) pointed to the establishment of cluster-specific technology centres as a sustainable means to provide access to information. Such a cluster-specific technology centre would be responsible for applied research and development; testing and quality standards; technical advice; network brokering; technician and management training; and conducting technical studies. A cluster-specific technology centre would safeguard the cluster‟s competitiveness by providing essential, specialised services and ensuring access to new information and ideas. The subsequent section discusses the various roles that government can take in facilitating industrial cluster formation.

2.9 The role of government in industrial cluster formation

Government can play a pivotal role in cluster formation. Clusters" emergence and development are a result of a combination of capabilities, incentives and opportunities (Feldman & Braunerhjelm, 2006). Capabilities provide the basis of competitive advantages that enable firms to take advantage of business opportunities (see Chapter 4). However, if there are no incentives for the efficient use of capabilities, those capabilities will remain latent. At the same time, the provision of resources without sufficient capabilities would be wasteful and will not lead to development. Chapter 4 demonstrated the sectors in which the NWP"s comparative advantages lie.

Government initiatives determine the path a cluster will take once maturity has been reached. The public promotion of clusters is recommended to be restricted to more developed stages of the cluster lifecycles. Policies that aim to initiate or strengthen the competitive advantage of firms are not recommended. These types of initiatives are not sustainable and the cluster is likely to die once the support has run out. In contrast, policies that enhance micro-level incentives seem to be critical and more effective (Maggioni, 2006). This is because firm-based micro-level incentives provide the necessary support to circumvent the obstacles entrepreneurs face in the early stages of commercialisation. The early phases of commercialisation are a crucial stage in the development of industrial clusters, as seen in the role of entrepreneurs in the formation of clusters (see section 2.8.9) as well as in the genesis and evolution of clusters (see sections 2.3.2 and 2.3.3). Most European policy-makers recommend the promotion of firm-based micro-level incentives as an effective vehicle of promoting cluster emergence and growth (Maggioni, 2006).

Effective policy formulation and implementation depend on the policy-makers" comprehension of dynamics of cluster emergence as well as the characteristics of different types of clusters. Cluster formation depends on changes in technology, business models and supporting institutions (Feldman *et al.,* 2006). Policies that do not understand the dynamics of cluster formation promote the creation of weak clusters that will not be able to withstand fierce competition for skilled labour, finance and customers. Policy-makers should design strategies that are neutral across clusters, and that enhance the productivity of several firms and institutions simultaneously

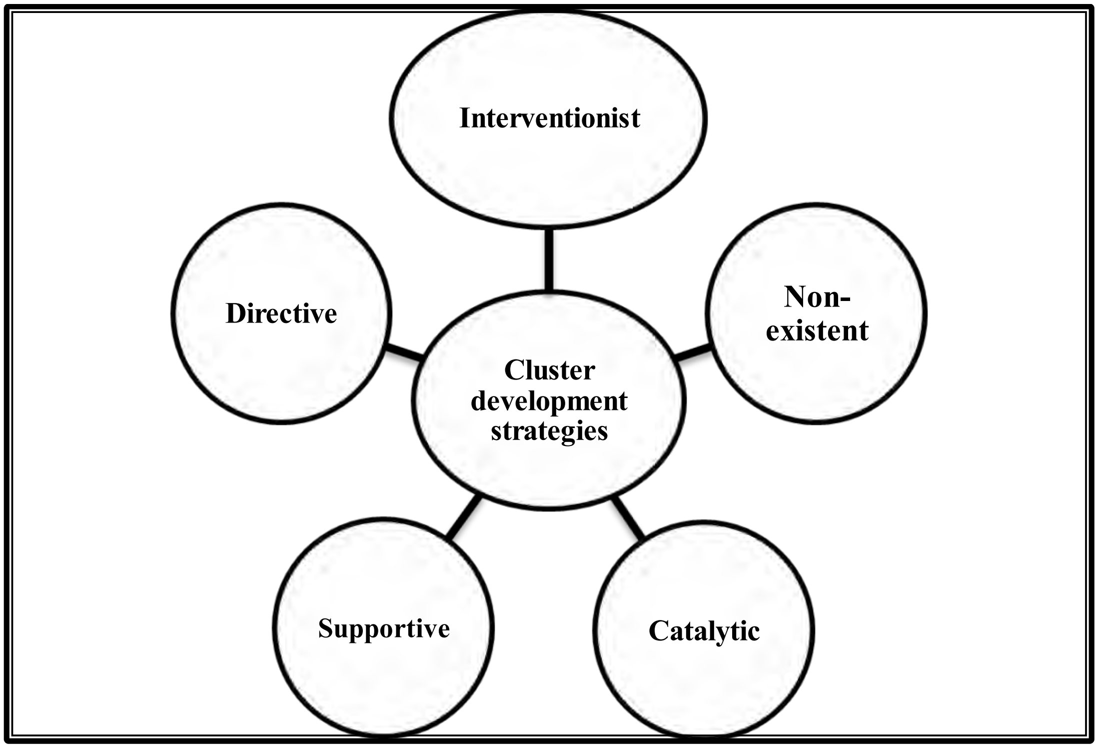
(Porter, 2002). Strategies and policies implemented should be designed to create a favourable environment (see section 2.8.1) for sustainable cluster formation. Such policies should facilitate the establishment and utilisation of externalities, linkages and the effective flow of information between firms (Porter, 2002). Government initiatives should also involve both the private and public sectors, ensuring that market competition is maintained to keep firms innovative and efficient.

Market failures such as a lack of access to information, limited managerial experience and knowledge to effectively use information and coordination failure prompt the use of cluster development initiatives by government (Enright, 2003). The level of government involvement in cluster development varies across countries. The local or regional government is responsible for cluster development initiatives in large developed countries. In contrast, the national government plays the primary role in cluster development initiatives in developing countries (Enright, 2003). The smaller the geographic scope of a cluster, the more effective the government initiatives will be in addressing cluster members‟ needs.

The role of government intervention in cluster development varies from non-existent to interventionist, as illustrated in Figure 2.6. It can be non-existent where government has no policies or strategies in place to enhance cluster development. Government can play a catalytic role in cluster development by bringing vested interests together to initiate collaboration and enhance cluster development. Alternatively, government initiatives can be supportive by taking the catalytic role a step further through the provision of infrastructure, education or training.

The directive role involves the implementation of programmes to improve the local business environment. Under interventionist initiatives, government determines the evolutionary path of cluster development through subsidies, targeted incentives, protection or regulation (Enright, 2003). The strategies, instruments and policies that government can use to promote industrial cluster formation are discussed in the subsequent section.

Figure 2.6: Forms of government intervention in cluster development



Source: Enright, 2003

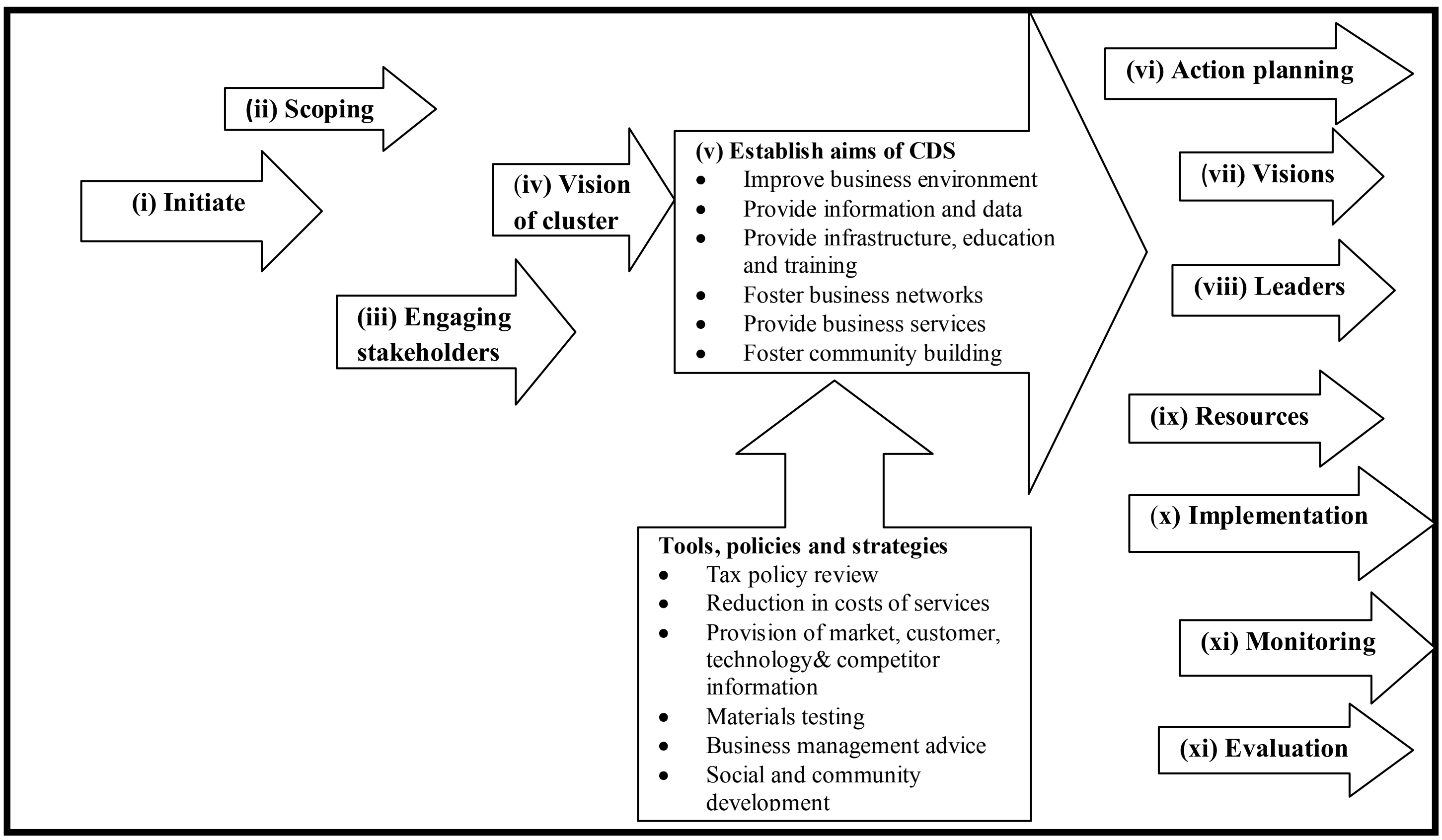
2.10 Strategies, instruments and policies to promote industrial cluster formation

As mentioned earlier, it should be noted that government"s role in cluster formation promotion is recommended to be either catalytic, supportive or directive (Enright, 2003; Rosenfeld, 2002; Cook, 2003; see section 2.9). This section provides an outline of the steps that can be taken in the formulation of a cluster development strategy drawing on the work of Enright (2003) and Cooke (2003).

The first stage involves the *(i) initiation of dialogue* (see Figure 2.7) between private and public sector organisations at a political-policy formulation interface. Rosenfeld (2002) highlighted that dialogue can be initiated by the formation of a council or association for firms concentrated in a region, if no clusters exist. The council or association will give the concentrated firms (potential cluster) a collective identity, represent their needs, provide a platform for the cluster firms to agree on the articulation of needs and draw up mechanisms to receive government grants and contracts (Rosenfeld, 2002). The council or association establishes the foundation of the cluster"s social infrastructure needed for firms to engage in networking (see section 2.8.7). The council or association therefore represents regional firms in dialogue with the government.

The next phase involves *(ii) scoping* of the various potential sectors to include in the regional cluster promotion strategy (see Chapters 4 and 5). This will depend on the assembly of personnel and financial resources necessary to carry out the scoping exercise effectively. Once this is achieved, an envisioning exercise is carried out to establish the existing assets in the industry or sector. Additionally, the envisioning exercise identifies the learning requirements in the cluster. This process also involves *(iii) engaging various stakeholders* such as trade associations, knowledge centres, intermediaries (agents), consultants, investors, lawyers and specialist government agents to come up with a common *(iv) vision for the cluster* (see Figure 2.7).

Figure 2.7: Elements of a cluster development strategy formulation



Source: Enright, 2003 and Cooke, 2003

Step *(v)* in the cluster development strategy formulation is the *establishment of aims*. Access to information enhances the competitiveness of firms in a cluster (see section 2.8.10). A cluster development strategy can provide information and data on business and economic trends, market developments, consumer trends, competitors" trends and technological trends in consulting reports. Furthermore, cluster-specific infrastructure and cluster-specific education and training should be provided to the cluster to ensure that a favourable environment is built to create competitive and sustainable clusters (see section 2.8.1). Business networks and inter-firm collaborations should be facilitated through introductions, referral lists and industry associations. Business service provision includes basic research, market research, materials testing, business process consulting, accounting and record keeping as well as advice on business management (see Figure 2.5). The provision of these services will enhance firms" economic performance, particularly small and medium-sized firms that cannot afford and/or perform these services due to limited finances, scale and skills (see section 2.5.16).

Over and above improving the business environment and improving firm performance, cluster development strategies also aim to improve social and community development. This is achieved through enhanced economic performance, which, in turn, is channelled to improve the livelihoods of the communities surrounding the cluster. Once the objectives are outlined, *(vi) actions are planned* and implemented using the appropriate resources required for successful strategy implementation. *Visions* are evaluated, the *implementation* process appraised, new *leaders* identified and additional *resources* are identified and mobilised in the second phase of the strategy implementation process in order to take the process a step further (Cooke, 2003; see Figure 2.7).

2.11 Summary and conclusion

This chapter provided a background on the industrial cluster phenomenon by describing the definitions and characteristics of industrial clusters, viewpoints on the genesis and evolutionary process of industrial clusters, the advantages as well as some disadvantages associated with industrial cluster formation. Descriptions of the different types of cluster found in the literature were also provided. This chapter provided some insight into the necessary conditions for the formation of industrial clusters, the role of government in industrial clusters and the strategies as well as instruments and policies to promote industrial cluster formation.

To reap the benefits of clustering is not straightforward and easy, particularly for developing countries. Developing countries" characteristics are different to those in developed countries. Issues such as widespread poverty, surplus unskilled and semi-skilled labour, lack of social cohesion and the absence of local institutional infrastructure are key challenges to cluster formation in developing countries. High levels of internal segmentation strengthen inequalities among firms. This results in extreme differences in bargaining power and the unequal distribution of collective efficiency gains. These factors ultimately impede cluster formation in developing countries.

Policy-makers should not naively view clusters as a panacea for growth and development. Detailed analysis is needed to initiate and scope the potential industries in which to initiate cluster formation. This process should take into consideration the characteristics of the country or region, the global economy, the cluster form to be promoted and the particular prerequisites for successful and sustainable cluster formation. In-depth analysis is also necessary to establish the correct set of tools to promote cluster formation. Rigorous and continuous monitoring and evaluation are also needed to ensure that the initiatives are sustainable and are able to create globally competitive clusters. Chapter 3 proceeds to provide an in-depth description and appraisal of the methods and data used in empirical studies to identify industrial clusters. Additionally, based on the appraisal of the methods, Chapter 3 also motivates why the structural path analysis and power of pull were used to identify industrial clusters in the NWP of South Africa in this study.

CHAPTER 3: METHODS USED TO IDENTIFY INDUSTRIAL CLUSTERS

3.1 Introduction

The main aim of this chapter is to provide an in-depth description of the methods and data that are used in empirical studies to identify industrial clusters. Additionally, based on the afore-mentioned appraisal, this chapter also motivates why the structural path analysis (SPA) and power of pull (PoP) methods were used to identify industrial clusters in the NWP of South Africa.

This chapter proceeds as follows; section 3.2 provides an in-depth description of the methods; major methods (see section 3.2.1) and minor method (see section 3.2.2) that are used in empirical studies to identify industrial clusters. Section 3.3 motivates why the SPA and PoP methods were used to identify industrial clusters in this study. Section 3.4 discusses the types of data used in the empirical analysis to identify industrial clusters; and section 3.5 concludes the chapter.

3.2 Methods to identify clusters

Cluster analysis is conducted using different methods at different levels of analysis (Roelandt & Den Hertog, 1999). Table 3.1 shows the three levels – macro-, meso- and micro-level – at which cluster analysis can be conducted, as stated by Roelandt, Gilsing and Van Sinderen (2000). At the *macro-level*, the objective of cluster analysis is to identify industry-level clusters and to provide insights into the mechanisms that improve innovation and shape industrial policy. The aim is to enhance collaboration between research institutions and industry. An increase in collaboration improves the competitiveness of a region and also enhances the region or country‟s competitive advantage. The second level at which cluster analysis can be conducted is the *meso-level.* Meso-level cluster analysis identifies inter- and intra-industry linkages in the different stages of the production chain of similar end products. Cluster analysis is mainly conducted in order to enhance competitiveness in the value chain (the production and distribution structure) of an industry or sector at this level. This is achieved by conducting a Strengths, Weaknesses, Opportunities and Threats (SWOT) or benchmark analysis of different stages of the value chain. A SWOT analysis reveals the weaknesses in an industry‟s value chain and highlights ways to improve or build on the weaknesses. A SWOT analysis at the meso-level also reveals the strengths of an industry that will improve competitiveness. *Micro-level* cluster analysis, the third level of analysis, aims to enhance cooperation between firms and their main suppliers, competitors, research entities and other bridging institutions. Micro-level analysis aims to identify potential strategic partners in the value chain for cluster formation. Clusters at this stage are characterised by specialised suppliers around one or a few core enterprises (inter-firm linkages).

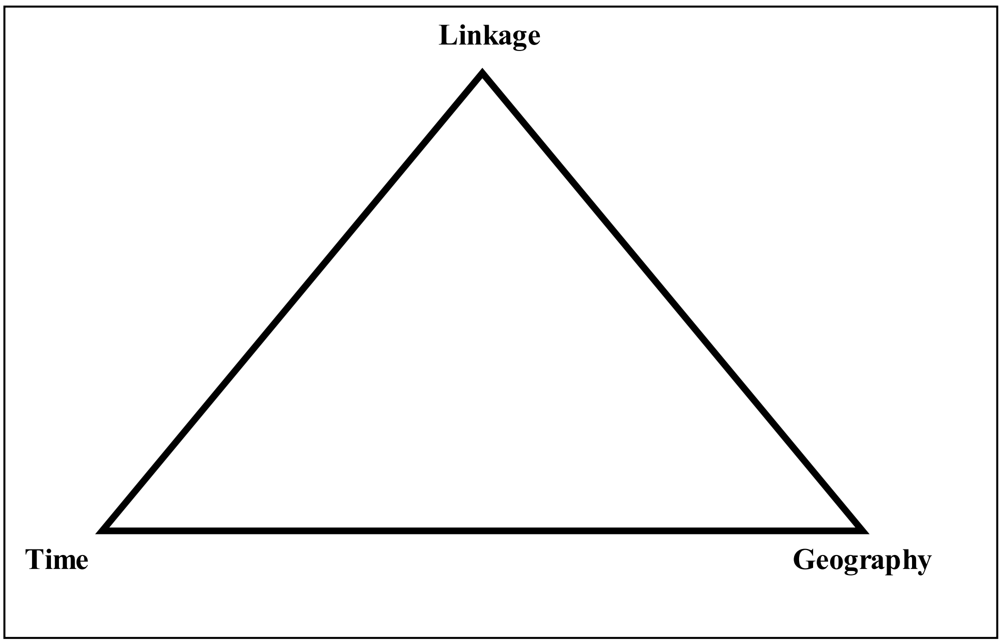
Table 3.1: Levels of cluster analysis

Level of analysis	**Cluster concept**	**Focus of analysis**
National level *(macro)*	Industry-level linkages in the economic structure	• Specialisation patterns of a national/regional economy • Need for innovation and upgrading products and processes in mega-clusters
Branch or industry level *(meso)*	Inter- and intra-industry linkages in the different stages of the production chain of similar end product(s)	• SWOT and benchmark analysis of industry value chains • Exploring innovation needs
Firm level *(micro)*	Specialised suppliers around one or a few core enterprises (inter-firm linkages)	• Strategic business development • Chain analysis and chain management • Development of collaborative innovation projects

Source: Roelandt, Gilsing and van Sinderen (2000)

Feser (2001) highlighted that when conducting cluster analysis, an important element is to relate the concepts to the measures that can be investigated. Figure 3.1 illustrates the dimensions of clusters that can be measured and can be incorporated in empirical analysis. *Linkage* relates to the factors that bind firms in a cluster together, such as innovation, labour and inputs (functional and spatial links; see section 2.1.2). *Geography* refers to the co-location of firms in the cluster. This means that the cluster can be localised where firms co-locate in a specific geographic boundary. Alternatively, clusters can be non-localised where firms are dispersed. In such cases multi-region clusters are formed (Feser, 2001). The third dimension, *time,* relates to the stage of development of the identified cluster. This varies from existing, declining, emerging or potential clusters. Existing clusters have a strong presence and have significant linkages, while declining clusters are characterised by a decline in growth and linkages. Emerging clusters lack critical mass to transform them into existing clusters (see section 2.6.2: latent clusters). Potential clusters emerge as a result of trends, policy stimulation or chance events (see section 2.3).

Figure 3.1: Dimensions for measuring industrial clusters



Source: Feser, 2000

The subsequent section discusses the major methods used to identify industrial clusters.

3.2.1 Major methods for identifying industry clusters

This section presents the methods to identify industrial clusters that are widely used in the literature. These methods can be applied to macro-, meso- or micro-level analysis depending on the aims and the scope of the investigation.

3.2.1.1 Location quotient

The location quotient (LQ) is one of the most popular methods used to investigate the existence of industrial clusters (Goetz, Shields & Wang, 2010). The principle behind the LQ is to compare the relative size of a particular industry relative to the size of the same industry in the regional or national economy. This method compares the similarities between the local economy and the national economy to determine in which sectors the local economy is specialised (Wilkerson & Williams, 2007). This can be done by analysing employment or output data. The LQ can be calculated using the following equation:

$$LQ = \frac{\%LE_i}{\%NE_i} \tag{3.1}$$

Where % LE_i is the percentage of regional employment in industry i; and
% NE_i is the percentage of national employment in industry i.

The LQ is a number that is either greater than, equal to or less than one. An LQ score greater than one implies that the region‟s employment in that industry is greater than the national levels (Deller, 2010). An LQ score less than one highlights regional employment in a sector that is less than the national levels. Lastly, an LQ score equal to one implies a region whose proportion of economic activity in a sector is the same as the national level. This interpretation highlights that LQ also identifies a region‟s importing and exporting industries (Goetz *et al*., 2010). A region has exporting industries if it has an LQ score greater than one. This implies that the industries in the region produce enough to meet local demand and have excess to sell to other regions. As a result, these regions are assumed to have an enabling environment for cluster formation. Importing industries are given by LQ scores of less than one. This indicates that the industry‟s production is not sufficient to meet local demand and therefore the region must import to supplement production and meet local demand.

For the LQ method to be most informative, regional disaggregated employment data must be used (Woodward & Guimaraes, 2010). Qualitative methods such as focus groups and interviews with industry experts validate the LQ"s findings in the industrial cluster identification process. This is because qualitative methods provide information about the industry and provide a better understanding of the relationships among the various players in the industry (Shields, Barkley & Emery, 2010). LQ can easily be recalculated and replicated for other regions or over time (Žižka, 2010). The LQ was applied to identify industrial clusters in a cluster mapping project in South Carolina, USA by Porter and Associates. The project, sponsored by the Harvard University"s Institute on Strategy and Competitiveness, aimed to uncover the locality of the economy"s comparative advantages (Woodward *et al.,* 2010). Clusters were identified if an industry"s share of regional employment was greater than the national share of employment in that industry; that is, an LQ score greater than one. The potential clusters had to meet an additional condition, which is, to have a growing share of employment over time. However, Woodward *et al*. (2010) alleged that Porter"s model for the identification of clusters using the LQ does not provide new empirical methods that can identify industrial clusters. This is because the LQ has some shortcomings when used as a method to identify clusters.

This method shows a region"s specialisation and not potential clusters (Woodward *et al.,* 2010). The LQ only shows the sectors in which the region"s production is more efficient relative to the nation; i.e. specialisation. An arbitrary threshold can be set to determine specialisation and to circumvent this problem. This would enable the observation of regional specialisation in cases where the industries" LQ scores are above the threshold. Malizia and Feser (1999) suggest a threshold of 1.25, while Isaken (1996) as well as Malmberg and Maskell (2002) suggest a threshold of 3. However, it is noteworthy that this approach is subjective and these cut-off values are determined arbitrarily.

Another shortcoming of the LQ is that equation 1 measures the relative importance of an industry in terms of its contribution to employment. It does not reflect the relative size of the industry in question. This has the problem that small industries in the economy can have high LQs when highly disaggregated employment data is used (which is recommended). The LQ depends on the availability of disaggregated regional employment data, which may not be readily available due to factors such as disclosure rules (Rosenfeld, 1997: Woodward *et al.,* 2010).

Furthermore, the LQ is an impartial measure of clusters as it takes no account of the inter-industry trade linkages of spatially concentrated firms (Doeringer & Terkla, 1995; Rosenfeld, 1997). Another drawback of the LQ is that it cannot distinguish internal from external economies of scale. High employment resulting from the presence of many small firms or from one large firm cannot be distinguished from the effects of clustering. The latter is a case where a high LQ score is not a result of the existence of a cluster or agglomeration economies.

Furthermore, Ellison and Glaeser (1997) highlighted that since clustering occurs in discrete time; the probability of identifying clusters that occur by chance is high when the LQ method is used (see section 3.2.1.2). This problem can be addressed by applying statistical tests to the LQ, such as bootstrapping[6] to take into account the presence of a large number of firms in a region due to chance (Moineddin *et al.,* 2003; O"Donoghue & Gleave, 2004). Overall, the LQ is not a reliable method in which to map regional clusters. Several studies have used the LQ as an initial step into more detailed analysis in the identification of clusters. Barkley and Henry (2010) used the LQ as a screening method to identify industries with a competitive advantage as a first step. Input-output analysis was then conducted to identify industries with the greatest linkages to the firms in the region (see section 3.4.1). As a final step, the „identified promising industries" were ranked according to their potential economic and fiscal impacts on the local economy.

3.2.1.2 Ellison-Glaeser Index

Ellison and Glaeser (1997) proposed the Ellison-Glaeser (EG) index, an alternative to the LQ to measure the levels of industrial agglomeration or the localisation of industries and to identify industrial clusters (see section 2.5.7). Ellison *et al.* (1997) posited that clusters were formed as a result of localised industry-specific spill-overs, natural advantages, or pure random chance (see section 2.3). The EG index aims to test whether observed clustering patterns are likely due to localised industry-specific spill-overs and natural advantages rather than chance. "The index tests whether levels of concentration observed across territorial units are greater than it would be

[6] Bootstrapping is a method of re-sampling to allow assigning measures of accuracy to sample estimates (Azzalini & Hall, 2000). It uses sample data, for example the number of clusters in a region to resample other samples. That is, the method allows for other clusters in that region to be approximated using an existing sample. This reduces the probability of identifying the presence of a large number of firms in a region due to chance.

expected to arise randomly, as if the firms had chosen locations by throwing darts on a map" (Ellison *et al*, 1997). Firms are assumed to make random location decisions; likened to throwing darts on a map. The EG index takes into account the differences in firm size of firms in a cluster and the different sizes of the geographic areas of the available data. This allows the comparison of EG scores across industries and the measurement of the strength of cross-industry agglomeration. The index also compares firm location to concentration across industries, countries and over time. The index defines the share of total geographical concentration for industry *i* and can be calculated using equation 2:

$$G_{EG}^{k} = \frac{\sum_{i}(l_i^k - x_i)^2}{1 - \sum_{i} x_i^2} \tag{3.2}$$

Where $x_i = \frac{\sum_{k} z_i^k}{\sum_{i}\sum_{k} z_i^k}$ is region *k*"s share in employment in industry *i*, at the national level;

$l_i^k = \frac{z_i^k}{z_i}$ Where:

l_i^k - the share of employment of region *k* in industry *i;*

z_i^k - the number of employees in industry *i*, in region *k;* and

z_i - the number of employees in industry *i*, at the national level.

Index values less than 0 indicate an industry that is not geographically concentrated and is dispersed across the area. An index score between 0 and 0.02 indicates a weak and insignificant concentration of industry. Index values between 0.02 and 0.05 indicate medium strong geographical concentration. Strong geographical concentrations are indicated by index scores above 0.05 (Bertinelli & Decrop, 2002).

The EG index takes into consideration the random nature of the spatial distribution of firms (Ellison *et al.,* 1997). The notion of randomness of location choice in the dartboard model ensures that the differences in the size of the establishments, the size of the industry or the fineness of the data under investigation do not affect the index. This enables the index to be comparable across different industries and different countries. Additionally, these factors enable the index to measure changes in the levels of concentration over time (Ellison *et al.,* 1997). Another advantage of the EG index is that it is insensitive to the levels of spatial agglomeration at which data are collected. This means that the index separates spatial aggregation from the measurement of agglomeration. This method takes into account the random distribution of economic activity across an area; that is, high industry concentration due to the existence of one or a few large firms. The EG index can be easily computed and interpreted. Computation of the index only requires spatial level employment data. In addition, the EG index accounts for the size distribution of the firms in a geographical area (Woodward *et al.,* 2010). This means that it accounts for the effects of scale economies when determining the existence of clusters. This method addresses some of the main problems with the LQ. The main focus of this method is to capture the random agglomeration of firms as well as agglomeration caused by spill-overs and natural advantages (Ellison *et al*., 1997).

The main drawback of this method is that it does not provide information on the geographical proximity of concentrated industries (Reveiu, 2012). It does not measure the spatial dependencies and the spatial autocorrelation between regions. "Spatial autocorrelation occurs when values of a variable observed at close locations are more similar than those observed at locations more distant. Positive spatial autocorrelation occurs when high values of a variable tend to cluster together in space and vice-versa" (Reveiu, 2012). This method does not identify potential clusters but only identifies industries or regions that might be investigated further in order to determine the existence of clusters. Furthermore, the nature of employment data used to measure agglomeration does not allow for the inclusion of small and medium-sized enterprises in the cluster identification process (Stejskal, 2011). This is a major problem, particularly for South Africa, which has a relatively large informal sector made up of SMEs that are at the core of growth and development strategies (Valodia & Devey, 2012)

3.2.1.3 Moran's spatial correlation coefficient/ Local Moran statistic

Moran‟s spatial correlation coefficient measures the concentration (high or low) of firms in a region in a given industry (Anselin 1995). It also establishes whether the number of firms in an adjacent region is high or low. Gibbs and Bernat, (1997) described the steps involved in computing the local Moran statistic using data on the number of establishment in a region as follows. Firstly, the mean number of establishments in a given industry across all regions is calculated. Secondly, standard deviations from the mean number of establishments are calculated. Thirdly, a spatial weights matrix is constructed. This matrix delineates the regions that are considered to be neighbours. This can be local municipalities, district municipalities, provinces or countries depending on the scope of the study. The distance between regions is measured by the spatial matrix, which determines whether or not regions are contiguous (Anselin, 1995). The spatial weight matrix can be specified either to represent "queen contiguity" or "bishop contiguity" (Goetz *et al.,* 2010). Queen contiguity specification considers regions to be adjacent if they share a boarder. Bishop contiguity considers regions to be contiguous if they are to the immediate east, north, west and south of each other. The final step in computing the local Moran statistic is to apply equation 3 below:

$$I = \frac{n}{S_0} \frac{\sum_i \sum_j w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_i - \bar{x})^2} \tag{3.3}$$

Where n is the sample size;

x is the number of establishments at locations i and j;

$\bar{x}$ is the mean of the number of establishments;

w_{ij} are the elements of the weight matrix, and

S_0 is the sum of the elements of the weight matrix: $S_0 = \sum_i \sum_j w_{ij}$.

The Moran statistic lies between -1 and +1 although the weight matrix strongly influences the range of the values (Waller & Gotway, 2004). A positive I statistic represents strong patterns of spatial clustering (Reveiu, 2012). A positive I statistic shows a cluster of neighbouring regions with a similar number of establishments (high or low), therefore representing a contiguous region. A negative *I* statistic represents neighbouring regions with dissimilar numbers of establishments or a regular pattern (Kosfeld & Lauridsen, 2012).

An advantage of this method is its ability to detect relationships across space (across regions). This method can identify mega-clusters that span across regional or national borders. Gibbs *et al.* (1997) identified clusters in different industries in rural counties in the USA using the Moran spatial correlation coefficient. They identified clusters by differentiating the counties into four groups, namely:

i. Counties that had no firms in a particular industry;
ii. Counties that had firms that were not clustered;
iii. Counties that where at the periphery of clusters; and
iv. Counties that had a high concentration of firms (clusters).

They identified clusters by comparing the Moran *I* statistic to a critical value[7]. A county was considered to be a central county in a cluster (group iv above) if it had a county variable above average and had a local Moran greater than the critical value. All the neighbouring counties to the central county in a cluster were considered to be peripheral parts of a cluster (group iii). This method requires industry-specific data on the location of plants in the region to be linearly informative about the other plants in the same industry and in other regions for spatial autocorrelation to be measured effectively (Lafourcade & Mion, 2007). The Moran statistic, however, is not an adequate measure of spatial concentration (clusters), because it only identifies the spatial patterns of firms and does not determine the nature of the underlying linkages between firms (Reveiu, 2012).

3.2.1.4 Competitive shifts or shift share analysis

Competitive shifts or shift share analysis aim to determine whether a region‟s share of employment or the number of establishments in a particular industry is changing faster or slower than the national rate (Shields, 2003). Under this method, the regional differences in growth are

[7] The critical value is the highest local Moran statistic expected to occur by chance (Gibbs *et al.,* 1997).

isolated from industry growth and national growth effects (Žižka, 2010). This is achieved by factorising the change in the value of either the number of employees, revenues or value added, into three components. Goetz *et al.* (2010) illustrated these three components using the number of employees as national growth, industrial mix and competitive share. The national growth component represents an increase in the number of jobs in a region that accrues from growth in the national economy (national employment growth) (Shields, 2003). The industrial mix component represents growth accruing from industries in the region that have higher growth rates than the national rates (Goetz *et al.,* 2010). Lastly, the competitive/local share represents regional growth accruing from local competitive advantages.

Industrial clusters are usually identified by analysing the third component; competitive/local share. Growth induced by local competitive factors is also the component that the success of regions is attributed to (Stejskal, 2010). Once the growth components have been factorised, the effect of the absolute change in the indicator and the effect of the change in its structure is calculated. Shift share analysis is based on the assumption that regional growth in the economy accrues as a result of a combination of nationwide growth, growth in branch structure and growth induced by competitive local factors (Žižka, 2010).

The national growth component (NG) is calculated as follows:

NG **=** *Industry employment* ***X*** *National average growth rate of total employment*

Where Growth = *(employment in 2012 –employment in 2007) / employment in 2007;* (2007 is the base year)

The Industrial mix (IM) component is calculated as follows:
IM = local industry employment ***X*** *(national industry growth rate – national average growth rate).*

The local share (LS) is given by:
LS = local industry employment ***X*** *(local industry growth rate —national industry growth rate).*

The total of the three shares NG, IM and LS should be equal to the total local employment change over the period:

Total Employment Change/ shift term = National Growth Share + Industry Mix Share + Local Share.

The local economy is growing faster than the reference economy if a positive shift term is obtained, and the opposite is also true. Shift share analysis requires sectoral local and national or regional employment figures, revenues or value added for a minimum of two years (Žižka, 2010). The main advantage of employing shift share analysis in identifying industry clusters is that it is easy and effective in measuring the competitiveness of sectors as well as the economy (Yoo, 2003). It requires limited econometric capacity to conduct as it is not very complex. Shift share analysis determines the performance of different sectors in the local economy relative to the national economy. It also reveals the contributions to local employment made by a particular industry or by a group of industries in the local economy. Shift share analysis identifies whether or not a region has a competitive advantage from local factors. That is, if the region"s employment in a sector is growing at a faster rate than the national employment growth in the sector, then it is assumed to have a competitive advantage (Goetz *et al.,* 2010). Shift share analysis was conducted as an initial step in the cluster identification process in a study to investigate the existence of industry clusters in Northeast Minnesota (USA) (Northeast Minnesota Industry Cluster Study, 2001). Case studies were then used as a second and complimentary step to verify the results of the shift share analysis (see section 3.2.1.8).

This method has limited use as it involves selecting appropriate intervals at which the change in employment or the number of establishments can be measured (Shields, 2003). The results of shift share analysis at industry level; Standard Industrial Classification (SIC) 2, are too broad and general, rendering them practically useless (Yoo, 2003). For the analysis to provide meaningful results, detailed SIC 4-digit level data must be used (Shields, 2003). However, another drawback arises from the use of SIC 4-digit data. Problems of data suppression or non-availability are usually experienced at SIC 4-digit level (Yoo, 2003). Furthermore, shift share analysis may produce misleading results. For instance, if a sector experiences a decline in employment, but also experiences an increase in output, shift share analysis calculations will show that the regional economy is growing at a rate lower that the national economy. Shift share analysis will disregard the fact that the regional economy may have a comparative advantage (Goetz *et al*., 2010). This pitfall can be addressed also by analysing average labour and capital productivity for the region or sector under investigation. Shift share analysis is only a descriptive tool of the local economic trends; it does not provide explanations for the observed trends and underlying inter-linkages (Blair, 1990; Goetz *et al*., 2010).

3.2.1.5 Location probability and attractive score models

Location probability and attractive score models are based on the principles of firm location theory. It is assumed that understanding the evolution of a firm"s location decisions provides a better understanding of the different economic linkages associated with its economic activities (Cader, Leatherman & Crespi, 2010). This is because an analysis of firm location decisions over time reveals the nature and extent of the linkages, as firms factor in the benefits of a particular location in the decision-making process. Firms" location choices are influenced by potential benefits such as close proximity to sources of technological advancement (Cassar & Nicolini, 2003; see section 2.5.2), availability of advanced telecommunication infrastructure (Malecki, 2001; see section 2.5.17), advanced transport systems, product demand, cost of inputs and other related services and incentives (Cader *et al.,* 2010).

There are contentions in the literature on the most appropriate ways to model location choice and as a result there is no universally agreed-upon method or technique. The aim of modelling location choice is to determine which factors enhance the firm"s competitiveness the most. In addition, modelling firm location aims to provide an understanding of the extent of clustering or dispersion economic activity (Cader *et al.,* 2010). Modelling location choice involves analysing location specific factors to simulate the discrete[8] location choice decision of firms. Discrete choice models such as binomial and multinomial models are commonly used. Several models have been used to model location choice in empirical studies. For example, Basile *et al.* (2003) used the probit or ordered probit model, Devereux *et al*. (2004) used the tobit model, Gunther *et*

[8] The outcome being modelled is of a discrete nature; that is, one location has to be selected over other locations.

al. (1998) used the logit or multinomial logit model, Guimaraes *et al.* (2004) used the conditional logit and Poisson models, while Coughlin and Segev (2000) used the negative binomial model.

Cader *et al.* (2010) posit that the conditional logit model is superior to other models owing to its ability to incorporate several location choices, including the firm‟s existing location. The model is based on a random utility maximisation framework. Industry, establishment and community characteristics are the basis on which the firm‟s location decision is modelled. This method of industry cluster identification has the drawback that it does not provide insight into the scale of the economic activity to be generated; for example, it does not provide insight into the quality or number of jobs to be created by a cluster (Leatherman & Kastens, 2010). Additionally, this method does not actually identify clusters; it models a measurement of economic concentration. Caper *et al.* (2010) used LQ as a measure of clusters in an ordinary least squares (OLS) estimation of the factors influencing firms‟ location decisions.

3.2.1.6 Analytic hierarchy process and matching models

Several studies have realised that community participation in the economic development decision-making process is an important input and helps to make the programmes more effective (North Central Regional Centre for Rural Development, 1997). Analytic hierarchy process (AHP) and matching models are based on the premise that the economic development process should incorporate economic, social and environmental elements. This implies that the formulation of development programmes should incorporate these elements to achieve more proactive, cost efficient and effective programmes (Johnson, 2010). There is little research on the preferences of local residences on economic development outcomes (Davis & Harris*,* 2010). The AHP method provides a means to incorporate and assess the economic, public and environmental impacts of a development project in a region (Goetz, Deller & Harris, 2007). The AHP method involves three steps. Firstly, the community‟s preferences in development goals are inferred by interviewing community leaders or individuals (Goetz *et al.,* 2007). The citizens‟ preferences are incorporated into the analysis by voting or averaging to create priority or cardinal or preference weights (Saaty, 1990; Johnson, 2010). The second step involves quantifying the impacts of cluster formation in alternative sectors. The final step involves applying the preference weights to the predicted impacts of cluster formation in each sector to derive a community-specific measure or a score for each industry (Johnson, 2010).

Cox (1996) and Cox, Alwang and Johnson (1997) interviewed groups of citizens and asked them to rank industry impacts in a study of three states in Virginia, USA. The ranking of economic development outcomes changed significantly after taking into account the citizens‟ preferences. More importance was placed on aspects such as pollution effects, as well as an increase in wage levels as compared to an increase in the number of jobs. A main drawback of this model is its inability to identify the optimal sector or policy to achieve the goals (Goetz *et al.,* 2007). This method only incorporates the community‟s opinions on development programmes, but has no appropriate empirical method to determine the optimal choice or how to achieve those goals. In other words, this method does not identify clusters; it merely incorporates the preferences of the community and models potential impacts. Another drawback of this method is that people tend to make impulsive decisions; particularly when ranking industry impacts, and as a result this may result in different community-level preferences over time (Cox, Alwang & Johnson., 2000).

The community based business model (CBM) is a matching method whose principle is to match the goals of the community with the location requirements of firms (Goetz *et al.*, 2007). This is done by compiling two indices; desirability and compatibility indices. The desirability index measures the similarities in the firm‟s requirements and the community‟s goals. Community goals include job creation, environmental protection, wage growth and growth in economic activity in the region. The compatibility index measures how well equipped the community is to meet the firm‟s requirements to establish a plant in the region (Cox *et al.*, 2010). Factors affecting the firm‟s location decision include infrastructure and skilled labour, among others. The best match is established when a firm meets the community‟s requirements (desirability index) and the community provides the factors that influence the firm‟s location decision (compatibility index). CBM cannot, however, identify clusters or the sector that will yield the most positive impacts for the region.

3.2.1.7 Expert opinion

This method involves gathering industry-specific information from key players in the regional economy, such as industry leaders, public officials, and other key decision-makers (Bergman *et al.*, 1999). This is done through interviews, focus groups and Delphi survey techniques, among other qualitative methods of gathering information. The aim of this method is to form expert opinions on issues such as business practices, supply chains, current investment patterns and potential opportunities for new products (Stough, Stimson & Roberts 1997). Expert opinion is used as a means to detect factors or to establish criteria for the identification of clusters. Expert opinion is usually used as a complimentary method in cluster identification to make up for the shortcomings of quantitative methods. It is a good way to examine quantitative results of cluster identification. One of the major advantages of expert opinion is that it is relatively easy to conduct. Expert opinion adds a new perspective and provides new ideas from the actual actors in the industry network (Yoo, 2003). Local actors‟ opinions on important economic factors are informed by everyday involvement in the industry. Therefore, expert opinion can reinforce or alter the results of quantitative analysis. Gathering data through this method is relatively cost effective. Furthermore, this method provides a good source of relevant information about the region and industries under investigation (Bergman *et al.*, 1999).

The main drawback of using expert opinion in identifying industry clusters is the reliability and validity of the information provided by the interviewees. The validity of expert opinion depends on the number of responses and the level of „expertise‟ that the expert has on the industry. Dorussen, Lenz and Blavoukos (2005) pointed out that, in surveys of expert opinion; experts are expected to be highly motivated and to be equally knowledgeable. However, they cautioned that in reality some experts may; not be motivated, be poorly informed and occasionally make mistakes. These factors affect the coherence of expert opinion. Unqualified expert opinion can be misleading in the cluster identification process and may result in big losses. Another shortcoming of expert opinion is that business officials are usually too busy to fill out a survey questionnaire, grant interviews or attend focus groups (Bergman *et al.*, 1999). Business officials are more likely to delegate participation in the survey to lower-level staff. On the other hand, government sector and university participants are more likely to participate. This increases the probability of disqualified expert opinion and unbalanced opinion. Furthermore, this method is rarely conducted in a systematic manner to enable the findings to be generalised and compared to other regions and industries.

3.2.1.8 Qualitative case study

Case studies in the cluster identification process are usually conducted following the assumptions of Porter"s diamond of competitiveness. The case study is usually set out to investigate the factors that create a competitive advantage for firms according to Porter"s diamond. According to Porter (2002), these factors are: factor conditions, demand conditions, industry strategy and rivalry, and related and supply conditions (see section 2.3.1). Case studies are also used to verify and explain observed patterns of the leading sector(s) in a regional study from quantitative analysis (such as LQ, shift share analysis or I-O analysis). Case studies are aimed at finding out whether the characteristics of clusters are present among agglomerated firms. Some of the aspects to be investigated in case studies (UNESCO, 2010; Stejskal, 2011) are:

i. Reductions in input and transaction costs (see section 2.5.12);
ii. Improved access to high-quality, low-cost information such as marketing information through sharing and cooperation (see sections 2.5.5 and 2.5.16);
iii. Higher levels of familiarity and trust (see section 2.5.9);
iv. Reductions in the time and cost of reaching cooperative and other agreements (see sections 2.5.4 and 2.5.5); and
v. The provision of specialised skilled labour, transport, communications and other infrastructure (see sections 2.5.12, 2.5.13 and 2.5.17).

Case studies create a framework or reference point for different studies conducted in different countries. Another advantage of this method is that the nature of factor conditions and related and supporting industries can be localised to a particular geographic location. A firm can therefore actively seek efficient suppliers and appropriate workforce skills in a particular location. Therefore, it is easy to observe the factors and identify regions in which cluster-related activities are taking place. Case studies were used in the Northeast Minnesota industry cluster study in the USA in 2001. The diamond of competitiveness concept was used as the framework for the case study together with other quantitative techniques to identify clusters (Woodward *et al.,* 2010).

Case studies are not appropriate when used as an individual approach to identify clusters. It must be used with other techniques to make up for its shortcomings (Woodward *et al.,* 2010). The main disadvantage of this method is that it is time consuming. The process of designing and validating an effective questionnaire is long and has to be done correctly in order to obtain meaningful results. Case study outcomes are quite unique to a particular region or industry as the individual elements of industries or regions are different (Reveiu, 2012). As a result, the comparison of results from different case studies and the formulation of generic conclusions are difficult as they are subjective and specific to each case. In addition, the results of case studies can quickly become obsolete as a result of dynamic changes in time. Case studies largely depend on the opinions of experts and this raises the problem of the validity of the expert‟s opinion (see section 3.2.1.7). Furthermore, unlike quantitative techniques, case studies are a qualitative technique and cannot map out and measure the strength of the production relations, innovative networks or cluster economic activity that is required in order to identify clusters (Roelandt *et al.,* 1999). This method is only effective to determine competitiveness and establishing the characteristics of the value chain at the meso-level (see section 3.1). Case studies should be used as a complimentary method to other quantitative methods when identifying clusters at the micro- and macro-levels to achieve better results (Hertog *et al.,* 1999).

The major methods used to identify industrial clusters are summarised in Table 3.2. Minor methods, which are used less frequently in empirical analysis, are discussed in the following section.

Table 3.2: Summary of the major methods for identifying industrial clusters

Method	**Method objectives**	**Input data**	**Industrial cluster potential measurement**	**Problem/ Barriers**	**Empirical studies using this method**
Location quotient	-Identify sectors in which an economy is specialised -Compare an industry‟s relative size to the regional or national economy	Output and/or employment data	-Impartial measure of clusters -Identifies a region‟s specialisation and not potential clusters	-Depends on the availability of disaggregated regional employment data -Takes no account of the inter-industry trade linkages	-Porter *et al* (2007): USA -O‟Donoghuea & Gleave (2004): UK
Ellison-Glaeser index	-Measure industry (and cross-industry) agglomeration -Establish the degree of geographic distribution of an industry in a territory	Employment data; Output data	-Identifies the industries and regions with the suitable characteristics for industrial clusters birth	-Data requirements exclude SMEs -Does not measure spatial agglomeration, dependencies or autocorrelation of industries	-Maurel & Sédillot (1999): France -Devereux *et al*. (2004): UK -O‟Donoghue & Gleave, 2004
Moran's I	-Measure the industry concentration of firms in a region -Establish concentration of firms in an adjacent region	Employment; Output	-Detects relationships across regions -Does not determine the nature of the underlying linkages between firms	-Requires industry-specific data on the location of plants -Requires detailed SIC 4-level data	-Vom Hofe & Bhatta (2007): USA -Sohn (2004): USA
Shift share analysis	-Compare industry regional employment dynamism to national levels. -Measure the competitiveness of sectors and the economy	Employment; Labour and capital productivity data	-Very broad categorisation of clusters -Reflects the total shift in employment in selected sectors of industry	-Does not explain the causes of changes in employment -Does not account for the influence of economic cycles -Requires detailed SIC-level analysis	Northeast Minnesota Industry Cluster Study, (2001): USA
Location probability and attractive	-Model the factors affecting a firm‟s location decision -Determine the likelihood of existence of clusters given firms‟	Survey data (see section 3.2.1.5)	-Does not actually identify clusters -Models a measurement of economic concentration	-Does not provide insight into the scale of the economic activity to be generated, e.g. the number of jobs to be created	-Cader, Leatherman & Crespi (2010): USA

score models	location decisions over time				
Analytic hierarchy procedure and matching models	-Quantify community‟s preferences for development goals -Assess the economic, public and environmental impacts of a development project -Match the goals of the community with location requirements of firms	Interviews; Surveys (see section 3.2.1.6)	-Identifies short-term and long-term development opportunities -Ranks combinations of community preferences and economic development outcomes	-It does not identify the best sector (cluster) or policy to achieve goals - Can have different community-level preferences over time	-Cox (1996): USA -Cox, Alwang & Johnson (1997): USA
Expert opinion	-Gather industry-specific information -Establish criteria for the identification of clusters	Interviews; Focus groups	-Identifies factors or criteria for the identification of clusters	-Can be misleading in the cluster identification -Not generalisable -It is just opinion, not axiom	Feser & Luger (2002): USA
Case study	-Map out competitive advantage of industry based on premise of Porter‟s diamond -Verify and explain observed patterns of regional competitive advantage from quantitative analysis	Interviews; Employment	-Determines the sector with potential for the existence and functioning of industrial clusters	-Too biased to a qualitative view -May need a lot of time -Validation of Porter's diamond model hypothesis is subjective	-Northeast Minnesota Industry Cluster Study (2001): USA

Source: Adapted from Stejskal (2011)

3.2.2 Minor methods

This section presents methods that are used less frequently in empirical studies to identify industrial clusters. These methods can also be applied to macro-, meso- or micro-level analysis depending on the aims and the scope of the investigation.

3.2.2.1 Geographical Information System mapping

Geographical Information System (GIS) mapping identifies where the economic activity of a particular sector is concentrated in a region in relation to the location of the labour force, specialised or non-specialised infrastructure in a region (Malczewski, 2006). It decomposes the economic activity of a region spatially. This method uses GIS software to analyse spatial data and presents the output in the form of maps (see section 4.4). This is achieved by using both economic and geographic data to depict the actual geographic location of economic activity or employment on a map (see section 4.4). In order to apply GIS mapping, a comprehensive map database with latitude and longitude coordinates for a specific location is required. Applying GIS mapping in cluster analysis has the main advantage that it provides in-depth spatial analysis of a region by mapping out the distribution of firms. Another advantage of GIS mapping is that it visually presents the geographic location and concentration of economic activity in one map (Takaeda *et al.,* 2008).

However, a limitation of this is that the concentration of economic activity in a geographic location does not necessarily mean clustering. As a result, the output of GIS mapping can be misleading if the results are not interpreted with caution. Such concentrations should be investigated further to determine whether they possess the characteristics of clusters (see section 2.4). For these reasons, GIS mapping should be used with other methods to make up for its shortcomings and to enable a more accurate identification of clusters. Takaeda *et al.* (2008) applied GIS mapping to investigate the geographical dispersion of firms in Yamagata prefecture in Japan. GIS mapping was also used in a study to investigate the existence of industrial and spatial clustering effects in ten research intensive industries[9] in Copenhagen, Denmark (Cities

[9] The ten industries were selected as a result of inferring with experts (expert opinion, see Section 3.2.1.7) in the region.

Alliance, 2012). This involved mapping the location of the firms included in the survey as a first step. Next, employment concentration was mapped out and clusters were identified if high employment concentration in a radius of 3 to 5 kilometres was detected. The identified clusters were further assessed based on the location choice decisions of the firms and interview data to determine the nature of the concentrations (Cities Alliance, 2012; see section 3.2.1.5).

3.2.2.2 Locational correlation or coefficient of correlation

The locational correlation (LC) or the coefficient of correlation is an explicit measure of clustering. The LC is the Pearson"s coefficient of correlation. When used as a method to identify clusters, LC measures the externalities (spill-overs) across industries (Porter, 2003). The LC is mainly calculated using employment data. The LC can identify the boundaries of a cluster by establishing whether or not industries are co-located. If they are in the same region, then it is assumed that externalities exist and therefore a cluster exists. The LC is calculated using equation 4 below:

$$r = \frac{1}{n-1} \sum_{i=1}^{n} \left(\frac{X_i - X}{s_X} \right) \left(\frac{Y_i - Y}{s_Y} \right) \qquad (3.4)$$

Where X_i and Y_i are the number of establishments in industries X and Y;
n is the sample size; and
s_x and s_y are standard deviations for X and Y

The coefficient of correlation is a number that lies between -1 and 1. The greater the absolute value of the score, the more the spatial links between the two industries and *vice versa* (Yingming, 2010). This method captures clusters across industries as opposed to only capturing intra-industry clusters. It takes into account the spatial relationships of firms (Goetz *et al.,* 2010). Porter (2004) calculated locational correlations for pairs of traded industries for different states in the USA to identify clusters. He used the states as the unit of analysis (the dependant variable) and employment as a proxy for industry size. Porter argued that if industries had a high correlation then they were co-located. However, the main drawback of this method is that although it detects co-location; co-location does not ensure cluster formation. Porter (2004) acknowledged that co-location could imply either spatial or functional interdependence, but not necessarily clustering. Functional dependencies arise as a result of historical reasons, chance, proximity to transport infrastructure, or natural resources (see section 2.2.1; Porter, 2004).

3.2.2.3 Wage analysis

Wage analysis as a method to identify clusters is mainly based on the assumption that workers in successful clusters receive higher wages. This is because the cluster will attract more firms in the region resulting in the division of labour and specialisation, an increase in the number of specialised jobs, an increase in the skills level of the workers (to meet the demand for skilled labour) and subsequently an increase in the wages of the skilled workers (Gibbs *et al.,* 1997). An analysis of the wage rates of industries in the region is of particular importance to policy-makers as it reflects the standard of living and the economic welfare of the region (Goetz *et al.,* 2010).

Wages also provide insights into the level of productivity and competitiveness of a particular industry relative to other industries in a region at a point in time. This method is simple and involves ranking the wages of industries and comparing them over time. Gibbs *et al.* (1997) found that the wages of workers in rural clusters were 13% higher than those of workers who were not part of the cluster in a study to investigate the existence of rural industry clusters in the USA. Furthermore, Goetz *et al.* (2010) investigated the existence of clusters in Pennsylvania, USA, using wage analysis. The wage indicator was calculated by dividing aggregated annual payroll by the number of employees for the North East state. This method, when applied as a method to identify clusters, is insufficient. This method only measures the assumed income effects from clustering. It does not adequately measure other characteristics of clusters.

3.2.2.4 Graph theory/ network analysis

Graph or network analysis in cluster identification is founded in the graph theory. The aim of this method is to identify „cliques" and other types of network linkages between firms and/ or industry groups (Yoo, 2003). Graph analysis is a theoretical method for detecting and analysing clusters. This method examines the linkages between firms and sectors by using simple network graphing software to illustrate the key intra-cluster purchasing linkages (Bergman *et al.*, 1999). This method illustrates the core role of a specific sector in the economy. Inter-linkages between sectors are represented by arrows and the direction of the arrow highlights the significant purchases of one sector in another sector.

The graph theory method uses input-output data to visualise the direct chain linkages between different sectors (Wang, 1997). This method involves the following steps as outlined by Champebell (1971). Firstly, an adjacency matrix comprising ones and zeros is derived by transforming the input-output matrix or the transaction table. Using a predetermined threshold value, „1" is assigned if a transaction value is greater than the threshold value and „0" is assigned if it is less (Vom Hoffe & Chen, 2006). This means that if there is an inter-industry linkage between industries *i* and *j* that is x_{ij} >0, then there exists x_{ji}=x_{ij}=1 between them otherwise x_{ij}=x_{ji}=0 (Yingming, 2010). The second step involves constructing the directed graphs. The directed graphs depict the significant inter-industry linkages, represented by the value „1" in the adjacency matrix, in a graph (Vom Hoffe *et al.,* 2006). Industries are represented by nodes, while industry flows are represented by connectors. An arc (ring or side) between two nodes represents the flow of goods and services from industry *i* to *j* and this connects the direction from *i* to *j.*

The ratio of the number of arcs to the maximum possible number of arcs in the directed graph (the connectivities) in which *n* is the number of industries shows the extent of functional linkages and networks of industries in a region (see section 2.2.1; Yingming, 2010). The more connectivities there are, the more functional links and networking among industries exist. The third step involves constructing distance matrices. These are constructed according to the number of distances between industries *i* and *j.* If industry *i* sold its output to industry *k*, industry *k* to industry *l* and *l* to *j.* Then the number of lines between *i* and *j* is 3. The centricity of an industry (measured by the ratio of all distances in the distance matrix relative to the number of steps of each row – industry) shows the status of the industry in its system. Lastly, clusters are identified on a directed graph by observing the number of sub-graphs composed of nodes accessible to one another. Meeusen and Dumont (1997) applied graph theory based on the assumption that firms place great importance on research and development cooperation as a way to create a competitive advantage in the network in national innovative systems. This assumption enabled the observation of the micro-agent interactions between firms and research institutions. These interactions were plotted on a graph as nodal points.

The main challenge of this method is that the results obtained from the analysis are complex and interpretation of the output is not easy (Bergman *et al.,* 1999). This limitation is exacerbated by the limited availability of appropriate software in economics to analyse the output from network analysis in industrial cluster identification. This is because this method is mainly applied in the social sciences. This method does not take into account linkages with firms or industries that are outside the geographical boundaries of the region under investigation (Openshaw, 1984). Furthermore, final demand from the I-O tables is not taken into account. This leaves out any linkages from consumption, investment government spending and exports in which significant shares of outputs for certain industries could lie.

3.2.2.5 Correspondence analysis

This method encompasses the use of various methods such as factor analysis, principle component analysis, multi-dimensional scaling and canonical correlation (Yoo, 2003). Correspondence analysis is a multivariate statistical mapping technique, which shows the relationships between variables through the analysis of tables of categorical data (Spielkamp & Vopel, 1999). This method and its counterparts aim to identify groups or categories of industries that have similar production or innovation patterns (Roelandt *et al.,* 2000). Correspondence analysis can be applied together with qualitative surveys to determine for example the variables that measure the innovative capacity of firms. In other words, it is a combination of surveys and multivariate statistical mapping. It is effective in providing up-to-date information on the relationships that exist between the variables under investigation. Arvanitis and Hollenstein (1998) applied correspondence analysis and analysed survey data to identify clusters among Swiss private firms and to gain insights into their innovative processes and performance. From the survey data, fifteen innovative indicators were constructed. Arvanitis *et al.* (1998) identified innovative clusters by analysing the relationships of the firms using correspondence analysis. An advantage of corresponding analysis is that with large numbers of variables it makes it easy to observe many relationships (Spielkamp *et al.*, 1999). Correspondence analysis however, involves many complex statistical steps and has not been applied in many empirical studies to identify industry clusters. This method also strongly depends on the availability of primary data from surveys such as expert opinion and case studies to map out the relationships between firms (see sections 3.2.17 and 3.2.1.8). Finally, correspondence analysis‟ reliance on survey data is further limited by the fact that surveys are costly and time consuming.

3.2.2.6 Spectral clustering

The main aim of spectral clustering techniques is to identify similarities in the data and to group them according to similarities in behaviour patterns (Von Luxburg, 2007). This is based on the eigenstructure of a similarity matrix so that elements in the same group are similar and elements in different groups are dissimilar (Bach & Jordan, 2003; Von Luxburg, 2007). The similarity matrix is a matrix that comprises the quantitative evaluation of pairs of data points in the dataset. Spectral clustering uses the top eigenvectors derived from the distance between data points (Ng, Jordan & Weiss, 2002). The eigenvalues (also known as the spectrum) of the similarity matrix of the data in spectral clustering are used to perform reduction techniques (dimensionality reduction) and cluster the data into fewer dimensions (clusters). Contention exists in the literature over the most appropriate eigenvectors to use and how to derive clusters from them when conducting spectral clustering. As a result, a number of variations exist in the literature (Weiss, 1999). The main tools for spectral clustering are graph Laplacian matrices, which are based on matrices in spectral graph theory (Chung, 1997). Graph Laplacians are used to encode the assumption that data points that are close should have a similar label (Von Luxburg, 2007).

In the field of discrete mathematics, determining the number of clusters is regarded as a most difficult problem (Von Luxburg, 2007). Kagawa, Kondo, Nansai and Suh (2010) demonstrated that the "spectral clustering method is extremely useful for addressing the industrial cluster problem". According to Von Luxburg (2007), the main advantages of spectral clustering are; "It is simple to implement, and can be consequently solved efficiently by standard linear algebra software". Spectral clustering often outperforms traditional clustering algorithms such as the k-means algorithm. It does not make strong assumptions on the form of the clusters. This method can be implemented efficiently for large datasets on the condition that the similarity matrix is sparse. Lastly, Von Luxburg (2007) highlighted that another advantage of spectral clustering is that it is a powerful tool that can provide good results if applied with care.

Kagawa *et al.* (2010) identified energy-intensive industrial clusters in the Japanese automobile supply chain using spectral clustering and structural path analysis (see section 3.2.2.7). Normalised cut values representing the minimisation of energy intensiveness between two environmentally friendly industrial groups were used to detect the most energy-intensive industrial clusters from the whole supply chain. Spectral clustering was then used to identify clusters by minimising the normalised cut values consisting of energy consumption induced by economic linkages among clusters (energy cut-values; numerator) and the energy consumption of sectors within a cluster (denominator). However, spectral clustering analysis has some shortcoming that should be noted. The results can become unstable if the choice of parameters for the neighbourhood graphs is not optimal. This means the results depend on the choice of the similarity graph. In addition, spectral clustering does not detect the correct clusters in any given dataset implying that it is not a „black box algorithm‟.

3.2.2.7 Structural path analysis

Structural path analysis (SPA) was developed by Defourny and Thorbecke (1984). "Structural path analysis shows, respectively, how influence is diffused from a given pole, through which specific paths it is transmitted and the extent to which it is amplified by the circuits adjacent to these paths" (Defourny *et al.,* 1984). SPA is a decomposition technique, based on the theory that the „connections‟ for transmitting a particular desired outcome in the economy lies in the different sectors of the economy (Kagawa *et al*., 2010). SPA uses data from input-output tables or a social accounting matrix. Accounting multipliers, also known as the global influence in a SAM, are decomposed into total influence according to the respective elementary paths flowing from two given poles (Defourny *et al.,* 1984). SPA allows the isolation and identification of the distinctive reaction mechanisms within the complex network of structural relations of the different economic agents. The magnitude of the desired outcome, however, will depend on expenditure pattern combinations and the sourcing of inputs (Ngandu, Garcia & Arndt, 2010). Two assumptions must hold for SPA to strictly apply to the economy;

i. Supply-related constraints to economic growth should not be binding; and

ii. Constant prices or Leontief form preferences and technology.

These assumptions imply that the proportions of consumption are fixed for consumers and input proportions for producers are fixed owing to fixed relative prices. This disincentivises changing the proportions or preferences and technology specifications (Ngandu *et al.,* 2010). The main aims of conducting SPA, according to Ngandu *et al.* (2010), are to:

i. "Identify the most important interactions or paths within an economic system; and
ii. To identify which individual poles (sectors, factors or households) are important transmitters of economic influence".

The main advantage of using SPA in industrial cluster identification is that it decomposes SAM multipliers into direct and indirect components and reveals the network through which transmission occurs. This is achieved by revealing the channels through which influence is transmitted in a macro-economic system (Defourny *et al.,* 1984). This method, like its peers multiplier analysis and multiplier decompositions, can help government by providing insight into the possible outcomes of certain policies. It is designed to provide a more detailed picture of the effects of shocks to exogenous accounts. SPA analyses I-O tables" output to trace the transmission of a global influence in the SAM by analysing the individual elements within the economic structure. It clearly distinguishes between the path and the origins of outcomes within the economic structure. That is, SPA can identify clusters by tracing the sectors with the strongest inter-linkages and identifying how those sectors link up with the rest of the economy. SPA traces the ultimate effects on endogenous variables to paths in the structural relationships in an economic structure. This method also identifies the elements in the economy that would not have been identified from traditional analysis of direct transactions between accounts or from analysing the global influence in a SAM (Roberts, 2005).

The application of the SPA method to identify industrial clusters in empirical studies is limited. The extensive literature search in this study identified a few studies that have used SPA to identify industrial clusters. Kagawa *et al.* (2010) for example used SPA to identify energy-intensive clusters comprising both upstream and downstream sectors in the automobile supply chain in Japan. SPA identified the total inter-linkages (cooperation) between all sectors to determine the clusters that can reduce the total environmental burden and save energy. However, SPA has the following shortcoming. This method does not determine the optimal number of clusters. It shows different clusters and how they are interconnected to the rest of the economy, but does not show the most important cluster in terms with the greatest economy wide effects (see sections 3.3.2 and 5.3.2). SPA uses I-O tables or a SAM. This data is dated or lagged in most cases, increasing the likelihood of identifying old trends and therefore clusters that may be declining (see section 3.4.1).

Table 3.3 below summarises the objectives, industrial cluster potential measurement, problems and some empirical studies using the method for the minor methods used to identify clusters .The proceeding section then discusses why SPA was used to identify industrial clusters in the NWP of South Africa.

Table 3.3: Summary of the minor methods for identifying industrial clusters

Method	Method objectives	Input data	Industrial cluster potential measurement	Problem/ Barriers	Empirical studies using this method
GIS mapping	-Provide in-depth spatial analysis of a region -Visually present geographic location and concentration of economic activity	-Detailed geographic data; -Employment data -Output data	-Identifies the locality of firms in a region -Should be used with other methods to accurately identify clusters	-Results can be misleading – geographic concentration is not necessarily clustering	-Takaeda *et al.* (2008): Japan
Locational correlation	-Measures the externalities (spill-overs) across industries -Define cluster boundaries	-Number of establishments	-Identifies the boundaries of a cluster (co-location of industries) -Identifies potential regional relationships	-Cannot distinguish between spatial and functional interdependence	-Porter (2004): USA -Goetz *et al*. (2010): USA
Wage analysis	-Analyse wages to measure the level of productivity and competitiveness of a particular industry	-Wages per industry -Number of workers	-Identifies industries paying the highest wages assuming that successful clusters pay higher wages -Measures the assumed income effects from clustering	-Does not adequately measure other characteristics of clusters	-Gibbs *et al.* (1997): USA -Goetz *et al*. (2010): USA
Graph theory/ network analysis	-Identify cliques" and other types of network linkages between firms and or industry groups -Identify key sectors in the economy	-Input-output data	-Identifies individual interactions between firm -Identifies networks and social capital between firms	-Difficult and complex to apply and interpret -Limited software application	-Meeusen & Dumont (1997): Belgium -Duque, Rey & Gomez (2009): Columbia
Correspondence analysis	-To show relationships between variables -Identify groups or categories of industries that have similar innovation patterns	-Survey data	-Effectively provides up-to-date information on the relationships that exist between firms	-Requires primary data from surveys to map out the relationships between firms. -Surveys are costly and time consuming	-Arvanitis & Hollenstein (1998): Switzerland
Spectral	-To identify similarities in the data	-Input-output	-Identifies clusters by grouping	-Results can become	-Kagawa *et al.*

clustering	and group them according to similarities in behaviour patterns	data	similar elements in the same group so that elements in different groups are dissimilar; -Determines the number of (optimal) clusters	unstable if sub-optimal neighbourhood graphs are used	*(*2010): Japan
Structural path analysis	-To identify the most important interactions or paths within an economic system; -To identify which individual poles (sectors, factors or households) are important transmitters of economic influence	- Input-output data	-Identifies cluster sectors that are important transmitters of economic influence (strong economy-wide inter-linkages)	-Does not determine the optimal number of clusters	Kagawa *et al*. *(*2010): Japan

Source: Adapted from Stejskal (2011) and author"s own summary

3.3 The structural path analysis and power of pull methods to identify industrial clusters in the NWP of South Africa

3.3.1 Why the structural path analysis method was used to identify industrial clusters in the NWP

In this study, the structural path analysis (SPA) method was the most appropriate method to identify industrial clusters in the NWP of South Africa. The SPA method, as compared to other available methods, has a number of specific factors that set it apart, as previously mentioned in section 3.2.2.7. A summary of these factors is listed below:

- It identifies the most important interactions or paths within an economic system;
- It identifies which individual poles (sectors) are important transmitters of economic influence;
- It decomposes inter-industry linkages (global influence) into total influence according to the respective elementary paths flowing from two given poles and reveals the network through which transmission occurs;
- It allows the isolation and identification of the distinctive reaction mechanisms within the complex network of structural relations of the different economic agents;
- It decomposes SAM multipliers into direct and indirect components, thereby identifying the elements in the economy that would not have been identified from traditional analysis of direct transactions between accounts or from analysing the global influence in a SAM;
- It can provide insight into the possible outcomes of certain policies;
- It is designed to provide a more detailed picture of the effects of shocks to exogenous accounts; and
- It can identify clusters by tracing the sectors with the strongest inter-linkages and identifying how those sectors link up with the rest of the economy.

Additionally, the SPA method was used because of two other factors, which are specifically relevant to the NWP of South Africa. These are listed below:

- The NWP SAM was readily available (DBSA SAM of 2006); and
- A SAM will incorporate the geographic scope of cluster definitions, which is the geographic concentration of firms in the NWP (see section 5.2.1).

3.3.2 Why the power of pull method was used to identify industrial clusters in the NWP

Since the SPA method does not determine the optimal number of clusters, the power of pull (PoP) method was used to prioritise the number of clusters to focus on. The PoP method defines network effects into a quantifiable criterion that can be used to determine the industrial clusters that should be prioritised (Lou, 2013). The principle behind this method is to focus on sectors that have the ability to „pull" itself and the activities and output of all other sectors. This also includes all sectors connected to it directly or indirectly throughout the economy. This ability of a sector is referred to as the PoP. According to Hirschman (1958), the basic assumption is that "a sector influences other sectors through inter sector linkages, so changes in sectors with relatively strong linkages will strongly impact the entire economy". A sector"s PoP is higher if the sectors", that it pulls", PoPs are high. These sectors" PoPs are determined by the sectors they further pull *ad infinitum* (Wasserman & Faust, 1994; Newman, 2008). The promotion of such sectors with the highest PoP on the margin will achieve the highest overall economy-wide stimulating effects.

Dietzenbacher (1992) proposed the method to calculate the PoP. This method analyses eigenvectors of the major eigenvalues of an inter-industry transaction matrix[10]. The eigenvector method captures the network perspective and the infinite regressive nature of inter-industry influences. In addition the eigenvector method assigns weights to inter-industry linkages in a systematic way to enable the determination of the importance of industry sectors. By applying SPA and subsequently the PoP method to a SAM for the NWP, industry sectors" PoPs can be assessed and ranked to determine the most significant industrial clusters.

The PoP method provides insights into which sectors should be promoted for cluster promotion. The results of the PoP method will provide insight into which sectors should be prioritised for cluster promotion to enhance firm competitiveness and growth in the NWP. This is because the PoP method reveals fundamental structural changes of the economy highlighting the key influencing sectors for long-term growth and development.

[10] See section 3.2.2.6 on eigenvalues and eigenvectors.

3.4 Data used in empirical analysis to identify industrial clusters

The application and usefulness of the various methods to identify industrial clusters depend on the availability of data. Tables 3.2 and 3.3 highlight that a major shortcoming of some of these methods (correspondence analysis, LQ, Moran‟s I, shift share analysis and case studies) relate to the nature and availability of data. Given the overview of the methods to identify industrial clusters in section 3.2, this section discusses the different types of data used in the investigation of industrial clusters.

3.4.1 Input-output data and social accounting matrices

The input-output (I-O) tables were developed by Wassily Leontief (Baumol & Raa, 2009). His aim was to trace the flow of money in the economy and to estimate economic impacts. The main principle behind I-O analysis is to show economy-wide structural relations between different sectors. I-O analysis examines the horizontal and vertical relationships (inter-linkages) between buyers and sellers. Industry linkages are identified by analysing vertical buying and selling patterns or by grouping industries based on how similar their buying-selling patterns are (Vom Hofe & Bhatta, 2007). Sectors in the economy are broken down into inputs (contributing sectors) and producing sector outputs (consuming sectors). For a given time period, an I-O table shows the transactions for a given industry, that is the industries it buys its inputs from and those it sells its output to. Additionally, I-O tables show both private and public sectors‟ utilisation of industry production, investment and exports.

A social accounting matrix (SAM) is an extension of I-O analysis. It is based on the principles of I-O analysis. A SAM is a general equilibrium model of the economy. It identifies the linkages between different sectors in the local economy. It maps out how the effects of changes in one sector affect other sectors in the local economy. A SAM also maps out how economic activity in the local economy is affected by changes in a specific sector (Raa & Sahoo, 2005). This method is based on the framework system of national accounts, which enables it to map out economic flows between producers (supply side) and institutional accounts (Robinson, Cattaneo & El-Sai, 2001.). As a result, income derived from production activities and its subsequent distribution to various socio-economic groups can be mapped out in a SAM. A basic SAM comprises factors of production, households and the production sector. The production sector comprises various sectors, i.e. agriculture, manufacturing, mining etc (see section 5.2). It pays wages and interest to factors of production (labour and capital) for services rendered. The wages and interest paid are utilised by households (rural and urban) to pay the production sectors for purchases of food, clothing etc.

3.4.1.1 The use of I-O data and SAM data to identify industrial clusters

The analysis of I-O tables and SAMs is also widely used in empirical studies as a method to identify industrial clusters (Shields *et al.,* 2012). The analysis of these data provides insight into the inter-linkages that exist between firms. As mentioned earlier, I-O tables and a SAM can trace economy activity in a local economy and show how the different players in the economy are interconnected (inter-industry linkages). This renders them as a useful tool in the identification of industrial clusters. The main advantage of using a SAM to identify industry clusters is that it has great flexibility in defining the data under analysis. This means that, owing to the internal consistency of the model (inputs must equal outputs), different units of measurement and definitions can be used in the model.

3.4.1.2 Variations of using I-O tables and SAMs as a method to identify industrial clusters

The earliest empirical report using I-O analysis, known as the *traditional I-O method,* to investigate the existence of industrial clusters can be cited as Isard, Schooler and Vietorisz‟s (1959) paper on industrial complex analysis. I-O tables map out the network relations of production in a systematic manner and focus on the commercial linkages between industries (the flow of goods and services). The aim is to identify non-trade-based dependencies and unseen complementarities and employ data reduction techniques to detect the most likely enterprises and industries that constitute candidates for strategic alliances. This approach is known as the traditional I-O method. Barkley *et al.* (2010) applied the *traditional I-O method* to identify upstate manufacturing industry clusters in South Carolina, USA. In their study, clusters were identified by applying three steps. Firstly, industry concentrations with high employment growth were identified. This was achieved by analysis of a combination of indicators[11]. The second step involved analysing the I-O tables for the identified industry clusters. This step involved identifying industries with the greatest number of linkages. The final step ranked the industry clusters identified according to the expected economic and fiscal impacts on the local economy.

Variations of I-O analysis have been applied in empirical reports to address some of the shortcomings of the traditional I-O method. The I-O method can be applied with principle component analysis (PCA). Roepke, Adams and Wiseman (1974) and Czamanski (1974) were the earliest adopters of the *PCA I-O analysis*. PCA uses maximum common variance in cluster identification to reduce the number of industries under analysis to a few potential clusters (see section 3.2.2.5 – Correspondence analysis). Vom Hofe *et al*. (2007) explain how this can be achieved in three alternative ways, namely (i) using PCA to group industries‟ inter-industry transaction matrices based on the similarities in buying patterns (R-mode analysis); (ii) using PCA to account for similarities in selling patterns by applying PCA to the transposed transaction table (Q mode analysis); and (iii) correlating the normalised transaction and the transposed transaction tables with each other to obtain a symmetric matrix and then applying PCA to this symmetric matrix to match a particular industry‟s buying patterns to an industry with similar selling patterns. The *PCA I-O analysis* can be used to determine national benchmark clusters in the national template approach to cluster identification (Feser & Bergman, 2000). To determine national benchmark clusters, national industry sectors are grouped into clusters with no regard to geographical location. These non-spatial clusters are then used as benchmarks to determine the geographic location of such industries as well as to determine the extent or scope of these clusters in the regional economy.

In another variation of I-O analysis, Roepke *et al*. (1974) allocated factor scores to groups of industries based on buying and selling patterns. Data similarity matrices were constructed using Pearson product movement correlations (Czamanski, 1974). The highest factor loading scores

[11] Industry concentrations were established based on the following criteria being met; the industry should: i.) have at least five establishments or more in 1996; ii.) employ more than 1000 people in 1996; iii.) experience positive employment growth between 1988 and 1996; iv.) have LQ greater than one or increasing between 1988 and 1996; and v.) have a positive competitive differential (shift share analysis component) between 1988 and 1996 (Barkley *et al.*, 2010).

were awarded to industries that were termed core-industries and low factor loading scores were awarded to secondary industries. Vom Hofe *et al*. (2007) proposed an alternative approach that incorporates commodity trade between the region and the rest of the nation enabling the identification of local and domestic clusters that are neither purely local or purely national phenomena.

Another variation of the *PCA I-O analysis* that aims to address the issue of identifying key sectors in the economy involves the use of the results of PCA with backward and forward linkage measures (inter-sectoral relationship indicators). In this version, the aim is to capture both the direct (measured by the coefficient matrix) and indirect effects of changes in final demand for different sectors using the partial multipliers from the Leontief inverse matrix (Hewings, 1974; Beyers, 1976; Vom Hofe *et al.,* 2007). This means incorporating commodity imports and exports by each industry into the regional I-O tables. Key sectors are identified using a power of dispersion index and a sensitivity of dispersion index. The sensitivity of dispersion index is derived from an inverse matrix and supply driven I-O model (Beyers, 1976). In this inverse matrix, sectoral gross output is derived from the primary inputs of production as the inverse matrix is based on the sales coefficient matrix.

3.4.1.3 Advantages of using I-O analysis as a method to identify industrial clusters

The main advantage of I-O analysis is that it identifies spatially agglomerated industry clusters particularly for relatively small regions (Ó hUallacháin, 1984). Secondly, I-O analysis summarises a great deal of information about the inputs (labour and capital) and outputs (intermediate goods and end products) from various sectors as well as the trade between various sectors (Almquist *et al., 2001*). I-O tables are focused on the economic linkages between actors in the production chain (Roelandt *et al*., 2000). Production matrices reveal the production flow in a network. This reveals the various players in the production network and the extent of inter-linkages between various players. I-O analysis also reveals the geographic extent of inter-linkages between firms. That is, it shows the geographic coverage or dispersion of firms in a network, which ranges from a single city or region to a country. This method of cluster identification is widely used and has been applied in several studies in several countries. Vom

Hofe and Chen (2006) highlight that PCA I-O analysis allows industries to be in several clusters at the same time by overcoming the restriction that these industries should be mutually exclusive. The national template approach has the advantage that it simulates the possible outcomes of cluster formation and the implementation of targeted economic development policies in a region (Feser, 2004).

3.4.1.4 Disadvantages of using I-O analysis as a method to identify industrial clusters

No matter which of the variations of I-O analysis discussed above, this method cannot measure how closely located the industries in a cluster are. I-O-based methods are a-spatial by design. As a result, they do not reflect the actual geographic distances (proximity) of firms in the clusters they identify (Latham, 1976). Groupings of industries according to similarities in buying or selling patterns do not provide insight into which clusters will give the most return on investment in cluster formation. I-O analysis does not differentiate between local and non-local buying and selling patterns. It excludes inter-linkages that do not trade locally at significant levels (Feser & Luger, 2002). Sub-national input-output tables exclude local trade (domestic exports and imports), which is the non-local buying/selling patterns (Vom Hofe e*t al.*, 2007). I-O analysis fails to meet the location criteria of industrial complexes (Czamanki & Ablas, 1979).

Another pitfall of I-O analysis is it failure to signify interdependencies between industries that are not in close geographical proximity (Bergman *et al*., 1999). Suppliers, distributors and parent organisations that do business with firms in the cluster that are located in other regions may be overlooked; as such linkages are not included in the traditional analysis of trade patterns between industries in the region in I-O analysis (Feser *et al.*, 2002). Furthermore, potential complementary industries that may enhance growth in the local economy through targeted cluster development strategies are not identified in traditional I-O analysis. Bergman *et al.* (1999) point out that the correlation coefficients in PCA I-O analysis are calculated only in the direct buy-sell dimensions resulting in the omission of second- and third-tier buyers and sellers in the groupings. The national template approach has a limitation in identifying mutually exclusive benchmark clusters, and this contradicts the idea of interdependence associated with clusters.

The Pearson product movement correlations of PCA I-O analysis can be easily influenced or distorted by outliers in the data owing to the diverse nature of I-O flows (Feser, 2005). Furthermore, Feser (2005) highlighted that "cluster templates derived from factor analysis may be compromised. This is because statistical factor analysis often loads a large number of industries on the first factors, and progressively fewer industries on subsequent factors. Resultantly, this identifies a few large composite clusters and a number of smaller, single member clusters". I-O analysis is also criticised for not adequately identifying key sectors in the economy that can generate the biggest impact on the economy (Duque, Rey & Gomez, 2009). This method identifies sectors that exhibit significant links with each other and therefore are already in line with cluster development strategies. However, complementary industries that might have contributed significantly to future growth and development are overlooked by focusing on existing clusters. I-O analysis has some limitations as a method to identify clusters. However, if it is applied with other methods, some of the shortcomings can be addressed and can provide more insightful results in the cluster identification process.

3.4.2 Other data

Employment data is widely used in empirical analysis to identify industrial clusters. For example, the LQ uses regional employment data to compare an industry‟s levels of specialisation relative to national levels. In most cases, disaggregated regional employment data provides more detail and is preferable to aggregated data. *Employment data and output data* are widely used interchangeably to measure the level of specialisation of economic activity for a particular region (see LQ – section 3.2.2.1, EG index – section 3.2.2.2; Shift share analysis – section 3.2.2.4). *The number of establishments in a region* is also used as a measure of the concentration of firms (see the Moran *I* statistic – section 3.2.2.3; Shift share analysis – section 3.2.2.4; the coefficient of correlation – section 3.2.2.2). Other methods use surveys to quantify characteristics associated with clusters, such as business practices, nature of the supply chain, and current investment patterns (see case studies, expert opinion, location probability models and AHP and matching models). Other methods, such as GIS, require a *comprehensive map database* with latitude and longitude coordinates for specific locations together with employment or output data. *Wages per* *industry* (see Wage analysis – section 3.2.2.3) are also used in empirical analysis to identify clusters. Wages of different industries are ranked and compared over time. Chapter 2, section 2.4 also discussed some typical measures that can be analysed to identify characteristics of industrial clusters.

3.5 Summary and conclusion

One of the objectives of this study is to provide an overview of the methods to identify industrial clusters (see section 1.6.2). This chapter classified methods to identify industrial clusters under two categories, namely major and minor methods. The major methods are widely used in the literature to identify industrial clusters. In contrast, the minor methods were found to be used less frequently in empirical studies to identify industrial clusters. Both the minor and major methods can also be applied to macro-, meso- or micro-level analysis depending on the aims and the scope of the investigation (see section 3.2). Tables 3.2 and 3.3 summarise the main characteristics of the major and minor methods of identifying industrial clusters, respectively. Based on the evaluation of the various methods to identify industrial clusters, an overview of the merits and characteristics of the SPA method were provided to illustrate why it was selected as the most appropriate method to identify industrial clusters in this study. Since the SPA method does not identify and prioritise the optimal number of clusters, the PoP method was also used. Therefore, an overview of the PoP method was also provided to illustrate how clusters are prioritised according to their overall power to stimulate demand in the rest of the economy. In addition, the data used in an empirical analysis to identify industrial clusters was also discussed.

The following chapter determines the comparative advantage of the NWP of South Africa by providing a sector-based spatial overview of the province‟s economy.

CHAPTER 4: THE COMPARATIVE ADVANTAGE OF THE NORTH WEST PROVINCE OF SOUTH AFRICA: A SECTOR-BASED SPATIAL OVERVIEW

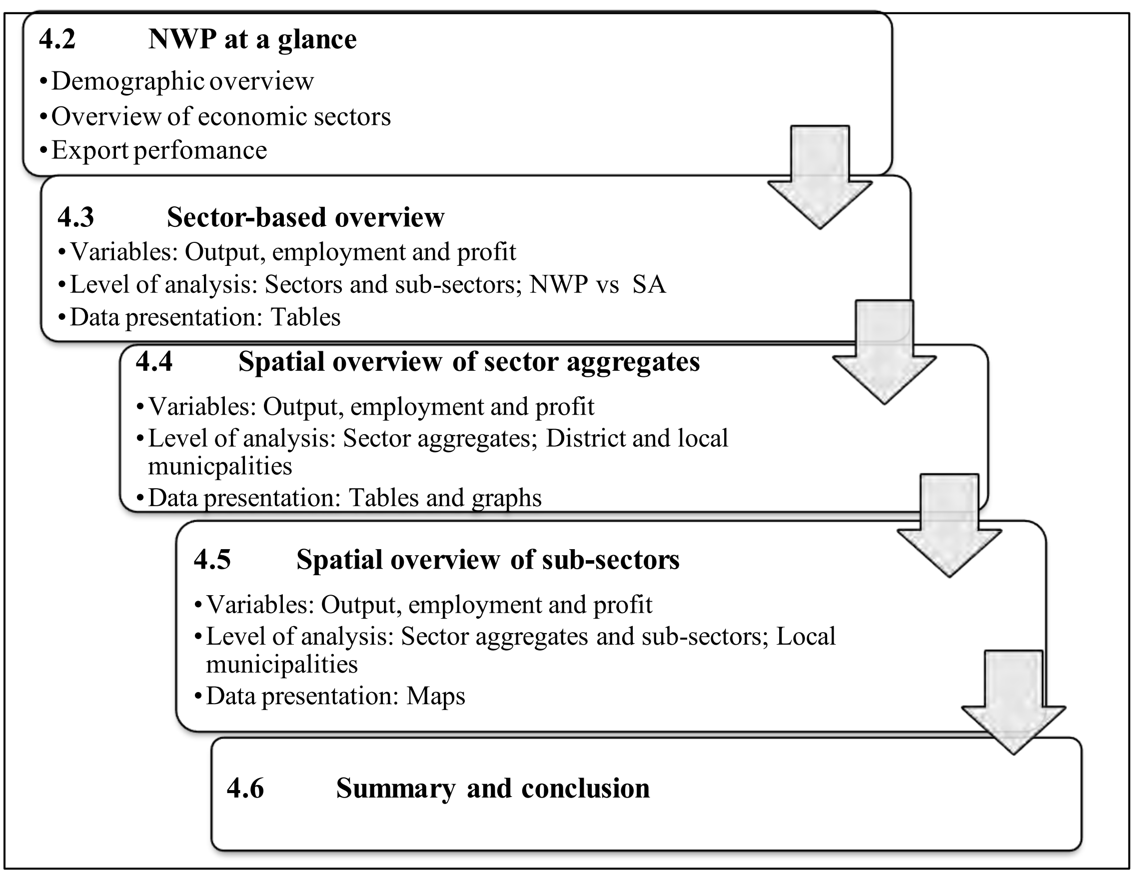
4.1 Introduction

This chapter provides an overview of the economy of the North West Province (NWP) in order to highlight the sectors in which the province‟s comparative advantage lies. Although several methods to identify industry clusters exist (see section 3.2), Shields, Barkley and Emery (2009) highlighted that most of these methods share two common aims, namely:

i. Identifying a cluster that has the most potential for growth and expansion. This involves a detailed sector analysis of sector trends in order to identify matches between clusters and regional characteristics; and
ii. Narrowing down potential sectors to identify a small set of clusters that best fit the characteristics of the region. This approach, although subjective, involves narrowing down sectors to a list of sectors that provide the most local economic development impacts, such as job creation, high wages, high contributions to the local tax base and minimal negative environmental impacts. In this case, targeting will allow the efficient use of limited economic development resources.

This chapter addresses the first objective given above, as indicated by Shields *et al*. (2009), by providing a detailed overview of the sector trends and mapping out the characteristics of the regional economy of the NWP of South Africa. Barkley and Henry (2001) stated that "a prerequisite to developing a cluster is the identification of regional competitive advantage based on labour force characteristics, unique regional attributes, availability and quality of public and private infrastructure, and proximity to input and product markets". Comparative advantage analysis reveals the structure of production highlighting the sectors, sub-sectors, products or services and locality in which the province has a more competitive production function relative to other sectors (Meintjes, 2001). This is an essential first step in the identification of industrial clusters in the NWP as it indicates the concentration and the locality of the different economic activities in the province. This chapter is organised as follows: following an overview of the data used throughout the chapter in section 4.1.1, section 4.2 provides an overview of the NWP. This comprises a demographic and economic as well as an overview of the province‟s export performance. Section 4.3 provides a sector-based overview of the provincial economy. In this section, the performance of the NWP in all the sectors and sub-sectors will be analysed relative to the performance of the national economy. This will highlight the significance of the NWP‟s contribution in the various sectors and sub-sectors relative to the national economy. Section 4.4 provides a spatial overview of the NWP‟s performance in the aggregated sectors across the district and local municipalities. Section 4.5 analyses the performance of the NWP in each sector and sub-sector at local municipal level. This illustrates the spatial distribution of production of the various sectors and sub-sectors in the NWP. Section 4.6 provides a summary and conclusion of the key finding of the analysis Figure 4.1 below depicts the structure of this chapter, illustrating the levels of analysis involved in each section.

Figure 4.1: Outline of the chapter



4.1.1 Data

The data used to conduct the analysis throughout this chapter was obtained from the Quantec Easy Data, RSA Regional Market Indicators database (2013) and therefore will not be continuously quoted throughout the chapter. The industries are classified under the Standard Industrial Classification (SIC) system into ten aggregated sectors, namely:

i. Agriculture, forestry and fishing;
ii. Mining and quarrying;
iii. Manufacturing;
iv. Electricity, gas and water;
v. Construction;
vi. Wholesale and retail trade, catering and accommodation;
vii. Transport, storage and communication;
viii. Finance, insurance, real estate and business services;
ix. Community, social and personal services; and
x. General government.

Detailed/sub-sector data is available for five of the sectors, namely:

i. Manufacturing;
ii. Electricity, gas and water;
iii. Wholesale and retail trade, catering and accommodation;
iv. Transport, storage and communication; and
v. Finance, insurance, real estate and business services.

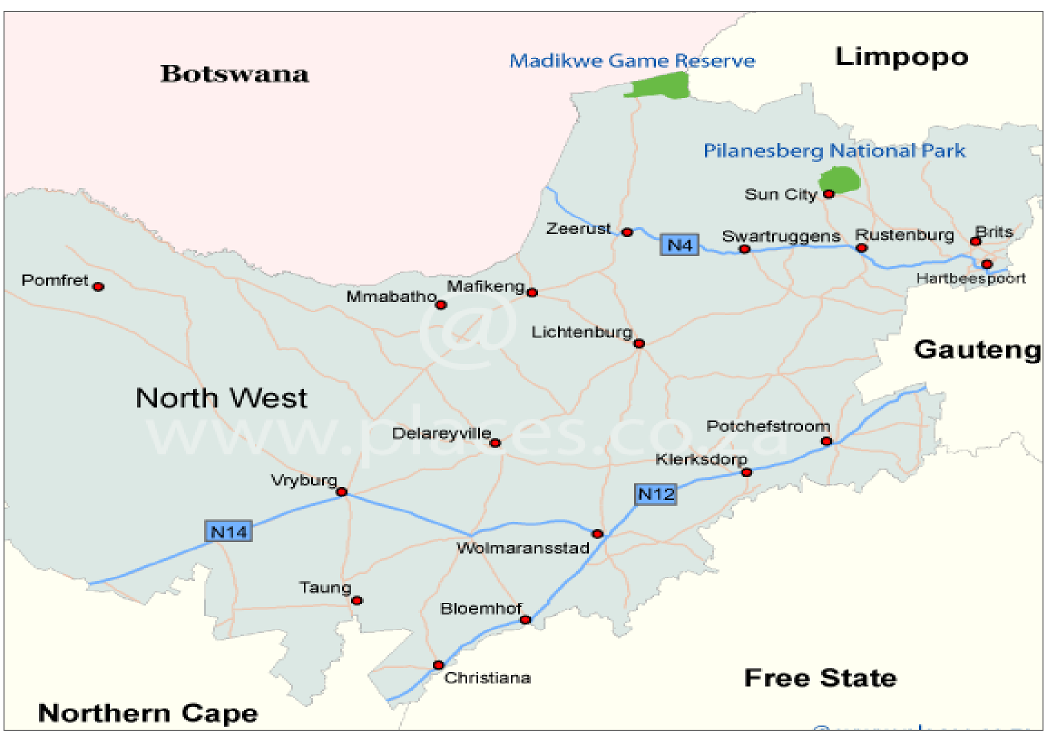
The rest of the sectors‟ data is provided as sector totals (aggregates). District and local municipality demarcations are based on the 2006 election‟s demarcation of local municipalities (Quantec Easy Data, 2013). The following section provides a brief overview of the NWP.

4.2 NWP at a glance

4.2.1 Geographic and demographic profile

The NWP is situated in the northern part of South Africa on the Botswana border as shown in Figure 4.2. The provincial capital of the NWP is Mahikeng (previously Mafeking). The NWP covers a total area of 106 512 square kilometres (accounting for 8.7% of South Africa"s land area), thereby making it the fifth largest province (Statistics South Africa, 2013). Based on the 2011 census, the NWP has a population of 3.5 million people (Statistic South Africa, 2013). It contributes 6.43% to the South African population. The NWP is relatively less populated (ranks 6th) compared to Gauteng Province, the most populated province in South Africa (11.3 million people accounting for 22.39% of the South African population). The NWP population comprises 90.1% black African, 7.3% white, 2% coloured and 0.6% Indian/Asian people. The population of the NWP is relatively young with a majority of the population below the age of 35. Two-thirds of the people speak Setswana (63.4%); the rest speak Afrikaans (9%), isiXhosa (5.5%), Sesotho (5.8%) and Tsonga (3.7%) (Statistics South Africa, 2013).

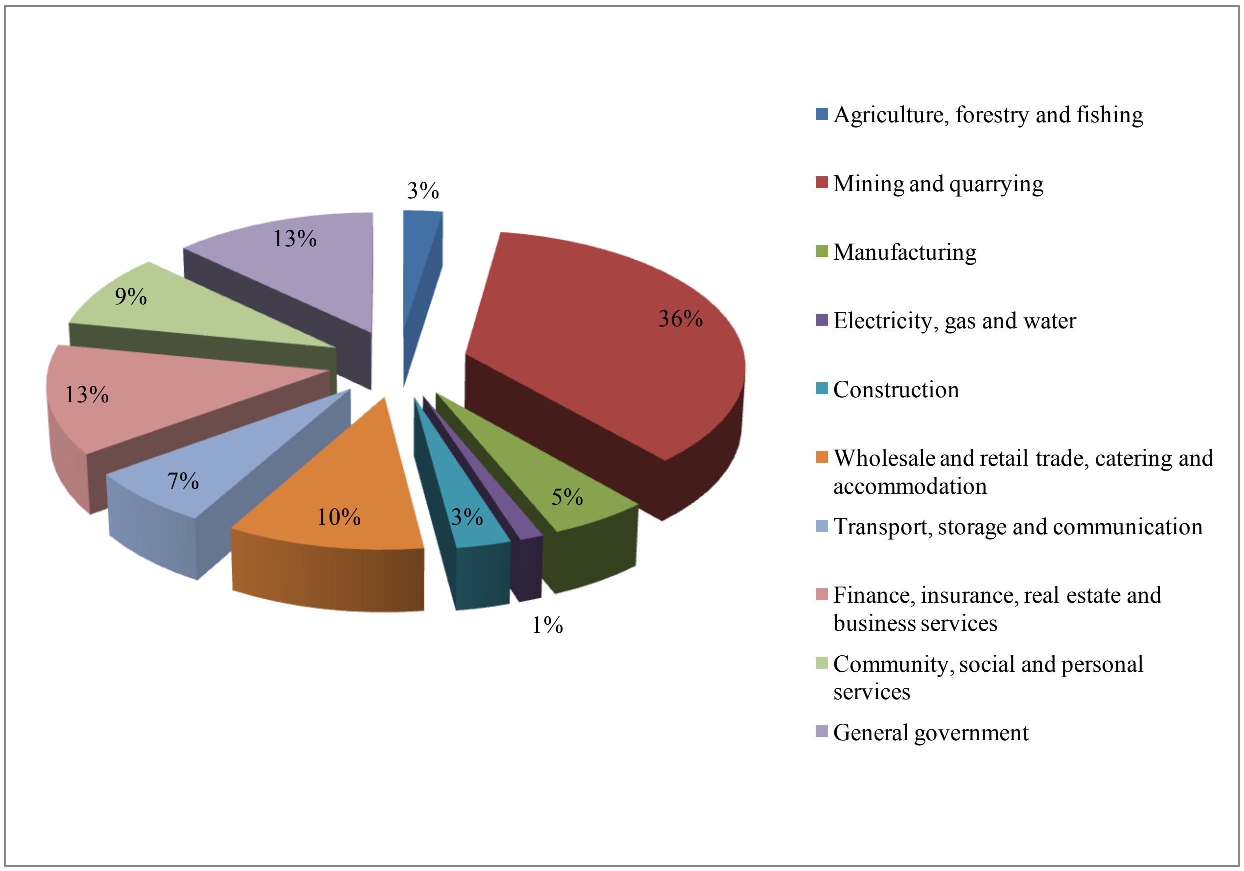
Figure 4.2: North West Province



4.2.2 Economic overview

Figure 4.3 shows the output per sector in the NWP in 2011. The main economic activities in the NWP in terms of contributions to output are mining and quarrying. The NWP"s contribution to the mining and quarrying national output was 36% in 2011. Other leading contributors to national output in the NWP were the finance, insurance, real estate and business services and general government sectors. The sectors making the least contributions were electricity, gas and water (1%), agriculture, forestry and fishing (3%) and construction (3%). A more detailed analysis of the NWP"s economic sectors" performance will be provided later in this chapter (see sections 4.3 to 4.5).

Figure 4.3: NWP"s output per sector in 2011



Source: Quantec Easy Data, 2013

4.2.3 NWP's export performance relative to other provinces in South Africa

Table 4.1 shows the value of exports per province for South Africa in 2011. The leading exporting province in South Africa in 2011 was Gauteng. R470.2 billion (68%) worth of South African exports originated from Gauteng. KwaZulu-Natal ranked second with a share of total export of 11.2%. The least contributions to the total value of South African exports originated from the Northern Cape 0.8% and Free State 0.4%, respectively. The NWP exported goods and services worth R19.1 billion (2.8% share) in 2011. This indicates that exports are moderately important in the province and that more efforts can be directed toward enhancing the province‟s export performance.

Table 4.1: Provincial contributions to South African exports in 2011

Province	**Value of exports**	**Share of total value of exports**
Gauteng	R470.2 Billion	68.00%
Kwazulu-Natal	R77.4 Billion	11.20%
Western Cape	R54.7 Billion	7.90%
Eastern Cape	R34.2 Billion	5.00%
North West	R19.1 Billion	2.80%
Limpopo	R15.2 Billion	2.20%
Mpumalanga	R12.4 Billion	1.80%
Northern Cape	R52.4 Billion	0.80%
Free State	R29.6 Billion	0.40%

Source: Statistics South Africa, 2013

4.2.4 NWP exports in 2011

Table 4.2 shows the NWP‟s top 20 export sectors (HS 2[12]). These top 20 sectors accounted for 98.3% of the NWP‟s R19.1 billion exports. This indicates that these sectors are the main exporting sectors in the province. The leading export sector was HS 71 Pearls, precious stones, metals, coins, etc., which accounted for 58.46% of NWP exports. Other leading export sectors in the province were HS 76 Iron and steel (16.8%); HS 26 Ores slag and ash (8.3%); HS 28 Inorganic chemicals, precious metal compound, isotopes (3.79%); and HS 10 Cereals (3.03%).

The NWP‟s top 20 export sectors are relatively diversified, although a large proportion (75.26% of HS 71 and HS 72), is in the resource sectors. This indicates the need to diversify the province‟s export portfolio through exploring the comparative advantage and the promotion of industrial clusters.

Table 4.2: Top 20 export sector for the NWP in 2011

HS 2 code and description	**NWP export value in 2011 (billion)**	**Share of NWP exports (%)**
HS 71: Pearls, precious stones, metals, coins, etc.	R 11.17	58.46
HS 72: Iron and steel	R 3.21	16.80
HS 26: Ores, slag and ash	R 1.59	8.31
HS 28: Inorganic chemicals, precious metal compound, isotopes	R 0.73	3.79
HS 10: Cereals	R 0.58	3.03
HS 84: Nuclear reactors, boilers, machinery, etc.	R 0.46	2.40
HS 25: Salt, sulphur, earth, stone, plaster, lime and cement	R 0.22	1.13
HS 08: Edible fruit, nuts, peel of citrus fruit, melons	R 0.15	0.79
HS 85: Electrical, electronic equipment	R 0.11	0.60
HS 73: Articles of iron or steel	R 0.11	0.55
HS 82: Tools, implements, cutlery, etc. of base metal	R 0.10	0.50

[12] The Harmonised Commodity Description and Coding System (HS System (HS)) classification is an international numerical product nomenclature that was developed by the World Customs Organisation (WCO). The HS system organises products in a logical and legal structure for the collection of customs duty and international trade statistics (WCO, 2008).

HS 31: Fertilizers	R 0.09	0.47
HS 87: Vehicles other than railway, tramway	R 0.06	0.31
HS 32: Tanning, dyeing extracts, tannins, derives, pigments etc.	R 0.06	0.30
HS 33: Essential oils, perfumes, cosmetics, toiletries	R 0.06	0.30
HS 90: Optical, photo, technical, medical, etc. apparatus	R 0.03	0.15
HS 39: Plastics and articles thereof	R 0.03	0.14
HS 21: Miscellaneous edible preparations	R 0.02	0.12
HS 63: Other made textile articles, sets, worn clothing etc.	R 0.02	0.12

Source: Statistics South Africa, 2013

This study aims to identify industrial clusters to enhance the competitiveness of firms in the NWP. Furthermore, by matching the potential clusters to the results of the DSM for products and services, the exports of firms in the NWP can be further enhanced (see sections 1.3 and 5.5.3). It is important to understand the NWP‟s comparative advantage in order to effectively promote cluster formation and exports. The following section provides a sector-based overview of the NWP. The following section provides a sector-based overview of the NWP‟s performance in each sector relative to the national economy, focusing on the following indicators:

i. Output and output growth;
ii. Employment and employment growth;
iii. Labour remuneration and wage per worker; and
iv. Profit and profit growth.

4.3 Sector-based analysis of the NWP

In this section, a detailed analysis of all the sectors and sub-sectors [13]is conducted to provide an overview of the NWP‟s performance relative to the national economy.

[13]Given the nature of the data available for analysis in this chapter (see section 4.1.1), sectors and sub-sectors are compared in this section taking full cognisance of the fact that sectors‟ totals include the sub-sector totals.

4.3.1 Output per sector and sub-sector for the NWP and South Africa

Table 4.3 below illustrates the output (Gross Value Added (GVA) at current prices) per sector as well as sub-sector in 2011 for South Africa and the NWP. The short-term growth, the medium term-growth in output and ranking of NWP‟s share in GVA[14] and the NWP‟s percentage share of output are also shown. Output growth rates are calculated using GVA at constant prices. From Table 4.3, it is clear that:

i. The NWP‟s biggest contribution to GVA was in the mining and quarrying sector. The NWP‟s share of output was 25.6% of national output in the sector resulting in the sector ranking first in share of output relative to all other sectors and sub-sectors.
ii. Other sectors in which the province contributed significantly to national output and ranked high were community, social and personal services (9.1%), agriculture, forestry and fishing (7.2%) and the other non-metal mineral products sub-sector (7.1%).
iii. The province‟s share of output was small in petroleum products, chemicals, rubber and plastic (1.9%); textiles, clothing and leather goods (1.7%); wood, paper, publishing and printing (1.3%); and the transport equipment (0.05%) sub-sectors.
iv. The transport and equipment sub-sector contributed the least, 0%, to output ranking last.
v. Short-term growth (1 year) in output in the province was highest in the transport and storage sub-sector (11.9%), although this was lower than the national growth (13.7%) rate in the sector.
vi. Short-term growth was also high in other non-metal mineral products (10%) and catering and accommodation services (7.8%) sub-sectors, although growth was also lower relative to national growth rates of 11.2% and 15.7%, respectively, in the same sectors.
vii. The sharpest decline in short-term output growth that was experienced for both the NWP and South Africa was the in the textiles, clothing and leather goods (-19.6% and -12.7%, respectively) and communication (-9.9% and 0- 9.1%, respectively) sub-sectors.
viii. In the medium term, the sub-sectors with the highest growth rates overall were water (4.2%) and food, beverages and tobacco (3.9%).

[14] In this section, the analysis focuses on both the sectors and sub-sectors. The ranking of the NWP‟s share in national GVA per sector and sub-sector was done only to provide insight into the relative importance of the province‟s share in each sector or sub-sector.

Table 4.3: Output per sector and sub-sector for the NWP and South Africa

	South Africa				North West				
Detailed sector	**GVA (R million current prices) in 2011**	**Ranking in GVA in 2011**	**Short-term growth (%; 1 year)**	**Medium-term growth (%; 3 years)**	**GVA (R million current prices) in 2011**	**% share of GVA in 2011**	**Ranking in % share of GVA in 2011**	**Short-term growth (%; 1 year)**	**Medium-term growth (%; 3 years)**
Agriculture, forestry and fishing	63982.06	**17**	-0.40	-0.50	4612.02	7.2	**3**	1.50	0.90
Mining and quarrying	260373.12	**7**	0.20	0.00	66687.84	25.6	**1**	1.40	0.80
Manufacturing	357745.17	**5**	2.40	-1.00	9614.83	2.7	**20**	1.50	0.00
Food, beverages and tobacco	76705.89	**15**	6.30	2.90	2590.43	3.4	**18**	4.90	3.90
Textiles, clothing and leather goods	10602.26	**26**	-12.70	-1.70	182.21	1.7	**26**	-19.60	-1.90
Wood, paper, publishing and printing	30914.21	**21**	1.30	-0.40	409.57	1.3	**27**	-1.90	-0.70
Petroleum products, chemicals, rubber and plastic	86377.47	**13**	0.40	-0.30	1670.1	1.9	**25**	-0.60	1.20
Other non-metal mineral products	15504.44	**24**	11.20	-1.30	1104.84	7.1	**4**	10.00	0.30
Metals, metal products, machinery and equipment	69922.68	**16**	5.10	-3.70	1670.31	2.4	**22**	3.60	-3.60
Electrical machinery and apparatus	8835.01	**27**	-0.50	-0.50	339.3	3.8	**17**	-2.80	0.00
Radio, TV, instruments, watches and clocks	4321.48	**28**	5.70	1.50	90.78	2.1	**24**	3.70	1.70
Transport equipment	26761.11	**23**	2.40	-1.00	12.95	0	**28**	1.50	0.00
Furniture and other manufacturing	27800.61	**22**	0.30	-3.10	605.49	2.2	**23**	-3.30	-3.10
Electricity, gas and water	78529.62	**14**	1.30	0.50	2314.78	2.9	**19**	1.20	1.20
Electricity	63734.62	**18**	2.40	-0.50	1695.69	2.7	**20**	2.50	-0.10
Water	14795	**25**	-2.10	4.10	619.1	4.2	**15**	-1.40	4.20
Construction	120416.36	**12**	0.80	3.10	5314.47	4.4	**12**	-0.70	-0.40
Wholesale and retail trade, catering and accommodation	386418.35	**3**	4.40	2.20	19149.96	5	**8**	3.70	-0.10
Wholesale and retail trade	347138.94	**6**	3.60	1.80	17348.38	5	**8**	3.40	-0.20

Catering and accommodation services	39279.42	**20**	15.70	7.20	1801.58	4.6	**11**	7.80	0.70
Transport, storage and communication	220053.34	**8**	3.30	2.10	12485.17	5.7	**6**	3.00	0.80
Transport and storage	162834.34	**11**	13.70	3.30	9720.42	6	**5**	11.90	1.70
Communication	57219	**19**	-9.10	0.30	2764.75	4.8	**10**	-9.90	-0.80
Finance, insurance, real estate and business services	565206.89	**1**	3.50	2.20	24163.56	4.3	**14**	2.60	1.10
Finance and insurance	198071.79	**9**	4.40	0.00	8642.59	4.4	**12**	3.60	-1.50
Business services	367135.1	**4**	3.10	3.40	15520.98	4.2	**15**	2.00	2.70
Community, social and personal services	183487.45	**10**	2.40	0.50	16655.27	9.1	**2**	2.20	0.30
General government	434210.86	**2**	3.90	3.50	23876.61	5.5	**7**	3.50	3.10

Source: Quantec Easy Data, 2013

4.3.2 Employment and labour remuneration per sector and sub-sector for the NWP and South Africa

Table 4.4 illustrates the total employment and total labour remuneration per sector as well as detailed sector in 2011 for South Africa and the NWP. Table 4.2 also shows the detailed sectors‟ ranking in contribution to employment, medium-term growth in employment and labour remuneration as well as the wage per worker for the detailed sectors. From Table 4.4, it is evident that:

i. The largest employer in the South Africa economy was the wholesale and retail trade, catering and accommodation sector, which employed 2.65 million people.
ii. The wholesale and retail trade sub-sector employed 2.4 million people, highlighting that this sub-sector accounted for 91% of the employment provided by the sector.
iii. Mining and quarrying was the largest employer (251 385 people) in the NWP, contributing 42.6% of national employment in the sector.
iv. Employing a substantially lower number of people (6 857) compared to the mining and quarrying sector (251 385), the other non-metal mineral products sub-sector was the second largest employer in the NWP. The NWP contributed 9.1% of national employment in this sub-sector.
v. The NWP‟s third largest contribution to national employment, 6.7% (2 564 people), was in the electrical machinery and apparatus sub-sector.
vi. The sub-sectors employing the least number of people were the radio, TV, instruments, watches and clocks (545) and water (726).
vii. Other sectors in which the North West‟s share of national employment was high were the general government (6.4%) and community, social and personal service (6.2%).
viii. The highest wage per worker in South Africa was (R46 883) paid in the electricity generation sub-sector.
ix. In the NWP, the highest wage per worker (R35 808 (total labour remuneration divided by the number of people employed per sector) in 2011 was paid in the communication sub-sector.
x. The lowest wage per worker in 2011 was paid in the other non-metal mineral products (R1 834) and the textiles, clothing and leather goods manufacture sub-sector (R2 374).

xi. The most jobs were created in the mining and quarrying sector (medium-term employment growth of 13.7%) in the NWP between 2009 and 2011.

xii. Only the electricity sub-sector and the electricity, water and gas sectors also experienced positive growth in employment of 5.4% and 2.3% respectively in the NWP between 2009 and 2011. The rest of the sectors lost jobs in the medium term, with the most job losses in the agriculture, forestry and fishing sector (-13.7%).

xiii. Wage growth was the highest in the electricity sub-sector (14.9%) and lowest in the furniture and other manufacturing sub-sector (0.6%).

Table 4.4: Employment and labour remuneration per sector and sub-sector for the NWP and South Africa

	South Africa						**North West**						
	Employment			**Labour remuneration**			**Employment**				**Labour remuneration**		
Detailed sector	**Total employment (number) in 2011**	**Ranking in total employment (number) in 2011**	**Medium-term growth (%; 3 years)**	**Total labour remuneration (R million current prices) in 2011**	**Medium-term growth (%; 3 years)**	**Wage per worker (R)**	**Total employment (number) in 2011**	**% Contribution to total employment**	**Ranking in % contribution to employment**	**Medium-term growth (%; 3 years)**	**Total labour remuneration (R million current prices) in 2011**	**Medium-term growth (%; 3 years)**	**Wage per worker (R)**
Agriculture, forestry and fishing	703865	**8**	-9.80	19337.41	5.30	2747.32	34585	4.9	**13**	-13.70	1510.23	8.70	4366.7
Mining and quarrying	594682	**10**	3.60	22028.7	10.80	3704.28	251385	42.3	**1**	8.00	14034.13	12.80	5582.72
Manufacturing	1339486	**7**	-3.90	5656.83	8.00	422.31	60096	4.5	**15**	-4.80	2906.59	6.60	4836.59
Food, beverages and tobacco	241886	**16**	-1.70	1474.31	13.90	609.51	13335	5.5	**11**	-2.40	468.95	12.80	3516.77
Textiles, clothing and leather goods	152394	**17**	-6.50	159.02	3.10	104.35	4651	3.1	**26**	-4.80	110.43	2.50	2374.4
Wood, paper, publishing and printing	133935	**19**	-5.50	336.74	6.50	251.42	3035	2.3	**28**	-7.00	183.29	5.20	6039.05
Petroleum products, chemicals, rubber and plastic	144214	**18**	-3.40	850.25	6.10	589.58	4663	3.2	**23**	-4.90	437.07	5.40	9372.46
Other non-metal mineral products	75374	**23**	-10.10	381.93	7.00	506.72	6857	9.1	**2**	-11.90	125.78	3.90	1834.4
Metals, metal products, machinery and equipment	324206	**13**	-1.60	1156.75	6.60	356.8	13416	4.1	**20**	-2.50	592.44	6.00	4415.99
Electrical machinery and apparatus	38469	**26**	-1.90	315.84	9.60	821.03	2564	6.7	**3**	-1.60	249.25	9.50	9722.28
Radio, TV, instruments, watches and clocks	16777	**27**	0.00	67.03	5.40	399.55	545	3.2	**23**	-0.50	44.79	4.80	8225.26
Transport equipment	102256	**22**	-5.00	691.99	6.30	676.72	5989	5.9	**6**	-5.70	548.53	6.20	9159.14
Furniture and other manufacturing	109975	**20**	-5.60	222.96	0.50	202.73	5042	4.6	**14**	-4.70	146.08	0.60	2896.97
Electricity, gas and water	60085	**24**	2.00	25833.22	13.30	42994.45	2629	4.4	**16**	2.30	742.33	13.10	28231.3
Electricity	47399	**25**	4.20	22222.4	14.60	46883.5	1903	4	**21**	5.40	591.24	14.90	31060.7
Water	12686	**28**	-4.80	3610.81	6.70	28463.43	726	5.7	**10**	-4.20	151.09	6.80	20812.5
Construction	691321	**9**	-2.90	44026.67	8.10	6368.48	34578	5	**12**	-4.00	1943.08	4.50	5619.49
Wholesale and retail trade, catering and accommodation	2655383	**1**	-0.30	154582.32	8.60	5821.47	154020	5.8	**7**	-1.70	7668.34	6.10	4978.79
Wholesale and retail trade	2403943	**2**	-0.30	145163.67	8.60	6038.56	139339	5.8	**7**	-1.80	7236.34	6.40	5193.34
Catering and accommodation services	251440	**15**	0.00	9418.65	8.80	3745.89	14681	5.8	**7**	-0.50	431.99	2.10	2942.48
Transport, storage and communication	554574	**11**	0.70	76349.69	7.50	13767.26	17925	3.2	**23**	-3.60	4326.96	6.50	24139.5
Transport and storage	451396	**12**	1.10	55657.04	8.50	12329.99	15097	3.3	**22**	-3.70	3314.45	7.30	21954
Communication	103179	**21**	-0.70	20692.65	5.10	20055.2	2828	2.7	**27**	-3.10	1012.5	4.10	35808
Finance, insurance, real estate and business services	1973836	**3**	-1.20	208485.69	7.50	10562.47	83893	4.3	**17**	-2.40	9531.43	6.20	11361.4
Finance and insurance	256677	**14**	-0.60	86971.82	11.10	33883.76	10959	4.3	**17**	-1.20	3846.67	9.80	35101.6
Business services	1717159	**6**	-1.20	121513.87	5.30	7076.45	72935	4.2	**19**	-2.60	5684.76	4.00	7794.32
Community, social and personal services	1837581	**5**	-1.20	98436.02	8.00	5356.83	113187	6.2	**5**	-3.50	8657.61	7.80	7648.96
General government	1904885	**4**	3.80	385253.34	14.30	20224.5	121431	6.4	**4**	-0.30	21184.51	13.90	17445.7

Source: Quantec Easy Data, 2013

4.3.3 Profit per sector and sub-sector for the NWP and South Africa

The shares of profit accruing to the NWP and SA per detailed sector and the respective growth rates are shown in Table 4.5. The main findings are:

i. In 2011, the highest profit earning sector in South Africa was finance, insurance, real estate and business services. Profits in this sector amounted to R335.6 trillion with 11.9% medium-term growth in profits (see Table 4.5).
ii. This was followed by the business services sub-sector, which earned R228.3 trillion in profits. The NWP contributed 4% (R 9.1 billion) of the profits in the business services sector with medium-term growth in profits of 11.9%.
iii. For both the national and the provincial economies, the least profits were made in the textiles, clothing and leather good sub-sector, which amounted to R21.19 million and R14.43 million, respectively.
iv. For the NWP, the mining and quarrying sector accrued R37.9 billion in profits, making it the highest profit earning sector with 20.9% short-term growth and 8.5% medium-term growth.
v. The mining and quarrying sector also made the biggest contribution (85.9%) to national profits for the NWP, implying that most of the profit in the mining sector accrued to firms in the NWP.
vi. Firms in the NWP also earned significant shares of profits in the textiles, clothing and leather goods sub-sector (68.1%), manufacturing sector (45.9%) and food, beverages and tobacco sub-sector (36.7%).
vii. Short-term growth in profits was greatest in the construction sector (22.9%) for both the NWP and national economy (24.8%) in 2011.
viii. Mining and quarrying was the second most dynamic sector in the short term in the NWP, with a growth rate of 20.9% and this was marginally higher that the national growth rate of 19% in the same sector.
ix. In the medium term, profit growth prospects were greatest in the community, social and personal services (27.5%), electricity sub-sector (26.2%) and construction (22.9%) for the NWP.

x. The catering and accommodation services sub-sector (28.9%) and community, social and personal services (27.9%) were the most dynamic in the medium term for the national economy.

xi. Profits declined in the three-year period between 2009 and 2011 in the electrical machinery and apparatus (-13.6%) and the textiles, clothing and leather goods (-12.5%) sub-sectors in the NWP.

xii. The national economy"s profits declined in the electrical machinery and apparatus sub-sector (-14.1%) and the metals, metal products, machinery and equipment (-10.5%) sub-sector.

The following section analyses the spatial contributions of the sector aggregates in the NWP economy. This will localise the production from the different sector aggregates to the district and local municipalities in the NWP.

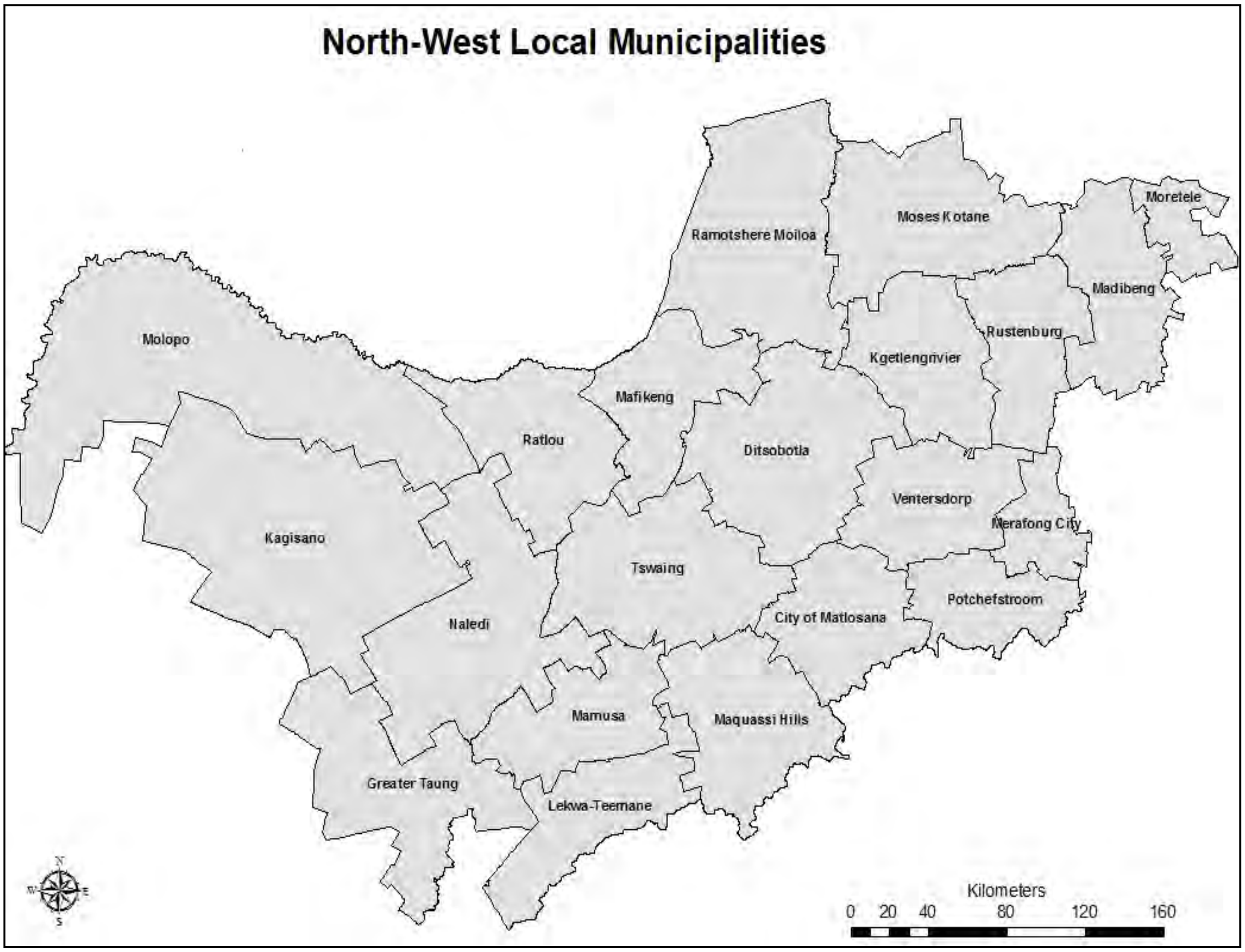
Table 4.5: Profit per sector and sub-sector for the NWP and South Africa

	South Africa				North West				
Detailed sector	**Gross operating surplus (R million current prices) in 2011**	**Ranking of share of profits**	**Short-term growth (%; 1 year)**	**Medium-term growth (%; 3 years)**	**Gross operating surplus (R million current prices) in 2011**	**% share of GOS**	**Ranking in % share of GOS**	**Short-term growth (%; 1 year)**	**Medium-term growth (%; 3 years)**
Agriculture, forestry and fishing	44801.27	**11**	11.90	0.40	3127.69	7	**8**	14.30	1.30
Mining and quarrying	44166.25	**12**	19.00	9.60	37941.71	85.9	**1**	20.90	8.50
Manufacturing	3984.21	**24**	3.90	-3.40	1829.05	45.9	**3**	5.00	-5.80
Food, beverages and tobacco	1117.27	**27**	3.10	-0.40	409.54	36.7	**4**	2.90	-1.00
Textiles, clothing and leather goods	21.19	**28**	3.10	-9.90	14.43	68.1	**2**	13.70	-12.50
Wood, paper, publishing and printing	8127.31	**22**	4.80	-3.50	107.38	1.3	**28**	2.20	-3.40
Petroleum products, chemicals, rubber and plastic	39754.89	**15**	-1.30	-2.40	740.49	1.9	**27**	-2.50	-0.60
Other non-metal mineral products	7279.55	**23**	16.20	0.60	557.41	7.7	**7**	13.70	2.40
Metals, metal products, machinery and equipment	23790.79	**18**	13.60	-10.50	583.41	2.5	**24**	11.70	-9.90
Electrical machinery and apparatus	1534.88	**26**	-11.30	-14.10	58.95	3.8	**21**	-13.30	-13.60
Radio, TV, instruments, watches and clocks	1789.59	**25**	9.90	0.10	35.76	2	**25**	7.60	0.00
Transport equipment	11549.3	**20**	2.70	-2.40	449.73	3.9	**20**	0.10	-0.60
Furniture and other manufacturing	16596.05	**19**	1.30	-2.60	330.28	2	**25**	-2.20	-2.70
Electricity, gas and water	53415.46	**10**	9.00	22.50	1596.84	3	**22**	9.40	21.50
Electricity	41886.51	**14**	8.90	25.80	1114.41	2.7	**23**	9.00	26.20
Water	11528.95	**21**	9.00	24.10	482.43	4.2	**17**	9.20	23.80
Construction	75389.34	**9**	24.80	27.10	3327.24	4.4	**15**	22.90	22.90
Wholesale and retail trade, catering and accommodation	225496.7	**3**	16.60	15.50	11168.63	5	**11**	15.30	12.70
Wholesale and retail trade	196347.7	**4**	16.90	14.00	9831.69	5	**11**	16.60	11.70
Catering and accommodation services	29148.95	**17**	14.40	28.90	1336.94	4.6	**14**	6.60	21.10
Transport, storage and communication	140949.2	**5**	8.80	3.60	12485.17	8.9	**6**	3.00	0.80
Transport and storage	105044.7	**7**	10.20	6.30	6274.58	6	**9**	8.20	4.40
Communication	35904.43	**16**	4.90	-2.80	1719.68	4.8	**13**	3.80	-4.10
Finance, insurance, real estate and business services	335619.4	**1**	8.60	9.50	13831.63	4.1	**18**	7.70	8.60
Finance and insurance	107316.3	**6**	14.60	5.10	4635.78	4.3	**16**	13.80	3.20
Business services	228303.1	**2**	6.00	11.90	9195.85	4	**19**	4.80	11.90
Community, social and personal services	82927.35	**8**	14.90	27.90	7784	9.4	**5**	14.50	27.50
General government	44056.49	**13**	5.20	5.70	2422.6	5.5	**10**	4.90	5.30

Source: Quantec Easy Data, 2013

4.4 Broad-sector-based spatial analysis of the NWP economy

Figure 4.4: North West Province local municipalities



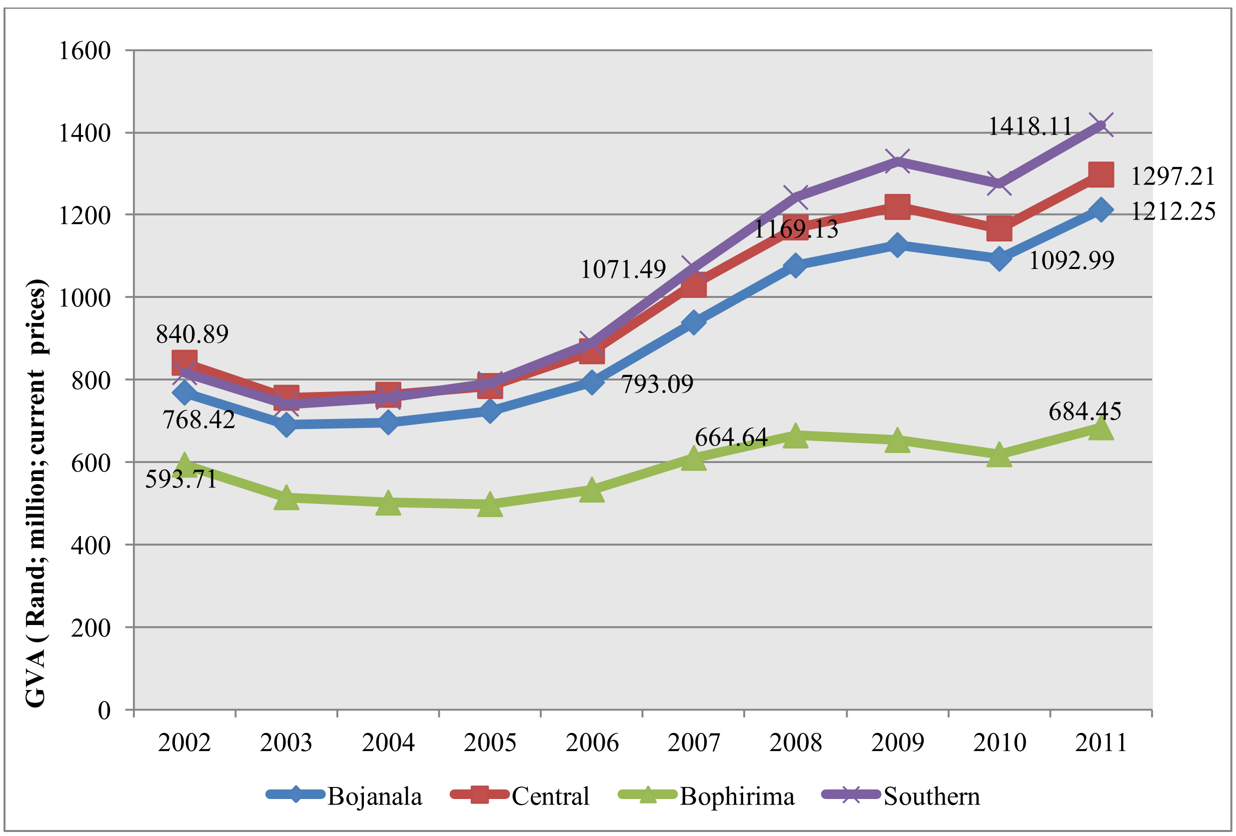
Micro-regional analysis will be conducted in this section to determine the geographic spread of economic activity across the province. The term „spatial economy" refers to the contributions of the various local and district municipalities to overall economic output and growth (Naude, 2006). This implies that, for example, total output and output growth of the province for each sector are sub-divided between the district and local municipalities of origin. Figure 4.4 illustrates the local municipalities of the NWP. Furthermore, the spatial analysis in this section will include the analysis of the spatial distribution of employment and profit in the ten SIC sectors in the NWP. As indicated in section 4.1, this is an essential first step in the identification of industrial clusters in the NWP. Data on output, employment and profit per district municipality between 2002 and 2011 is depicted in line graphs throughout this section. Data points at which significant shifts in the trend occur are labelled. The subsequent section presents the spatial trends in the agriculture, forestry and fishing sector.

4.4.1 Spatial contributions to output, employment and profit in agriculture, forestry and fishing

4.4.1.1 Spatial trends in agriculture, forestry and fishing output

Figure 4.5 depicts agriculture, forestry and fishing output per district municipality between 2002 and 2011. The Southern District Municipality produced the most agriculture, forestry and fishing output from 2005 onwards.

Figure 4.5: Agriculture, forestry and fishing output per district municipality between 2002 and 2011



Source: Quantec Easy Data, 2013

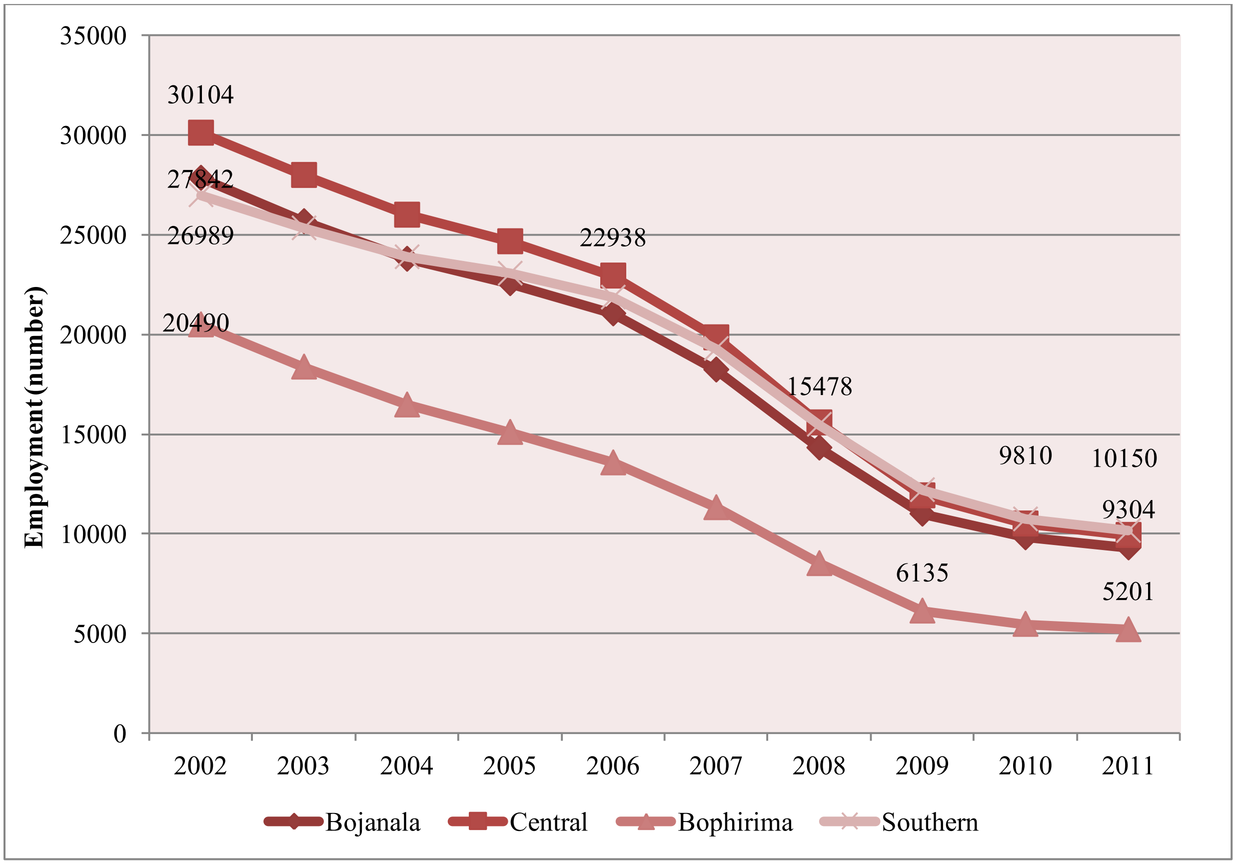
The Bophirima District Municipality contributed the least to agriculture, forestry and fishing throughout the time period with output levels that were less than half (R684.5 billion) of all the other three district municipalities outputs in 2011. The Southern District Municipality produced the highest output (R1.4 billion) in 2011, with the Central (R1.29 billion) and Bojanala (R1.21 billion) District Municipalities‟ outputs ranking second and third respectively.

At the local municipal level, the most significant contributors to agriculture, forestry and fishing output in 2011 were the local municipalities of Madibeng (R530.5 million) and Ditsobotla (R525.1 million), accounting for 11.5% and 11.39% of output, respectively. The Greater Taung local municipality contributed the least to agriculture forestry and fishing output (see Table 4.6). These trends can be attributed to the climatic characteristics of the NWP. The Greater Taung local municipality is situated in the western region of the NWP. This region is dry and therefore cattle and game ranching is more common (North West Business, 2013). The central, eastern and north-eastern regions of the NWP receive good rainfall and therefore are the main agricultural regions. The local municipality of Madibeng is situated in the north-east, while the Ditsobotla local municipality is situated in the central region of the NWP. These regions are suitable for the cultivation of a variety of crops, including wheat and maize (North West Business, 2013). As a result, these two local municipalities‟ shares of agriculture, forestry and fishing output rank first and second, respectively.

4.4.1.2 Spatial trends in agriculture, forestry and fishing employment

As illustrated in Figure 4.6 above, employment declined substantially in all district municipalities between 2002 and 2011. Employment in agriculture, forestry and fishing was highest in 2002 in all district municipalities. Bojanala was the leading employer in the sector in 2002 employing 30 104 people. The Bophirima District Municipality provided the least number of jobs in the sector throughout the time period (20 490 people in 2002 and 5 201 people in 2011). In 2011, the Southern District Municipality was the largest employer in the agriculture, forestry and fishing sector, employing 10 150 people. At the local municipal level, as shown in Table 4.6, employment was concentrated in the local municipality of Madibeng, which accounted for 12.55% of employment in this sector in the NWP. Other local municipalities that contributed significantly to employment in the sector in the NWP were Ditsobotla (11.46%) and Potchefstroom (9.81%). The local municipalities with the smallest contributions to agriculture, forestry and fishing employment in the NWP in 2011 were Moses Kotane (0.96%) and Greater Taung (0.98%).

Figure 4.6: Agriculture, forestry and fishing employment per district municipality in the NWP between 2002 and 2011

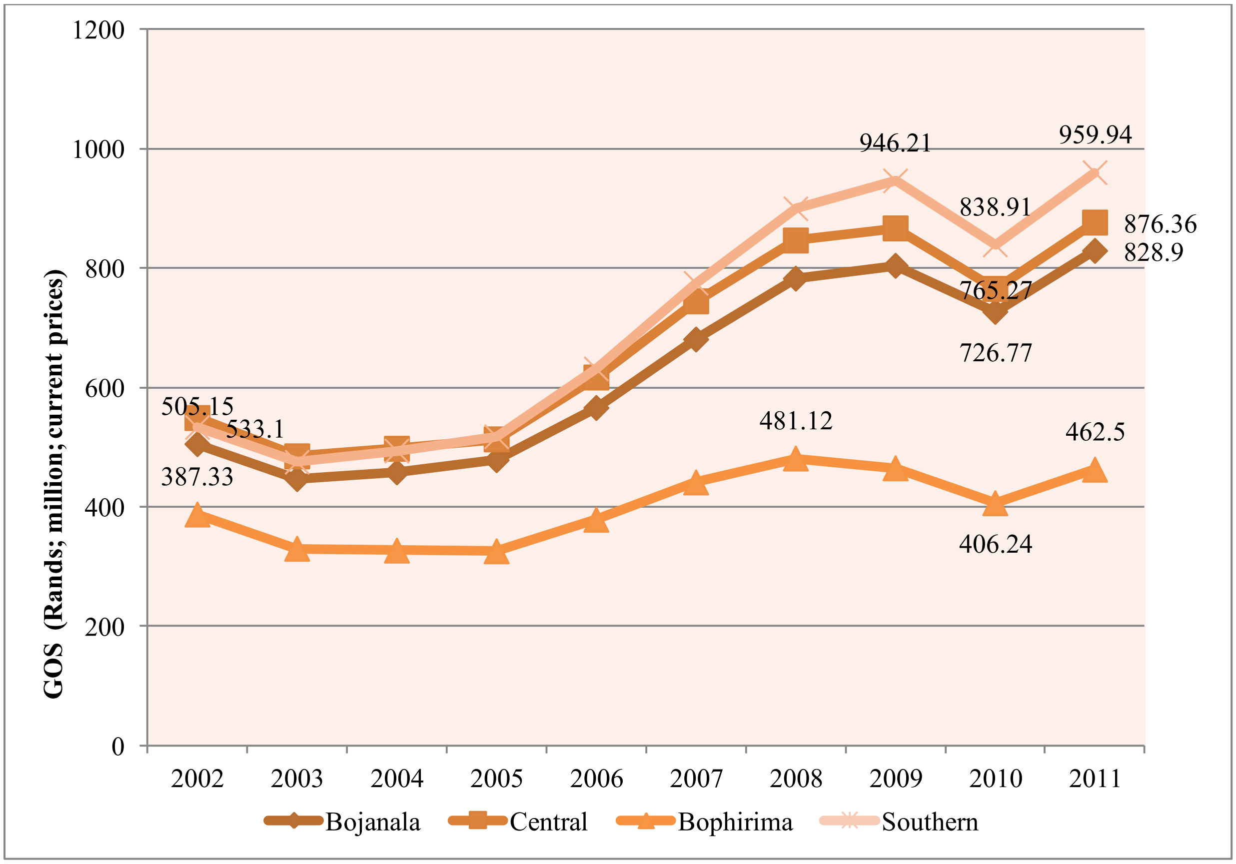


Source: Quantec Easy Data, 2013

4.4.1.3 Spatial trends in agriculture, forestry and fishing profit

Profits increased overall in all district municipalities between 2002 and 2011, although some fluctuations were experienced. Profits in the sector ranked as follows; the Southern District Municipality was the highest earner, followed by the Central, then Bojanala and lastly Bophirima District Municipalities (see Figure 4.7 and Table 4.6). Profits in agriculture forestry and fishing were concentrated in the local municipality of Madibeng (11.67%), the Ditsobotla local municipality (11.33%) and the Potchefstroom local municipality (9.2%). The following local municipalities accounted for less than 1% of manufacturing GOS; Moses Kotane (0.85%) and Greater Taung (0.8%; see Table 4.6). Table 4.6 shows the contributions to agriculture, forestry and fishing output, employment and profits per municipality (district and local) in the NWP.

Figure 4.7: Agriculture, forestry and fishing profit per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

Table 4.6: Spatial contributions to output, employment and profit in agriculture, forestry and fishing in 2011

District municipality	**Local municipality**	**Output**			**Employment**			**Profit**		
		GVA (Rand; million; current prices)	**% share**	**Rank**	**Employment (number)**	**% share**	**Rank**	**GOS (Rand; million; current prices)**	**% share**	**Rank**

Bojanala	Moretele	132.62	2.88	14	1103	3.19	13	91.99	2.94	14
	Madibeng	530.52	11.5	1	4341	12.55	1	365.04	11.67	1
	Rustenburg	362.32	7.86	5	2507	7.25	5	245.37	7.85	5
	Kgetlengrivier	147.8	3.2	12	1021	2.95	14	99.76	3.19	12
	Moses Kotane	38.99	0.85	20	333	0.96	21	26.73	0.85	20
BOJANALA TOTAL		1212.25			9304			828.9		
Central	Ratlou	109.85	2.38	15	915	2.64	15	74.15	2.37	15
	Tswaing	332.56	7.21	6	2291	6.62	6	224.47	7.18	6
	Mafikeng	261.91	5.68	7	2130	6.16	7	176.78	5.65	7
	Ditsobotla	525.14	11.39	2	3965	11.46	2	354.45	11.33	2
	Ramotshere Moiloa	67.75	1.47	19	630	1.82	19	46.52	1.49	19
CENTRAL TOTAL		1297.21			9930			876.36		
Bophirima	Kagisano	105.83	2.29	16	811	2.35	17	71.43	2.28	16
	Naledi	98.45	2.13	17	833	2.41	16	66.45	2.12	17
	Mamusa	213.68	4.63	9	1417	4.1	10	144.23	4.61	9
	Greater Taung	36.36	0.79	21	339	0.98	20	25.05	0.8	21
	Molopo	90.81	1.97	18	685	1.98	18	61.29	1.96	18
	Lekwa-Teemane	139.32	3.02	13	1116	3.23	12	94.04	3.01	13
BOPHIRIMA TOTAL		684.45			5201			462.5		
Southern	Ventersdorp	203.77	4.42	10	1504	4.35	9	137.54	4.4	10
	Potchefstroom	427.9	9.28	**3**	3393	9.81	3	288.82	9.23	3
	City of Matlosana	419.77	9.1	4	2544	7.36	4	283.33	9.06	4
	Maquassi Hills	217.13	4.71	8	1583	4.58	8	146.55	4.69	8
	Merafong City	149.55	3.24	11	1126	3.26	11	103.7	3.32	11
SOUTHERN TOTAL		1418.11			10150			959.94		

Source: Quantec Easy Data, 2013

4.4.1.4 Spatial growth trends in agriculture, forestry and fishing

Table 4.7 shows the average annual growth in agriculture, forestry and fishing output, employment and profit between 2002 and 2011. At the district municipal level, the highest growth rate (5.76%) in output in the sector was experienced in the Southern District Municipality. The Bojanala District Municipality was second with 4.6%, while the Bophirima District Municipality experienced the least growth (1.16%) in agriculture, forestry and fishing output relative to other district municipalities. At the local municipal level, the Moretele and Potchefstroom local municipalities recorded the highest growth rates in output (19.6% and 12.4, respectively). Output in the sector declined in the period in the following local municipalities Ramotshere Moiloa (-5.7%), Kagisano (-3.5%), Naledi (-3.4%) and Greater Taung (-3.1%). Concurrent with the employment (number) trends depicted in Figure 4.3, all four district municipalities experienced negative average annual growth in the sector between 2002 and 2011. Similarly, at the local municipality level, with the exception of Moretele (1.29%), all the local municipalities experienced negative annual growth in employment between 2002 and 2011 (see Table 4.4). Profitability in agriculture, forestry and fishing was greatest in the Southern District Municipality (11.2%). Profits in the sector increased the most in the Moretele local municipality, at an average annual rate of 25.56%. In contrast, profit in agriculture, forestry and fishing in the Ramotshere Moiloa local municipality shrank (-1.06%) in the ten-year period.

Table 4.7: Average annual growth in agriculture, forestry and fishing output, employment and profit between 2002 and 2011

District municipality	**Local municipality**	**Output growth**	**Employment growth**	**Profit growth**
Bojanala	Moretele	19.60%	1.29%	25.56%
	Madibeng	2.90%	-12.31%	7.95%
	Rustenburg	7.40%	-8.89%	12.93%
	Kgetlengrivier	0.50%	-13.61%	5.64%
	Moses Kotane	2.00%	-13.06%	7.09%
BOJANALA TOTAL		4.59%	-10.90%	9.90%
Central	Ratlou	8.90%	-7.36%	14.53%
	Tswaing	2.00%	-12.58%	7.24%
	Mafikeng	9.30%	-6.99%	14.93%

	Ditsobotla	6.60%	-9.33%	12.07%
	Ramotshere Moiloa	-5.70%	-18.66%	-1.06%
CENTRAL TOTAL		4.52%	-10.80%	9.90%
Bophirima	Kagisano	-3.50%	-16.50%	1.38%
	Naledi	-3.40%	-16.45%	1.57%
	Mamusa	5.80%	-9.59%	11.31%
	Greater Taung	-3.10%	-16.50%	1.67%
	Molopo	2.10%	-12.70%	7.34%
	Lekwa-Teemane	7.10%	-8.96%	12.67%
BOPHIRIMA TOTAL		1.16%	-11.60%	6.30%
Southern	Ventersdorp	2.30%	-12.68%	7.51%
	Potchefstroom	12.40%	-4.41%	18.23%
	City of Matlosana	5.90%	-9.76%	11.38%
	Maquassi Hills	0.80%	-13.17%	6.00%
	Merafong City	7.10%	-9.46%	12.31%
SOUTHERN TOTAL		5.76%	-9.70%	11.20%

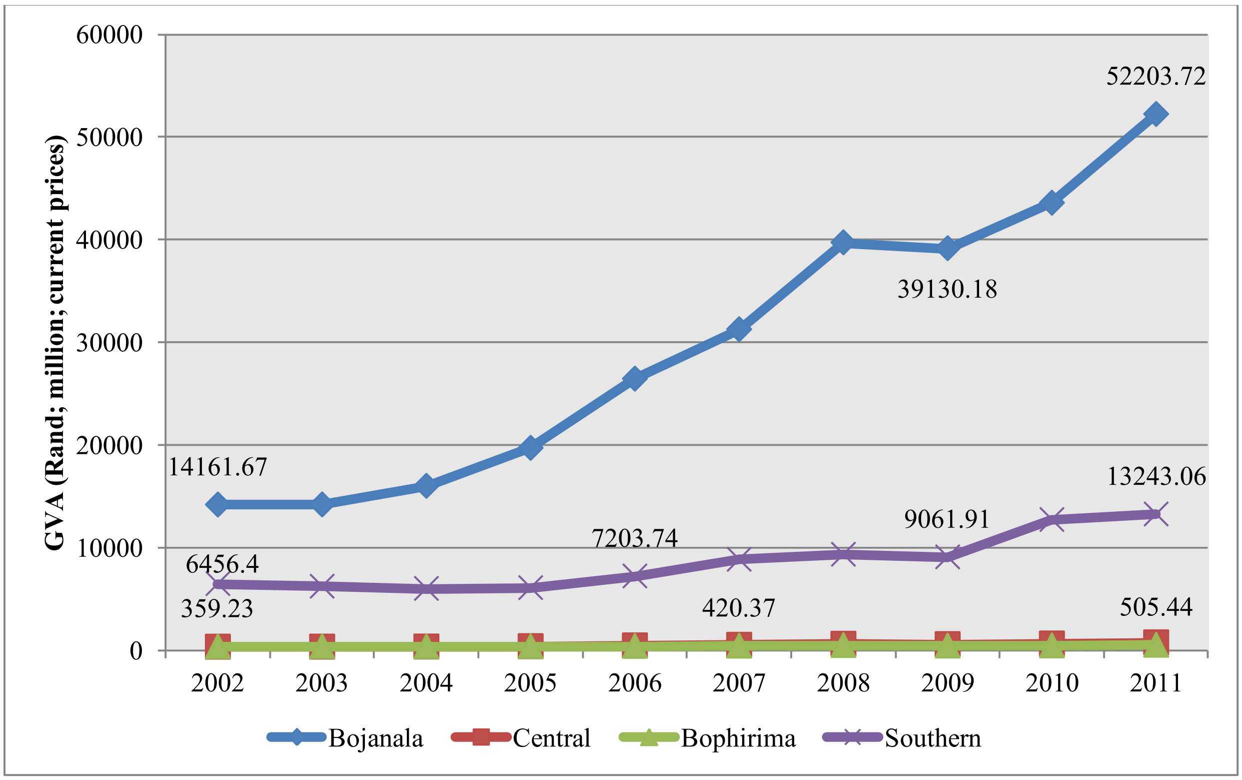
Source: Quantec Easy Data, 2013

4.4.2 Spatial contributions to output, employment and profit in mining and quarrying

4.4.2.1 Spatial trends in mining and quarrying output

Figure 4.8 illustrates mining and quarrying output of each district municipality in the NWP between 2002 and 2011. Mining and quarrying output was highly concentrated in the Bojanala District Municipality, which produced more than double the output of all the other district municipalities throughout the time period. The Southern District Municipality ranked second as the leading producer in the mining and quarrying sector. The Central and Bophirima District Municipalities alternated in contributing the least amount of mining and quarrying output in the time period 2002 to 2011. In 2011, the Bojanala District Municipality produced R52.2 billion of the R66.7 billion worth of mining and quarrying output produced in the NWP (see Table 4.3 and Figure 4.8). On a local municipality level, mining and quarrying output was highly concentrated in Rustenburg (52.68%; see Table 4.8). This is attributed to the fact that the NWP lies directly over the Rustenburg layered suite (RLS), a mineral ore deposit belt, which contains the world"s largest mineral deposits of chrome, gold, vanadium, manganese and platinum group elements.(It also spans across parts of Limpopo, Gauteng and Mpumalanga) (North West Business, 2013; Bafokeng Platinum, 2012). Other local municipalities making relatively high contributions to mining and quarrying output were Madibeng (14%), Merofong (10.7.3%) and Moses Kotane (10.52%). The NWP"s mining sector produces 70% of South Africa and the World"s platinum, and this is mostly from mines in the Rustenburg region (North West Provincial Government, 2013). In addition, the Rustenburg region also produces a third of the NWP"s gold output (North West Provincial Government, 2013). The Molopo, Naledi and Ventersdorp local municipalities made the least contributions to mining and quarrying output in the NWP (see Table 4.8).

Figure 4.8: Mining and quarrying output per district municipality between 2002 and 2011



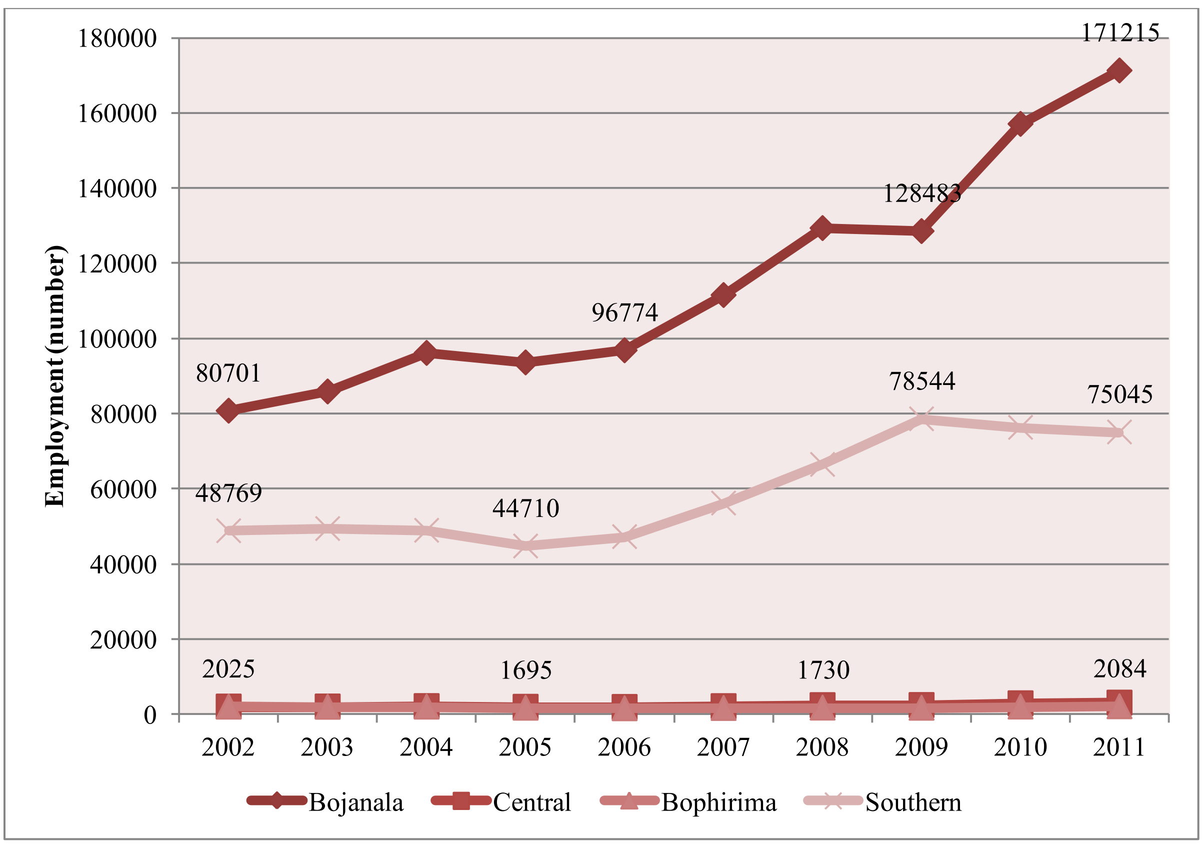
Source: Quantec Easy Data, 2013

4.4.2.2 Spatial trends in mining and quarrying employment

Following the trends in output, employment in the mining and quarrying sector was highly concentrated in the Bojanala District Municipality throughout the time period as shown in Figure 4.9. Employment in mining and quarrying in the Bojanala (171 215) and Southern (75 045)

District Municipalities amounted to 246 260 jobs in 2011. The NWP"s employment in the sector contributed 42.3% to national employment (see Table 4.4; Quantec, 2012). It was highly concentrated in the Rustenburg local municipality (45.57%). Other main centres of mining and quarrying employment in NWP in 2011 were Merofong City (16.47%), Madibeng (12.14%), City of Matlosana (11.52%) and Moses Kotane (9.05%) (see Table 4.8). These employment patterns are attributed to the country"s major ferrochrome operations located in Kroondal (Xstrata Alloys), Rustenburg (Samancor Chrome Mines) and Madibeng (Hernic Ferrochrome) (North West Business, 2013). These operations contribute substantially to employment in the NWP. In the gold mining sub-sector, four major companies operate in Carletonville: AngloGold Ashanti, Gold Fields, Harmony and DRD. Gold Fields" Driefontein mine alone employed 15 000 employees in 2010 (North West Business, 2013).

Figure 4.9: Mining and quarrying employment per district municipality in the NWP between 2002 and 2011

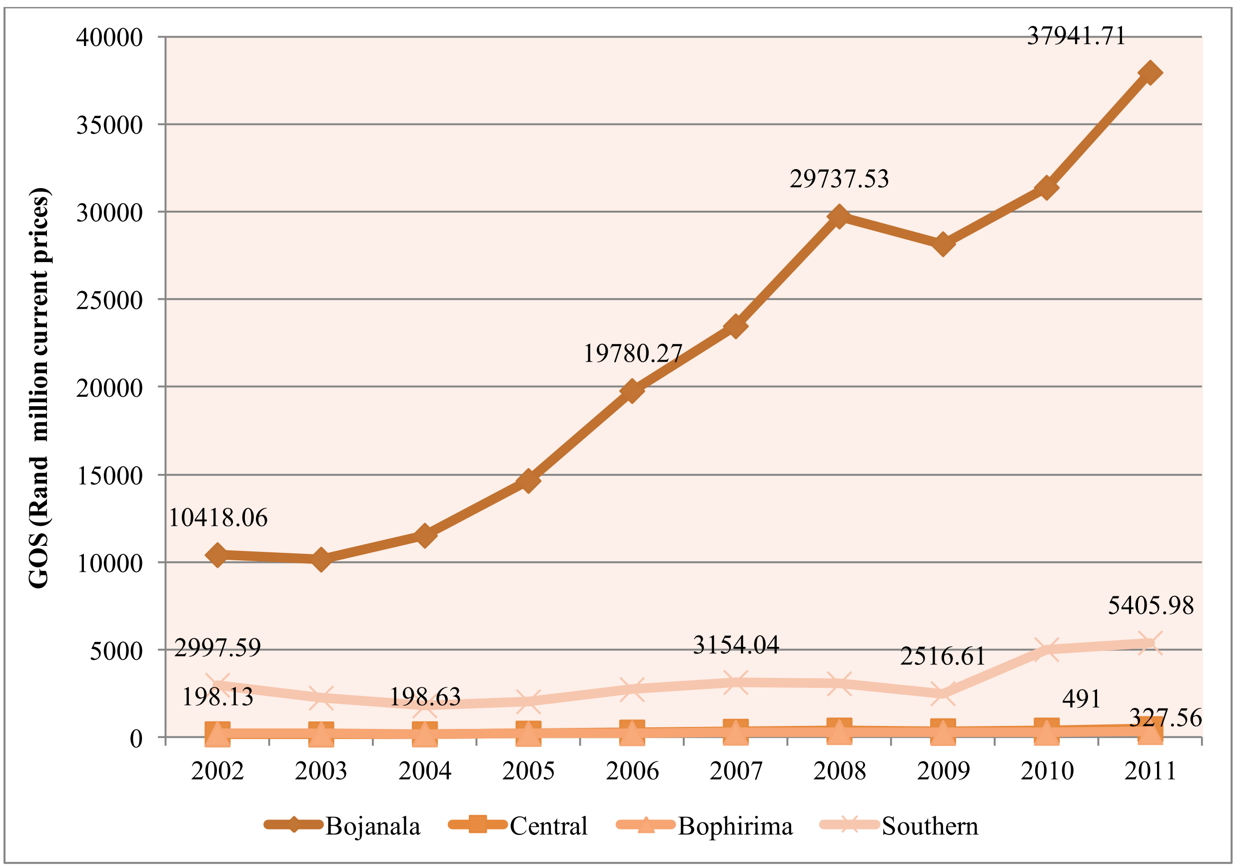


Source: Quantec Easy Data, 2013

4.4.2.3 Spatial trends in mining and quarrying profit

The NWP contributed 85.9% of profits in the sector to the national economy (see Table 4.5). The Bojanala District Municipality accrued R37.9 billion of the 2011 total profit in the NWP in mining and quarrying (see Figure 4.10). Five local municipalities, namely Rustenburg (57.94%), Madibeng (15.36%), Moses Kotane (11.56%), Merofong City (6.31%) and City of Matlosana (4.67%) accrued 95.85% of mining and quarrying profits in 2011 (see Table 4.8). All other local municipalities accrued profit shares of less than 1% in the mining and quarrying sector in the NWP in 2011.

Figure 4.10: Mining and quarrying profit per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

Table 4.8: Spatial contributions to output, employment and profit in mining and quarrying 2011

District municipality	Local municipality	Output			Employment			Profit		
		GVA (Rand; million; current prices)	% share	Rank	Employment (number)	% share	Rank	GOS (Rand; million; current prices)	% share	Rank
Bojanala	Moretele	89.11	0.13	16	348	0.14	16	63.11	0.14	15
	Madibeng	9337.26	14.00	2	30519	12.14	3	6782.72	15.36	2
	Rustenburg	35131.32	52.68	1	114557	45.57	1	25591.73	57.94	1
	Kgetlengrivier	633.46	0.95	7	3042	1.21	7	396.45	0.90	6
	Moses Kotane	7012.57	10.52	4	22749	9.05	5	5107.70	11.56	3
BOJANALA TOTAL		52203.72			17215			37941.71		
Central	Ratlou	68.75	0.10	17	281	0.11	17	45.70	0.10	17
	Tswaing	35.60	0.05	19	177	0.07	19	21.58	0.05	19
	Mafikeng	375.40	0.56	8	1582	0.63	8	253.89	0.57	8
	Ditsobotla	101.93	0.15	15	460	0.18	13	61.90	0.14	16
	Ramotshere Moiloa	153.94	0.23	11	542	0.22	12	107.94	0.24	11
CENTRAL TOTAL		735.61			3041			491.00		
Bophirima	Kagisano	157.25	0.24	10	432	0.17	14	112.94	0.26	10
	Naledi	11.16	0.02	20	57	0.02	20	6.04	0.01	20
	Mamusa	117.49	0.18	12	612	0.24	10	69.40	0.16	13
	Greater Taung	104.98	0.16	14	389	0.15	15	70.51	0.16	12
	Molopo	2.41	0.00	21	11	0.00	21	1.32	0.00	21
	Lekwa-Teemane	112.15	0.17	13	582	0.23	11	67.36	0.15	14
BOPHIRIMA TOTAL		505.44			2084			327.56		
Southern	Ventersdorp	44.63	0.07	18	230	0.09	18	26.39	0.06	18
	Potchefstroom	261.67	0.39	9	1160	0.46	9	146.67	0.33	9
	City of Matlosana	5144.26	7.71	5	28948	11.52	4	2064.58	4.67	5
	Maquassi Hills	635.15	0.95	6	3305	1.31	6	380.00	0.86	7
	Merafong City	7157.35	10.73	3	41401	16.47	2	2788.32	6.31	4
SOUTHERN TOTAL		13243.06			75045			5405.98		

Source: Quantec Easy Data, 2013

4.4.2.4 Spatial growth trends in mining and quarrying

The average annual output growth between 2002 and 2011 in mining and quarrying was negative for three district municipalities, namely Central (-20.7%), Bophirima (-7.05%) and Southern (-4.28%; see Table 4.9). Bojanala‟s output increased at an average annual rate of 1.94% in the ten-year period. Significant growth in output in the mining and quarrying sector in the NWP was also experienced in the Moretele (4.8%) and Kgetlengrivier (6.4%) local municipalities. With the exception of Bophirima (-1.2%), employment in mining and quarrying increased at the district municipal level in the NWP between 2002 and 2011. Employment declined in the following local municipalities; Greater Taung (-6.33%), Tswaing (-2.68%) and Ratlou (-0.38%). Significant growth in profits was experienced in the mining and quarrying sector in the NWP (with the exception of the Greater Taung local municipality). The Southern District Municipality‟s growth in profit (20.28%) outpaced all other district municipalities owing to the high growth rates in its local municipalities, i.e. Potchefstroom 29.34%, City of Matlosana 21.76%; and Merofong city 21.37%. The Potchefstroom local municipality recorded the highest growth rate in output of 9.8%, employment 17.85% and profit 29.34%.

Table: 4.9: Average annual growth in mining and quarrying output, employment and profit between 2002 and 2011

District municipality	**Local municipality**	**Output growth**	**Employment growth**	**Profit growth**
Bojanala	Moretele	4.79%	11.89%	19.06%
	Madibeng	3.76%	10.69%	17.32%
	Rustenburg	1.27%	8.23%	14.49%
	Kgetlengrivier	6.35%	15.24%	20.28%
	Moses Kotane	2.97%	10.10%	16.44%
BOJANALA TOTAL		1.94%	9.00%	15.25%
Central	Ratlou	-5.86%	-0.38%	8.80%
	Tswaing	-9.03%	-2.68%	4.43%
	Mafikeng	4.17%	11.36%	18.62%
	Ditsobotla	-4.94%	2.86%	7.18%
	Ramotshere Moiloa	4.79%	1.25%	7.51%
CENTRAL TOTAL		-2.07%	4.90%	11.57%

Bophirima	Kagisano	-1.16%	4.76%	12.20%
	Naledi	-2.61%	4.17%	14.71%
	Mamusa	-4.82%	2.69%	7.70%
	Greater Taung	-14.09%	-6.33%	-3.27%
	Molopo	-2.20%	3.38%	14.44%
	Lekwa-Teemane	-4.14%	3.87%	7.59%
BOPHIRIMA TOTAL		-7.05%	-1.20%	4.88%
Southern	Ventersdorp	-1.79%	5.89%	11.35%
	Potchefstroom	9.77%	17.85%	29.34%
	City of Matlosana	-4.00%	4.84%	21.76%
	Maquassi Hills	3.13%	11.76%	16.12%
	Merafong City	-5.30%	3.69%	21.37%
SOUTHERN TOTAL		-4.28%	4.50%	20.28%

Source: Quantec Easy Data, 2013

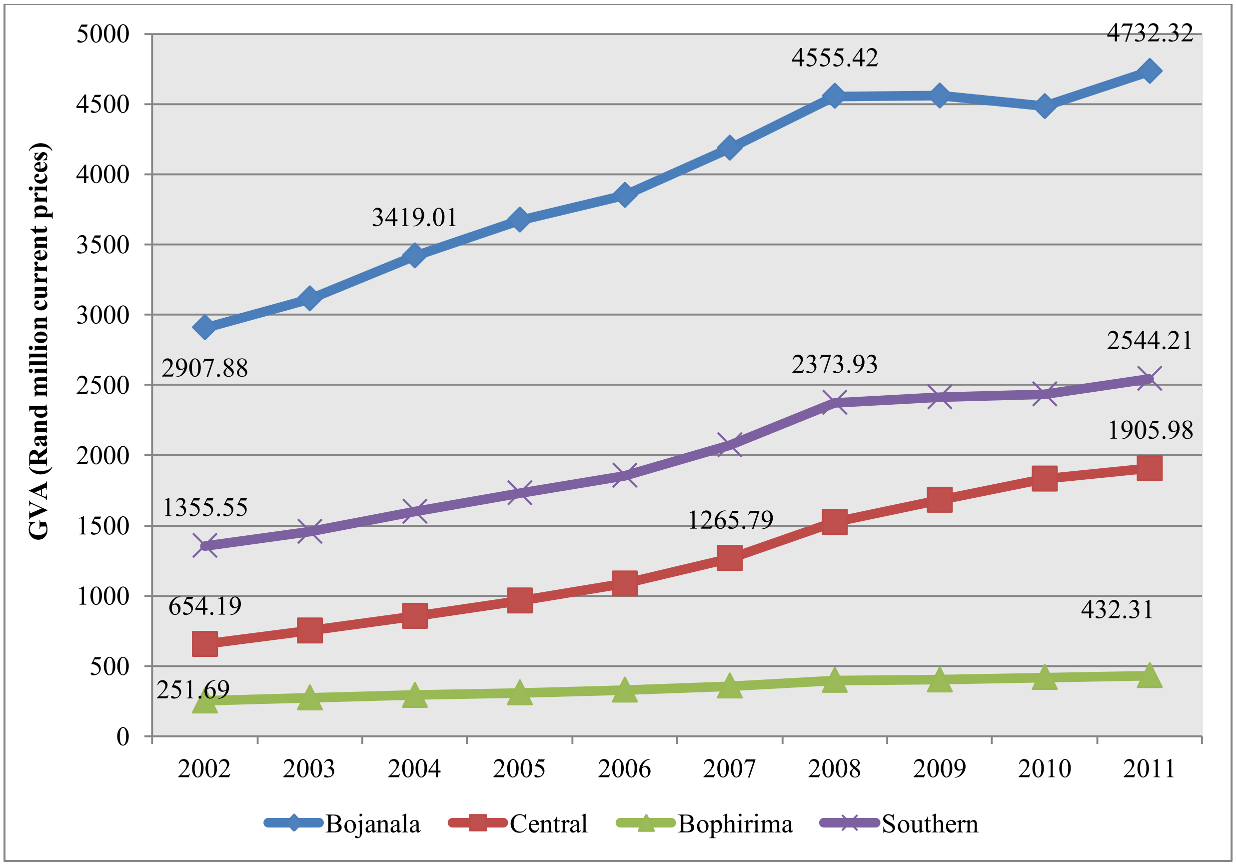
4.4.3 Spatial contributions to output, employment and profit in manufacturing

4.4.3.1 Spatial trends in manufacturing output

Figure 4.11 below shows the manufacturing output of each district municipality in the NWP. Manufacturing output increased from R5.169 billion in 2002 to R9.615 billion in 2011. The Bojanala District Municipality was the leading manufacturing producer throughout the period. In 2011, 49.2% (R4.72billion) of manufacturing output in the NWP originated from the Bojanala District Municipality. Bophirima contributed the least, less than 5%, to manufacturing output throughout the time period. The most significant contributor to manufacturing output in 2011 was the local municipality of Madibeng (see Table 4.10). It contributed 23.91% to manufacturing output, thereby making it the most important centre of manufacturing in the NWP. This is because major companies such as Bosch and Bridgestone are located in Madibeng, where they serve as an anchor to the automotive-supply sector, thereby contributing significantly to manufacturing output in the NWP (North West Business, 2013). Other less significant centres of manufacturing relative to the local municipality of Madibeng were the Rustenburg and City of

Matlosana local municipalities, which contributed 12.37 % and 11.94% respectively to total manufacturing output.

Figure 4.11: Manufacturing output per district municipality between 2002 and 2011



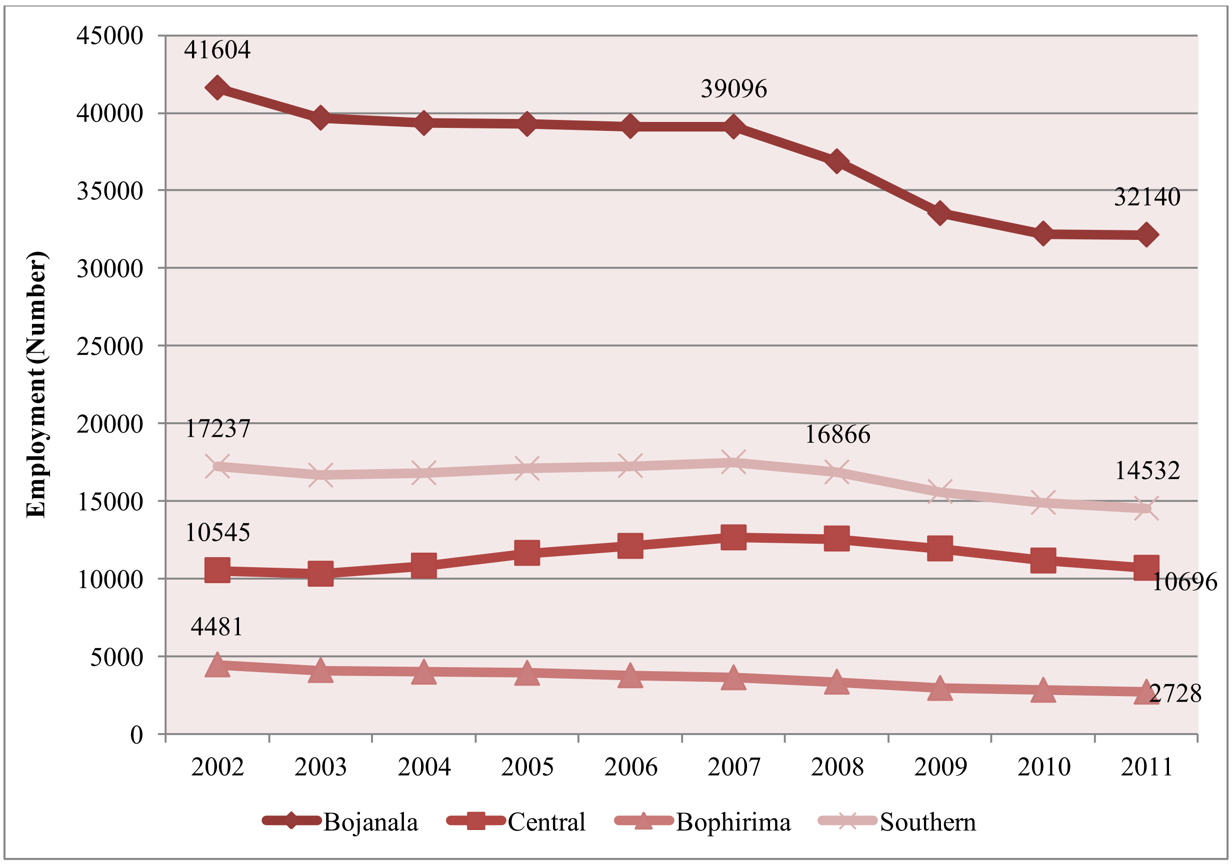
Source: Quantec Easy Data, 2013

4.4.3.2 Spatial trends in manufacturing employment

Manufacturing employment per district municipality in the NWP is shown in Figure 4.12. The NWP contributed only 4.5% to manufacturing employment in South Africa in 2011 (see Table 4.4; Quantec, 2012). Employment declined in all district municipalities in the period 2002 to 2011. In 2011, manufacturing employment was concentrated in the Bojanala (32 140 people; 53%) and the Southern (14 532 people; 24%) District Municipalities. These district municipalities accounted for 77% of manufacturing employment in the province. At the local municipal level, as shown in Table 4.8, employment was concentrated in the local municipality of Madibeng, which accounted for 26.67% of manufacturing employment in the province.

Madibeng houses a Bridgestone tyre plant that has seen an increase in employment in recent years after a R700 billion injection to upgrade the plant (North West Business, 2013). Other significant contributors to manufacturing employment were the City of Matlosana (12.01%) and Rustenburg local municipalities (11%). Steel manufacturing is the main manufacturing activity in the City of Matlosana, although large concentrations of cable suppliers and engineering works also exist (North West Business, 2013).

Figure 4.12: Manufacturing employment per district municipality in the NWP between 2002 and 2011



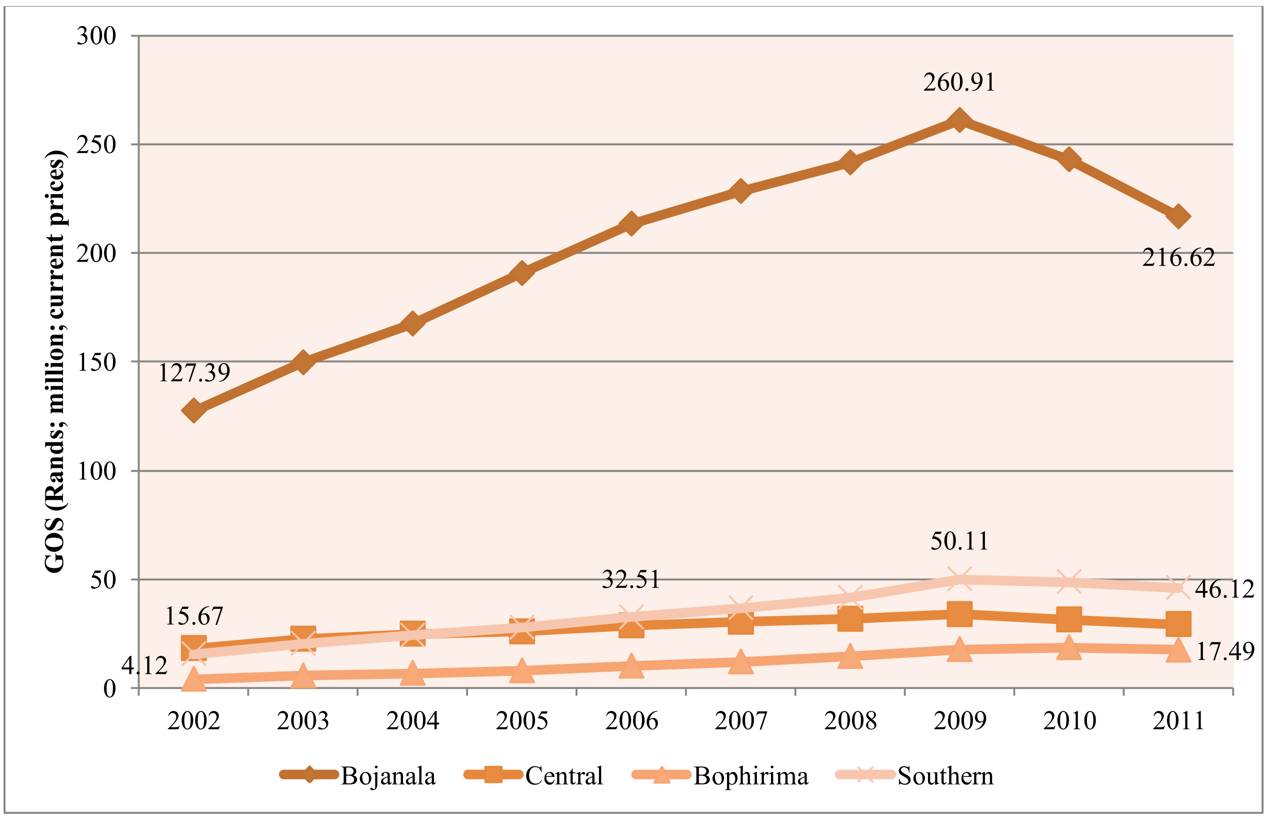
Source: Quantec Easy Data, 2013

4.4.3.3. Spatial trends in manufacturing profit

Manufacturing profits increased between 2002 and 2011 from as low as R4.12 million in Bophirima in 2002 to R216.62 million in Bojanala in 2011. In 2011, NWP profits in manufacturing accounted for 45.9% of total GOS (see Table 4.5: Quantec Easy Data, 2013).

Manufacturing profits were concentrated in the Bojanala District Municipality, as shown in Figure 4.11. The highest profit, R260.91 million, accrued to manufacturing firms in the Bojanala District Municipality in 2009. The Bophirima District Municipality accounted for the least profits in manufacturing throughout the time period (see Table 4.10 and Figure 4.13). Manufacturing profits are concentrated in the local municipality of Madibeng (19.62%), Rustenburg local municipality (14.33%) and the City of Matlosana (11.39%). The following local municipalities contributed less than 1% to manufacturing profits; Ratlou, Kagisano, Mamusa and Molopo (see Table 4.10).

Figure 4.13: Manufacturing profit per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

Table 4.10: Spatial contributions to manufacturing output, employment and profit in 2011

District municipality	Local municipality	Output			Employment			Profit		
		GVA (Rand; million; current prices)	% share	Rank	Employment (number)	% share	Rank	GOS (Rand; million; current prices)	% share	Rank
Bojanala	Moretele	648.8	6.75	7	5598	9.31	4	221.81	5.57	7
	Madibeng	2298.47	23.91	1	16025	26.67	1	781.83	19.62	1
	Rustenburg	1189.43	12.37	2	6609	11	3	570.92	14.33	2
	Kgetlengrivier	94.23	0.98	17	701	1.17	16	45.3	1.14	16
	Moses Kotane	501.39	5.21	8	3208	5.34	8	209.18	5.25	8
BOJANALA TOTAL		4732.32			32140			1829.04		
Central	Ratlou	73.25	0.76	18	413	0.69	18	29.72	0.75	18
	Tswaing	127.86	1.33	12	864	1.44	11	49.61	1.25	13
	Mafikeng	762.09	7.93	5	4416	7.35	5	362.53	9.1	5
	Ditsobotla	786.69	8.18	4	3972	6.61	6	385.83	9.68	4
	Ramotshere Moiloa	156.09	1.62	10	1031	1.72	10	70.8	1.78	10
CENTRAL TOTAL		1905.98			10696			898.492		
Bophirima	Kagisano	49.41	0.51	19	292	0.49	19	18.88	0.47	19
	Naledi	106.67	1.11	16	699	1.16	17	44.6	1.12	17
	Mamusa	28.97	0.3	20	190	0.32	20	10.33	0.26	20
	Greater Taung	112.19	1.17	15	715	1.19	15	58.41	1.47	11
	Molopo	0	0		0	0		0	0	
	Lekwa-Teemane	135.07	1.4	11	833	1.39	12	56.63	1.42	12
BOPHIRIMA TOTAL		432.31		21	2728		21	188.85		21
Southern	Ventersdorp	117.67	1.22	14	734	1.22	14	47.7	1.2	15
	Potchefstroom	762.74	7.93	5	3397	5.65	7	354.52	8.9	6
	City of Matlosana	1148.2	11.94	3	7218	12.01	2	453.76	11.39	3
	Maquassi Hills	120.02	1.25	13	751	1.25	13	49.87	1.25	13
	Merafong City	395.58	4.11	9	2432	4.05	9	161.98	4.07	9
SOUTHERN TOTAL		2544.21			14532			1067.83		

Source: Quantec Easy Data, 2013

4.4.3.4 Spatial growth trends in manufacturing

Table 4.11 depicts the growth in manufacturing output, employment and profit between 2002 and 2010. The highest growth rate (6.9%) in manufacturing output was experienced in the Central District Municipality. The Southern District Municipality was second with 2.9%, while the Bophirima District Municipality experienced the least growth (1.3%) in manufacturing output relative to other district municipalities. Kagisano and Ramotshere recorded the highest growth rates of 11.7% and 10.6% respectively at local municipality level. No manufacturing output was recorded for the Molopo District Municipality, and therefore no growth was recorded in total manufacturing in the local municipality (see Tables 4.10 and 4.11).

Table 4.11: Average annual growth in manufacturing output, employment and profit between 2002 and 2011

District municipality	Local municipality	Output growth	Employment growth	Profit growth
Bojanala	Moretele	4.10%	-1.7%	5.97%
	Madibeng	2.70%	-3.4%	3.35%
	Rustenburg	-0.70%	-4.7%	3.78%
	Kgetlengrivier	0.40%	-3.7%	6.52%
	Moses Kotane	2.70%	-1.9%	6.70%
BOJANALA TOTAL		1.90%	-3.3%	4.15%
Central	Ratlou	0.80%	-5.9%	5.25%
	Tswaing	7.80%	1.1%	11.41%
	Mafikeng	7.50%	1.4%	13.98%
	Ditsobotla	6.40%	-0.4%	13.07%
	Ramotshere Moiloa	10.60%	4.0%	15.42%
CENTRAL TOTAL		6.90%	0.4%	13.06%
Bophirima	Kagisano	11.70%	3.7%	16.92%
	Naledi	-0.40%	-5.8%	4.37%
	Mamusa	-6.50%	-11.9%	-3.51%
	Greater Taung	5.20%	-0.4%	10.64%
	Molopo	0.00%	0.0%	0.00%
	Lekwa-Teemane	0.80%	-5.9%	5.76%
BOPHIRIMA TOTAL		1.30%	-3.9%	6.62%
Southern	Ventersdorp	7.20%	1.6%	12.16%

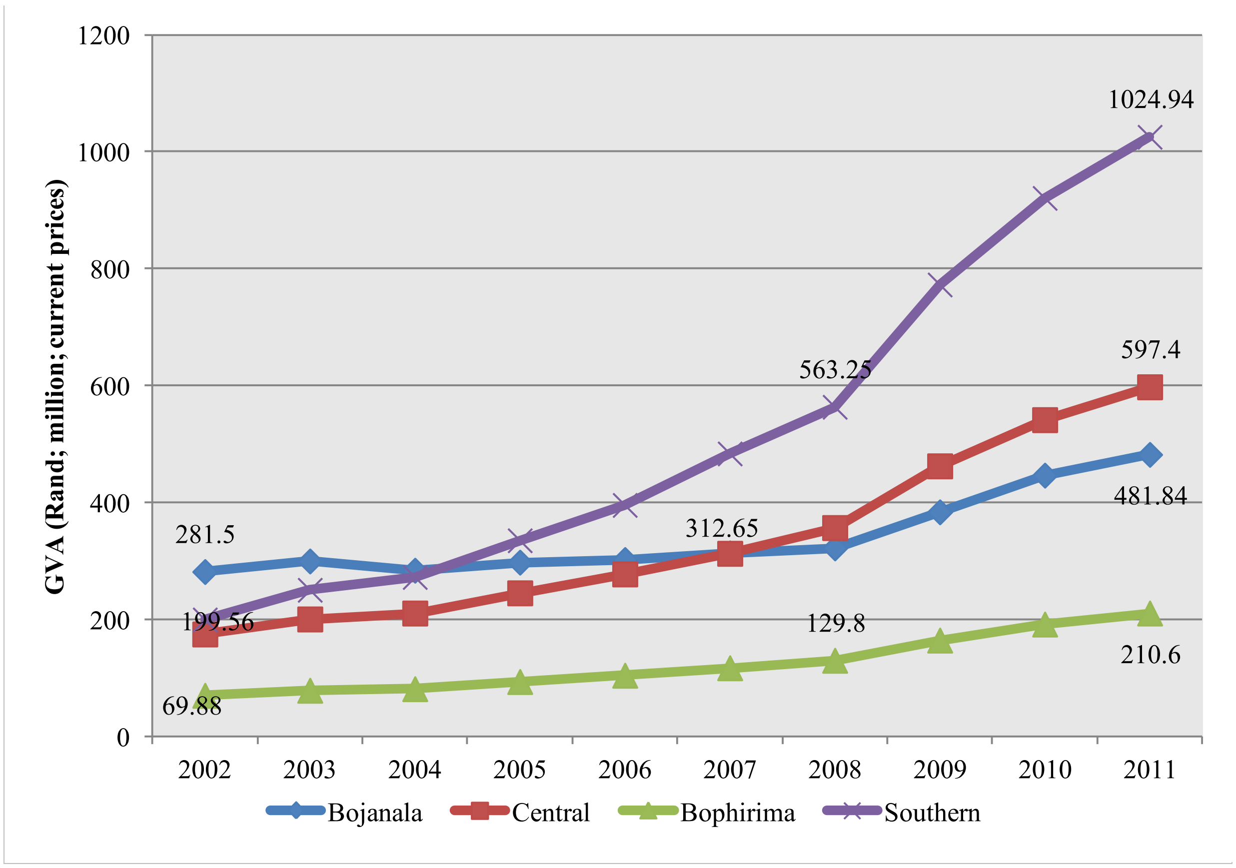
	Potchefstroom	-0.40%	-5.4%	4.54%
	City of Matlosana	5.30%	0.2%	9.26%
	Maquassi Hills	7.20%	1.2%	11.06%
	Merafong City	2.40%	-2.8%	5.92%
SOUTHERN TOTAL		2.90%	-1.9%	7.05%

Source: Quantec Easy Data, 2013

4.4.4 Spatial contributions to output, employment and profit in electricity, gas and water

4.4.4.1 Spatial trends in electricity, gas and water output

Figure 4.14: Electricity, gas and water output per district municipality between 2002 and 2011

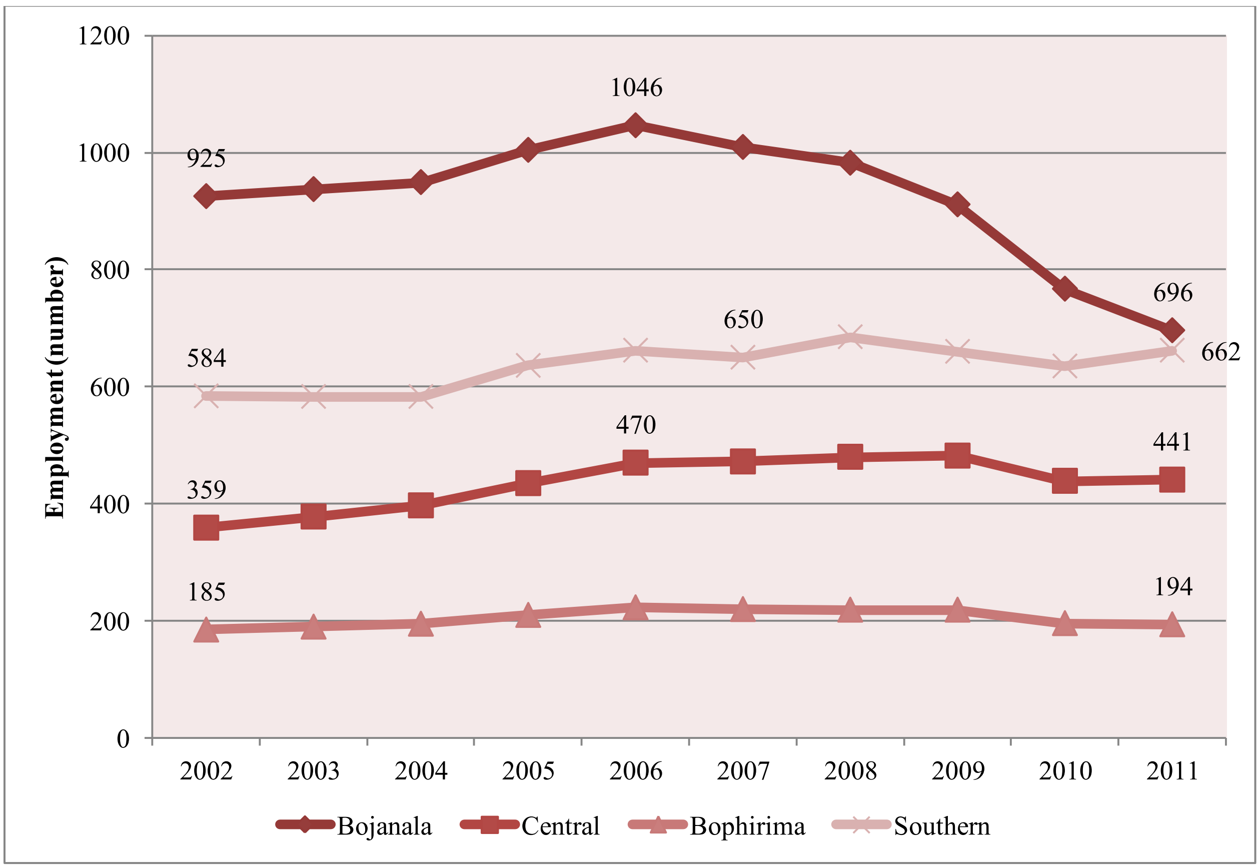


Source: Quantec Easy Data, 2013

Electricity, gas and water generation output in the NWP only accounted for 2.94% of output in the sector relative to other provinces in South Africa (see Table 4.3). Electricity, gas and water output in the NWP was greatest in the Southern District Municipality in 2011 (see Table 4.12 and Figure 4.12). The Southern District Municipality output in the sector amounted to R1.02 billion in 2011. Electricity, gas and water output at the local municipality level in the NWP in 2011 was highest in the City of Matlosana (22.79%), Mafikeng (10.9%) and Rustenburg (10.63%; see Table 4.12).

4.4.4.2 Spatial trends in electricity, gas and water employment

Figure 4.15: Electricity, gas and water employment per district municipality between 2002 and 2011



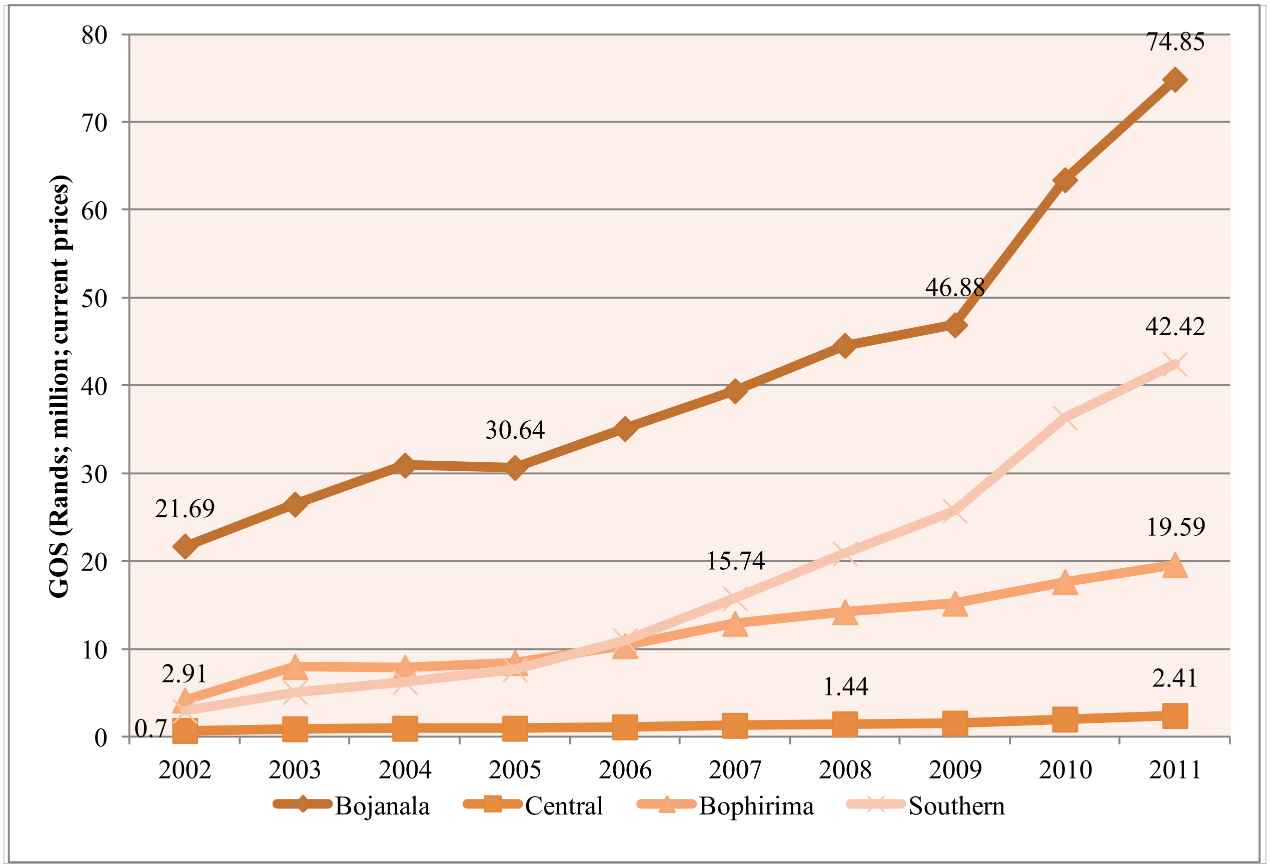
Source: Quantec Easy Data, 2013

The NWP"s share of employment in electricity, gas and water in 2011 was 4.37%. The least number of jobs in the sector were in the Bophirima and Central District Municipalities respectively between 2002 and 2011 (see Figure 4.15). Bojanala was the leading employer in the sector; although employment declined from 925 people in 2002 to 696 people in 2011 in the district municipality. Following the trends in the spatial distribution of output, employment in the NWP in electricity, gas and water was concentrated in the City of Matlosana, Rustenburg and Mafikeng local municipalities (see Table4.12). Molopo, Mamusa, Ratlou and Kgetlengrivier each contributed less than 1% to provincial employment in electricity, gas and water.

4.4.4.3 Spatial trends in electricity, gas and water profit

Figure 4.16 shows the gross operating surplus (R million current prices) per district municipality in the NWP in the period 2002 to 2011. Profits in the sector accruing to firms in the NWP contributed to 2.98% of national profits (see Table 4.5). Firms in the Bojanala District Municipality accrued the highest share of profits relative to other firms in the three other district municipalities in the electricity, gas and water sector. With the exception of the Central District Municipality, all other district municipalities experienced a marked increase in profit between 2002 and 2011 (see Figure 4.16). Table 4.12 shows the gross operating surplus per local municipality in the NWP in 2011. At least half of the profits (53.34%) in the sector accrued to four local municipalities, namely City of Matlosana (21.94%), Mafikeng (11.18%), Rustenburg (10.82%) and Potchefstroom (9.4%).

Figure 4.16: Electricity, gas and water profit per district municipality between 2002 and 2011



Source: Quantec Easy Data, 2013

Table 4.12: Spatial contributions to electricity, gas and water output, employment and profit in 2011

District municipality	**Local municipality**	**Output**			**Employment**			**Profit**		
		GVA (Rand; million; current prices)	**% share**	**Rank**	**Employment (number)**	**% share**	**Rank**	**GOS (Rand; million; current prices)**	**% share**	**Rank**
Bojanala	Moretele	116.56	5.04	8	127	6.35	5	74.85	5.13	8
	Madibeng	66.19	2.86	10	173	8.67	4	44.48	3.05	10
	Rustenburg	245.96	10.63	3	291	14.58	2	157.97	10.82	3
	Kgetlengrivier	23.62	1.02	18	19	0.93	18	14.29	0.98	18
	Moses Kotane	29.51	1.27	16	88	4.4	10	20.13	1.38	15
BOJANALA TOTAL		481.84			698			311.72		
Central	Ratlou	3.57	0.15	21	4	0.2	20	2.41	0.17	20
	Tswaing	39.39	1.7	13	31	1.54	15	23.87	1.64	13
	Mafikeng	252.2	10.9	2	220	11.04	3	163.16	11.18	2

	Ditsobotla	140.95	6.09	7	98	4.9	8	87.5	6	7
	Ramotshere Moiloa	161.3	6.97	6	89	4.45	9	102.42	7.02	6
CENTRAL TOTAL		597.41			442			379.36		
Bophirima	Kagisano	27.96	1.21	17	36	1.81	13	19.59	1.34	16
	Naledi	74.17	3.2	9	54	2.68	12	46.17	3.16	9
	Mamusa	19.99	0.86	19	10	0.49	19	12.33	0.84	19
	Greater Taung	50.47	2.18	12	64	3.22	11	33.87	2.32	12
	Molopo	7.9	0.34	20	7	0	21	0	0	21
	Lekwa-Teemane	30.1	1.3	15	24	1.18	17	18.5	1.27	17
BOPHIRIMA TOTAL		210.59			195			130.46		
Southern	Ventersdorp	64.42	2.78	11	32	1.61	14	42.42	2.91	11
	Potchefstroom	218.75	9.45	4	107	5.36	7	137.14	9.4	4
	City of Matlosana	527.45	22.79	1	373	18.71	1	320.18	21.94	1
	Maquassi Hills	38.23	1.65	14	25	1.23	16	22.73	1.56	14
	Merafong City	176.09	7.61	5	125	6.3	6	110.67	7.58	5
SOUTHERN TOTAL		1024.94			662			633.14		

Source: Quantec Easy Data, 2013

4.4.4.4 Spatial growth trends in electricity, gas and water

Table 4.13 shows average annual output, employment and profit growth rates in electricity, gas and water in the NWP between 2002 and 2011. The highest growth rate (8.9%) in output in the sector was experienced in the Southern District Municipality. The Bojanala District Municipality experienced an average annual decline in output of 2.6% between 2002 and 2011 (see Table 4.13). At local municipal level, Ventersdorp experienced 17.8% growth in electricity, gas and water output ranking as the most dynamic local municipality. Ranking second and third as the most dynamic (growing) electricity, gas and water output centres, the Mamusa and Ramotshere Moiloa local municipalities experienced growth rates of 13.4% and 11.5%, respectively. In the ten-year period 2002 to 2011, output in the sector declined in the Madibeng (-10.8%) and Moses Kotane (-10.1%) local municipalities. Positive employment growth was experienced in the Central (1.8%), Bophirima (1.32%) and Southern (3.92%) District Municipalities. Jobs in the sector were lost in Bojanala at a rate of -0.15% in the ten-year period. The most jobs in electricity, gas and water generation were created in the Ventersdorp (7.24%) and Mamusa (6.84%) local municipalities. Job losses in the sector occurred in the Madibeng (-1.58%), Moses Kotane (-2.19%) and Kagisano (-0.03%) local municipalities between 2002 and 2011. With the exception of Madibeng, profits increased across all district municipalities in the ten-year period, with the highest rate, 33.2%, being recorded in the Ventersdorp local municipality.

Table 4.13: Average annual growth in electricity, gas and water output, employment and profit between 2002 and 2011

District municipality	Local municipality	Output growth	Employment growth	Profit growth
Bojanala	Moretele	2.30%	1.06%	14.41%
	Madibeng	-10.80%	-1.58%	-0.48%
	Rustenburg	1.20%	0.48%	13.23%
	Kgetlengrivier	6.00%	3.03%	17.93%
	Moses Kotane	-10.10%	-2.19%	1.14%
BOJANALA TOTAL		-2.60%	-0.15%	8.96%
Central	Ratlou	1.70%	0.95%	14.17%
	Tswaing	5.90%	3.06%	17.84%
	Mafikeng	3.20%	0.65%	15.74%
	Ditsobotla	4.60%	1.82%	16.63%
	Ramotshere Moiloa	11.50%	4.10%	25.13%
CENTRAL TOTAL		5.40%	1.75%	17.88%
Bophirima	Kagisano	4.80%	-0.03%	20.07%
	Naledi	1.80%	1.18%	13.40%
	Mamusa	13.40%	6.84%	26.34%
	Greater Taung	2.70%	0.09%	16.02%
	Molopo	4.60%	2.60%	16.27%
	Lekwa-Teemane	7.00%	3.06%	19.27%
BOPHIRIMA TOTAL		3.70%	1.32%	13.76%
Southern	Ventersdorp	17.80%	7.24%	33.20%
	Potchefstroom	10.90%	4.44%	23.96%
	City of Matlosana	8.10%	3.79%	20.39%

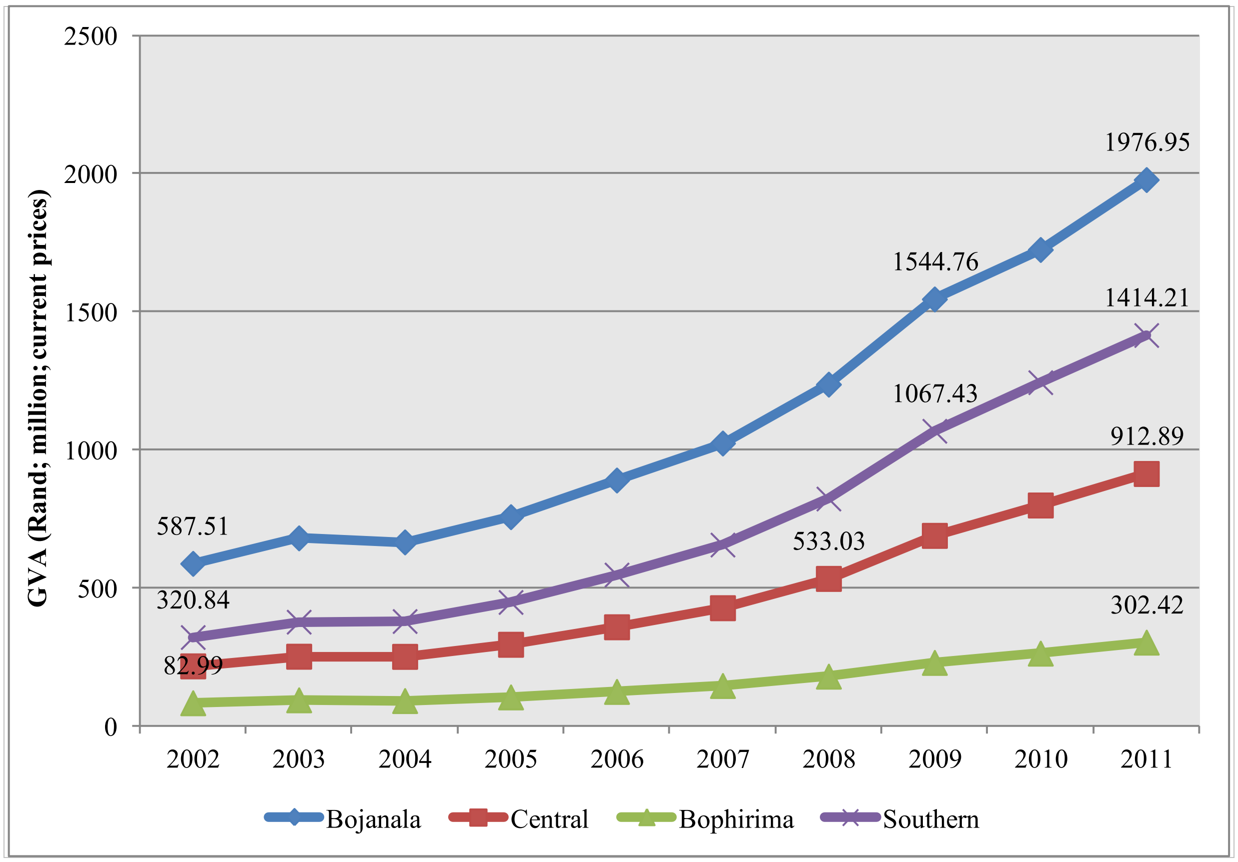
	Maquassi Hills	8.60%	4.52%	20.66%
	Merafong City	7.00%	3.08%	19.59%
SOUTHERN TOTAL		8.90%	3.92%	21.40%

Source: Quantec Easy Data, 2013

4.4.5 Spatial contributions to output, employment and profit in construction

4.4.5.1 Spatial trends in construction output

Figure 4.17: Construction output per district municipality between 2002 and 2011



Source: Quantec Easy Data, 2013

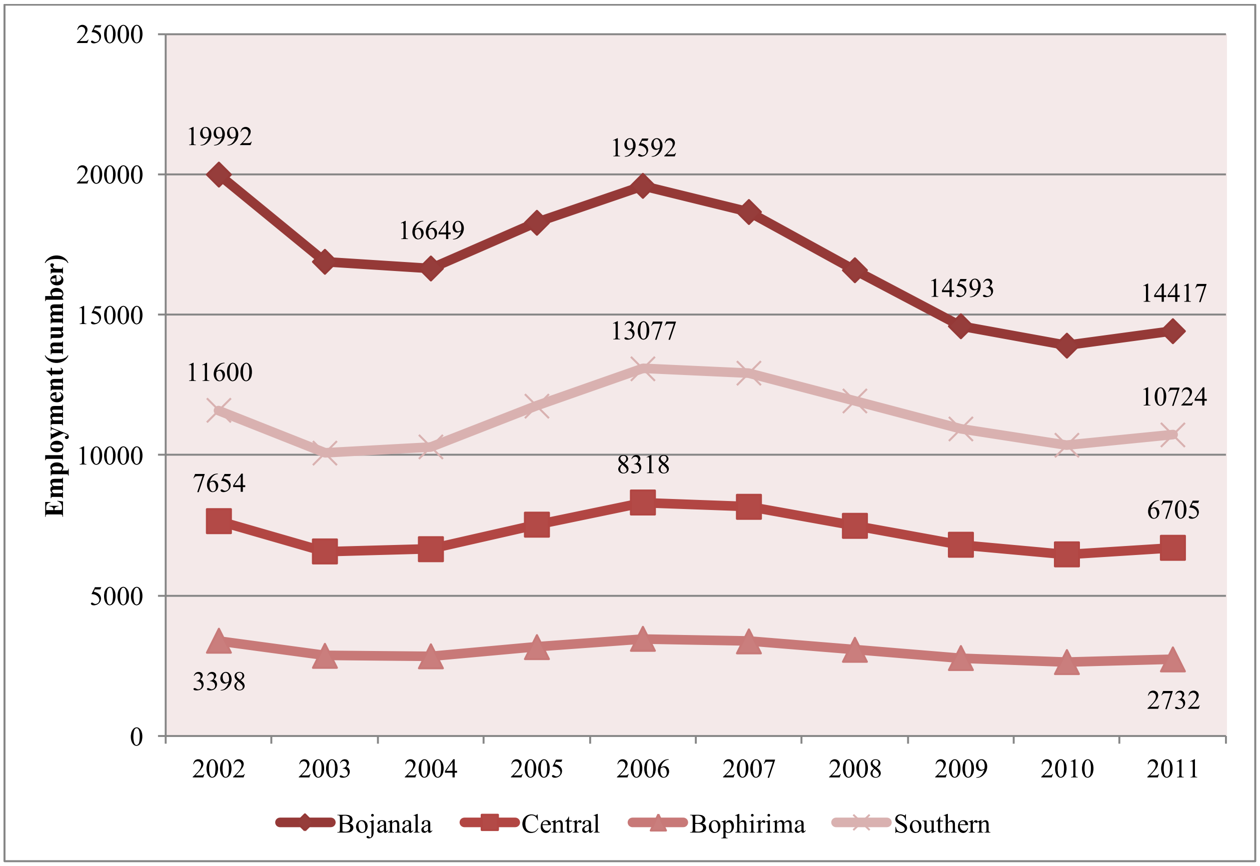
The NWP"s share of output in the construction sector in 2011 was 4.41%. Of the 4.41%, the Bojanala District Municipality accounted for the largest proportion of output between 2002 and 2011 relative to other district municipalities. In 2011, Bojanala"s output amounted to R1.97 billion, and the Southern District Municipality"s output ranked second (R1.41 billion) (see Figure

4.17). Bojanala accounted for 43% of construction output in the NWP in 2011, while the Southern district municipality contributed 31% (see Table 4.14). At local municipal level, the major contributors to construction output in the NWP in 2011 were Rustenburg (18.54%), City of Matlosana (15.23%), Madibeng (12.38%) and Mafikeng (10.72%). Construction in the NWP is of particular importance owing to the large number of cement manufacturers located in the province. Lafarge operates the biggest cement manufacturing plant in SA in the Ditsobotla local municipality. Other main cement manufacturers, Afrisam and PPC (three plants), also have plants in the NWP (North West Business, 2013). Demand in the construction sector has been driven by the housing and infrastructure industries. Government and private housing schemes such as Marikana (25km east of Rustenburg), the National Housing Corporation Finance, Impala housing project and Anglo Platinum"s 12 000 housing units in the NWP have ensured an increase in demand in the construction sector after the 2010 World Cup infrastructure upgrade. The least contributions (less than 1%) to construction output originated from Molopo (0.17%), Kagisano (0.59%), Tswaing (0.65%), Ventersdorp (0.7%) and Lekwa-Teemane (0.99%), as shown in Table 4.14.

4.4.5.2 Spatial trends in construction employment

In 2011, the NWP contributed 5% to national employment in the construction sector. Employment in the NWP construction sector declined over the period 2002 to 2011. In 2002, the sector employed 42 644 people and this declined to 34 578 people in 2011. The Bojanala District Municipality contributed the most to employment in the construction sector throughout the period, employing 14 417 people in 2011 compared to 19 992 in 2002 (see Figure 4.18). Table 4.14 shows that the Rustenburg, Madibeng and City of Matlosana local municipalities contributed to 52.41% of employment (15.83%, 12.86% and 13.72%, respectively) in the construction sector in the NWP in 2011. Other important centres of employment in construction were Mafikeng, Merofong City, Moretele and Potchefstroom.

Figure 4.18: Construction employment per district municipality in the NWP between 2002 and 2011

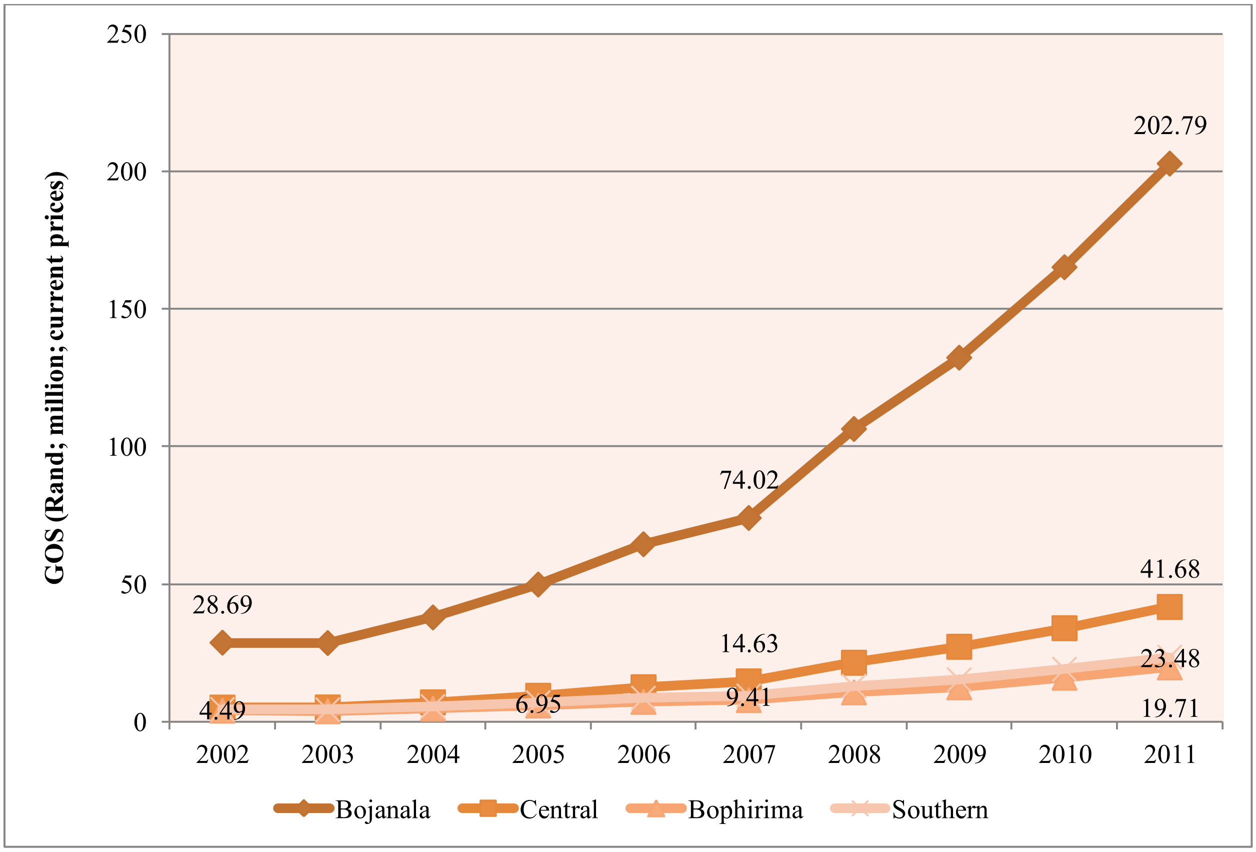


Source: Quantec Easy Data, 2013

4.4.5.3 Spatial trends in construction profits

Figure 4.19 shows the GOS in the construction sector per district municipality in the NWP. The NWP contributed 4.41% of national profits in the construction sector. Following the trends in output and employment, profits in the construction sector in the NWP were concentrated in the Bojanala District Municipality.

Figure 4.19: Construction profit per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

Profits in the district municipality increased from R28.69 million in 2002 to R202.79 million in 2011. At local municipality level, the total contribution of Kgetlengrivier, Ratlou, Tswaing, Ramotshere Moiloa, Kagisano, Naledi, Mamusa ,Greater Taung, Molopo, Lekwa-Teemane, Ventersdorp and Maquassi Hills amounted to 14% of profits in construction in the NWP (see Table 4.14). The main profit-earning centres in the construction sector were Rustenburg (18.54%), City of Matlosana (15.23%), Madibeng (12.38%) and Mafikeng (10.72%; see Table 4.14).

Table 4.14: Spatial contributions to output, employment and profit in construction in 2011

District municipality	Local municipality	Output			Employment			Profit		
		GVA (Rand; million; current prices)	% share	Rank	Employment (number)	% share	Rank	GOS (Rand; million; current prices)	% share	Rank
Bojanala	Moretele	323.91	6.09	7	2662	7.7	5	202.79	6.09	7
	Madibeng	657.94	12.38	3	4446	12.86	3	411.92	12.38	3
	Rustenburg	985.08	18.54	1	5474	15.83	1	616.73	18.54	1
	Kgetlengrivier	82.89	1.56	14	305	0.88	17	51.9	1.56	14
	Moses Kotane	232.66	4.38	9	1529	4.42	9	145.66	4.38	9
BOJANALA TOTAL		2282.48			14416			1429		
Central	Ratlou	66.58	1.25	15	438	1.27	14	41.68	1.25	15
	Tswaing	34.42	0.65	19	274	0.79	18	21.55	0.65	19
	Mafikeng	569.62	10.72	4	3364	9.73	4	356.62	10.72	4
	Ditsobotla	299.16	5.63	8	1972	5.7	8	187.3	5.63	8
	Ramotshere Moiloa	83.26	1.57	13	657	1.9	13	52.12	1.57	13
CENTRAL TOTAL		1053.04			6705			659.27		
Bophirima	Kagisano	31.48	0.59	20	213	0.62	19	19.71	0.59	20
	Naledi	106.98	2.01	11	865	2.5	11	66.98	2.01	11
	Mamusa	35.08	0.66	18	216	0.62	19	21.97	0.66	18
	Greater Taung	114.08	2.15	10	940	2.72	10	71.42	2.15	10
	Molopo	9.14	0.17	21	73	0.21	21	5.72	0.17	21
	Lekwa-Teemane	52.77	0.99	16	425	1.23	15	33.04	0.99	16
BOPHIRIMA TOTAL		349.53			2732			218.84		
Southern	Ventersdorp	37.5	0.71	17	309	0.89	16	23.48	0.71	17
	Potchefstroom	335.5	6.31	6	2545	7.36	6	210.05	6.31	6
	City of Matlosana	809.24	15.23	2	4742	13.72	2	506.65	15.23	2
	Maquassi Hills	100.86	1.9	12	826	2.39	12	63.14	1.9	12
	Merafong City	346.33	6.52	5	2301	6.65	7	216.82	6.52	5
SOUTHERN TOTAL		1629.43			10723			1020.14		

Source: Quantec Easy Data, 2013

4.4.5.4 Spatial growth trends in construction

Table 4.15 shows the average annual growth in construction output, employment and profit in the NWP between 2002 and 2011. Average annual growth in output in construction between 2002 and 2011 was positive for all district municipalities. The Southern District Municipality experienced 7.3% annual growth, while the Central District Municipality experienced 6.9%, Bophirima 5.3% and Bojanala 4.5%. Output in the sector contracted in Kgetlengrivier (-1%), Tswaing (-0.7%) and Mumusa (-2.5%) local municipalities in the ten-year period 2002 to 2011. Construction output, however, increased the most in the Naledi local municipality (13.9%) in the same period. The ten-year average annual employment growth in construction was negative for all four district municipalities. Similarly, employment growth was negative in all local municipalities with the exception of Ratlou, Ditsobotla, Naledi, Potchefstroom and Maquassi Hills. Profit increased at an average annual rate above 5% across all municipalities in construction between 2002 and 2011.

Table 4.15: Average annual growth in construction output, employment and profit between 2002 and 2011

District municipality	Local municipality	Output growth	Employment growth	Profit growth
Bojanala	Moretele	8.00%	0.0%	15.59%
	Madibeng	3.70%	-1.2%	12.08%
	Rustenburg	4.90%	-1.3%	12.60%
	Kgetlengrivier	-1.00%	-2.4%	8.61%
	Moses Kotane	3.60%	-1.2%	12.15%
BOJANALA TOTAL		7.30%	-1.1%	12.52%
Central	Ratlou	9.60%	0.6%	17.08%
	Tswaing	-0.70%	-2.2%	9.08%
	Mafikeng	6.70%	-0.5%	14.32%
	Ditsobotla	8.80%	0.3%	16.28%
	Ramotshere Moiloa	4.90%	-0.9%	13.16%
CENTRAL TOTAL		6.90%	-0.4%	14.58%
Bophirima	Kagisano	3.60%	-1.3%	12.33%
	Naledi	13.90%	2.4%	21.04%
	Mamusa	-2.50%	-2.0%	8.14%
	Greater Taung	5.00%	-0.9%	13.09%

	Molopo	1.40%	-2.5%	9.76%
	Lekwa-Teemane	4.60%	-1.0%	13.02%
BOPHIRIMA TOTAL		5.30%	-0.4%	9.20%
Southern	Ventersdorp	4.80%	-1.1%	12.71%
	Potchefstroom	9.00%	0.3%	16.33%
	City of Matlosana	6.80%	-0.4%	14.49%
	Maquassi Hills	10.80%	1.0%	18.03%
	Merafong City	6.60%	-0.6%	14.10%
SOUTHERN TOTAL		4.50%	-0.2%	14.88%

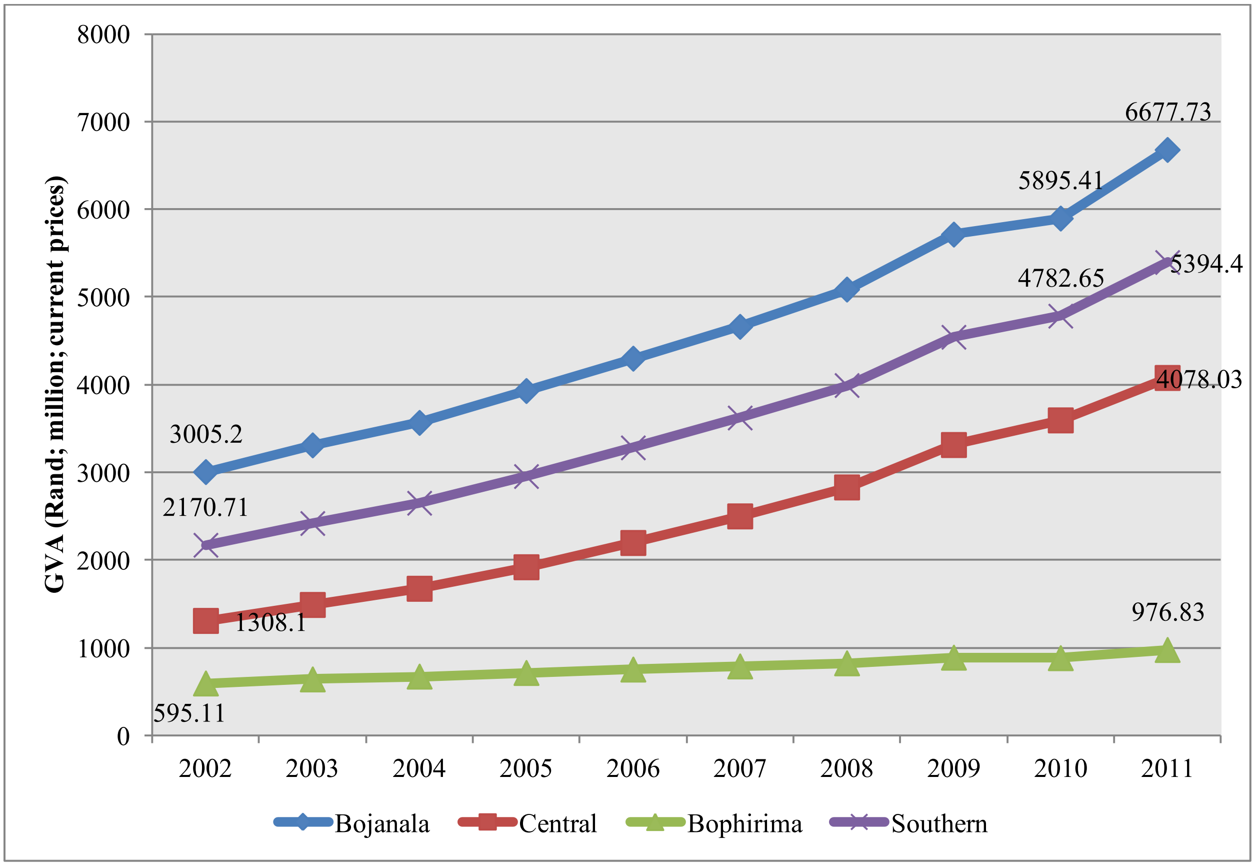
Source: Quantec Easy Data, 2013

4.4.6 Spatial contributions to output, employment and profit in wholesale and retail trade, catering and accommodation

4.4.6.1 Spatial trends in wholesale and retail trade, catering and accommodation output

The NWP‟s contribution to national output in the wholesale and retail trade, catering and accommodation sector was 4.95% in 2011 (see Table 4.3). Bojanala ranked as the leading wholesale and retail trade, catering and accommodation-producing district municipality in the NWP in 2011, while the Southern District Municipality ranked second, the Central District Municipality ranked third and the Bophirima District Municipality ranked last (Figure 4.20).

Figure 4.20: Wholesale and retail trade, catering and accommodation output per district municipality between 2002 and 2011



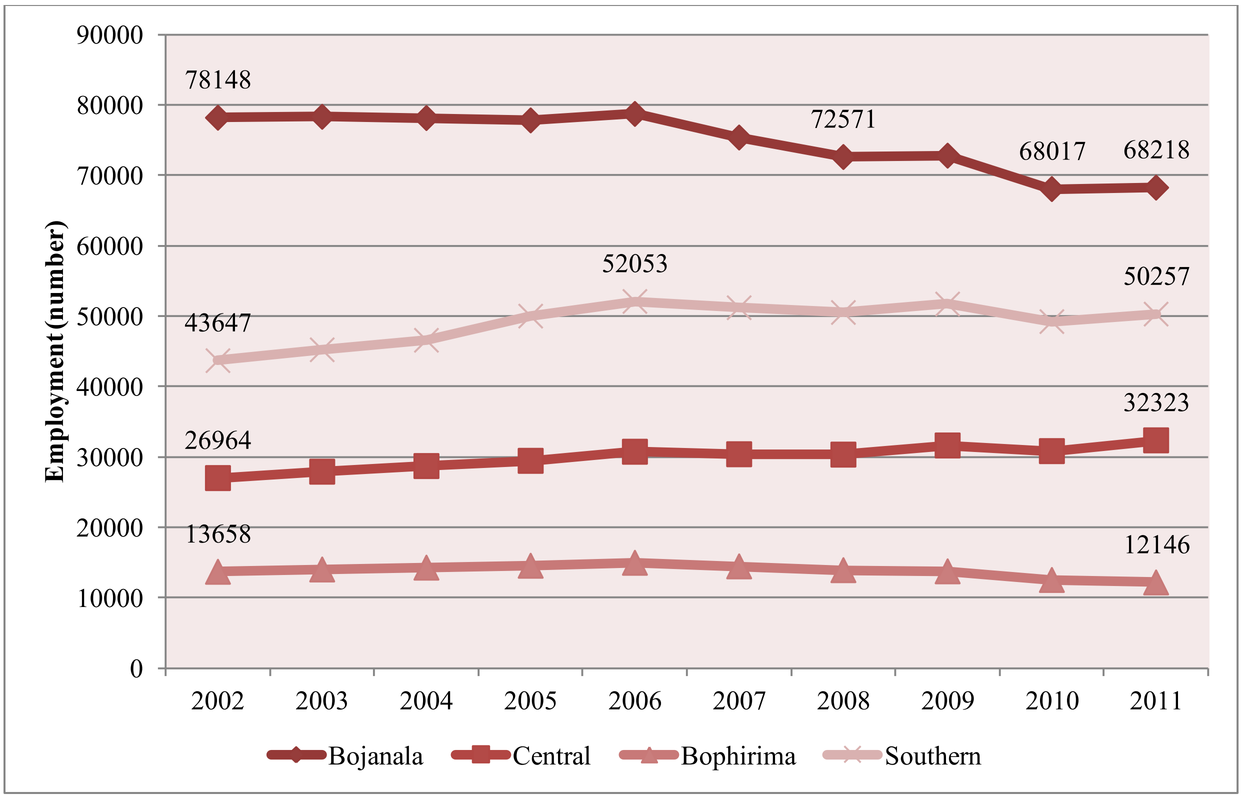
Source: Quantec Easy Data, 2013

The Bojanala District Municipality produced R66.77 billion in the sector in 2011. Wholesale and retail trade, catering and accommodation output was highest in the City of Matlosana (R3.16 billion), which produced 16.52% of NWP total wholesale and retail trade, catering and accommodation output and Rustenburg (R2.58 billion), which contributed 13.49%. The least shares of output in wholesale and retail trade, catering and accommodation, i.e. 0.11% and 0.71%, originated from the Molopo (R20.53 million) and Ventersdorp (R136 million) local municipalities.

4.4.6.2 Spatial trends in wholesale and retail trade, catering and accommodation employment

The wholesale and retail trade, catering and accommodation sector provided 2 655 383 jobs to the South African economy in 2011. 154 020 of these jobs were in the NWP; contributing 5.8% to employment in the sector (see Table 4.4).

Figure 4.21: wholesale and retail trade, catering and accommodation employment per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

The Bojanala District Municipality lost 9 930 jobs in the wholesale and retail trade, catering and accommodation sector between 2002 and 2011 (78 148 people to 68 218 people). However, it remained the largest employer in the province relative to the other three district municipalities (see Figure 4.21). The Central and Southern District Municipalities created new jobs between 2002 and 2011 (5 360 and 6 611 respectively; see Figure 4.21). The NWP"s share of output in the wholesale and retail trade, catering and accommodation sector was 4.95% in 2011 (see Table 4.3). Bojanala ranked as the leading wholesale and retail trade, catering and accommodation-producing district municipality in the NWP in 2011, while the Southern District Municipality ranked second, the Central District Municipality ranked third and the Bophirima District Municipality ranked last (see Figure 4.20). Output in Bojanala increased from R3.05 billion in 2002 to R6.67 billion in 2011. Bophirima‟s output in the sector, ranked fourth, increased from R595.11 million to R976.83 million.

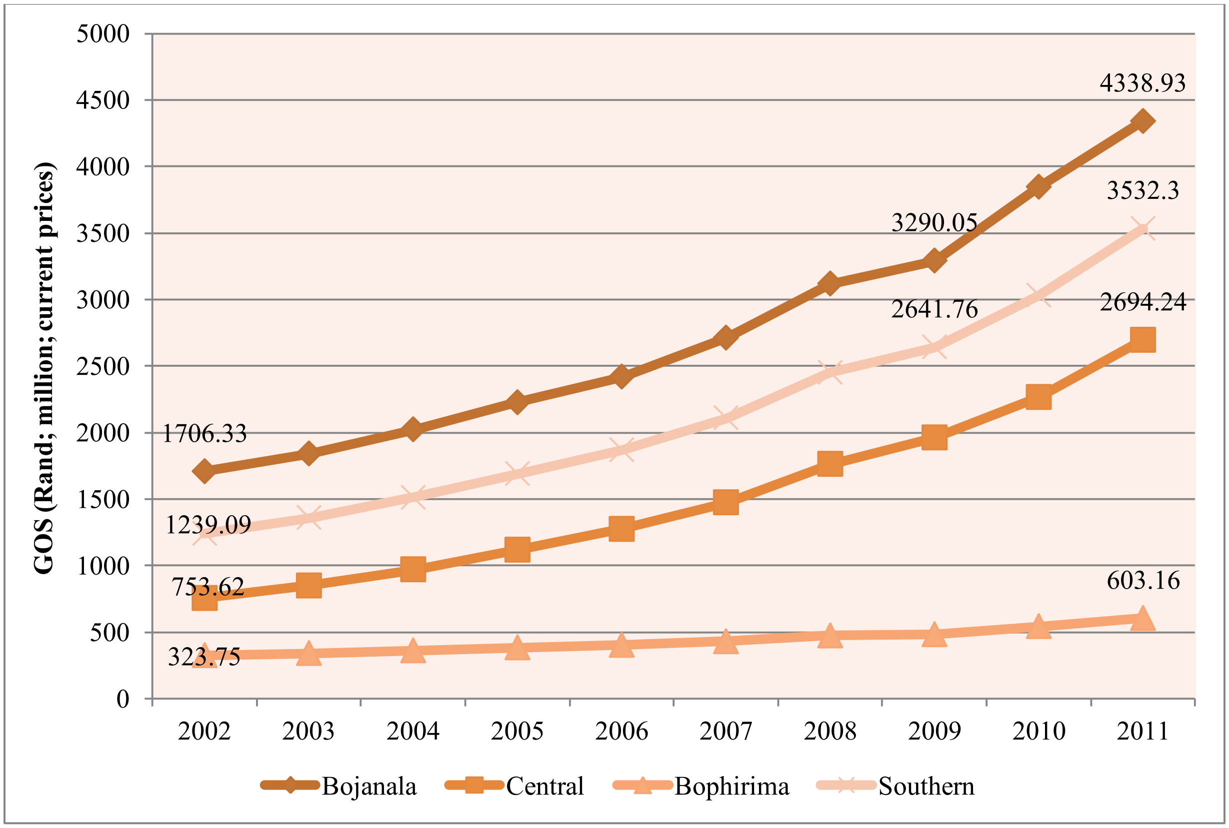
Wholesale and retail trade, catering and accommodation output was highest in the City of Matlosana (R3.16 billion), which produced 16.52% of NWP‟s total wholesale and retail trade, catering and accommodation output. Rustenburg produced the second highest wholesale and retail trade, catering and accommodation output (R2.58 billion), which contributed 13.49% to the provincial output. The NWP‟s close proximity to Gauteng provides access to the domestic market as well as international markets for the firms in the NWP, thereby making trade a significant economic activity in the NWP. The least shares of output in wholesale and retail trade, catering and accommodation, 0.11% and 0.71%, originated from the Molopo (R20.53 million) and Ventersdorp (R136 million) local municipalities. The main centre of employment in the wholesale and retail trade, catering and accommodation sector was Rustenburg, which employed 27 056 (16.15%) people in 2011 (see Table 4.16). The Madibeng local municipality was the second leading employer in the wholesale and retail trade, catering and accommodation sector, providing 25 491 jobs (15.21%). The least number of jobs (198) in the wholesale and retail trade, catering and accommodation sector were provided in the Molopo local municipality, which contributed only 0.12% to employment in the NWP.

4.4.6.3 Spatial trends in wholesale and retail trade, catering and accommodation profit

Figure 4.22 depicts the value of profits in the wholesale and retail trade, catering and accommodation sector accruing to the four district municipalities in the NWP. Of the R11.17 billion profits made in the wholesale and retail trade, catering and accommodation sector in the NWP, R4.33 billion (39%) accrued to firms in the Bojanala District Municipality in 2011. In 2011, the top-ranking local municipalities in wholesale and retail trade, catering and accommodation profits were the City of Matlosana (16.44%), Rustenburg (13.53%), Madibeng (12.58%) and Mafikeng (9.55%). The local municipalities whose shares of profits were in the median range in wholesale and retail trade, catering and accommodation in the NWP were

Moses Kotane, Moretele, Ditsobotla, Ramotshere Moiloa, Potchefstroom and Merofong City (see Table 4.14).

Figure 4.22: Wholesale and retail trade, catering and accommodation profit per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

Table 4.16: Spatial contributions to output, employment and profit in wholesale and retail trade, catering and accommodation in 2011

District municipality	Local municipality	Output			Employment			Profit		
		GVA (Rand; million; current prices)	% share	Rank	Employment (number)	% share	Rank	GOS (Rand; million; current prices)	% share	Rank
Bojanala	Moretele	826.51	4.32	10	7252	4.71	8	489.58	4.38	10
	Madibeng	2405.27	12.56	3	20150	13.08	3	1405.49	12.58	3
	Rustenburg	2583.17	13.49	2	20863	13.55	2	1510.96	13.53	2
	Kgetlengrivier	331.59	1.73	12	2267	1.47	14	191.68	1.72	12

	Moses Kotane	1174.75	6.13	7	9384	6.09	7	741.22	6.64	7
BOJANALA TOTAL		7321.29			59916			4338.93		
Central	Ratlou	277.21	1.45	15	2253	1.46	15	148.43	1.33	15
	Tswaing	332.06	1.73	12	2713	1.76	12	184.01	1.65	13
	Mafikeng	1808.36	9.44	4	14723	9.56	4	1066.24	9.55	4
	Ditsobotla	1405.27	7.34	5	10854	7.05	6	797.20	7.14	5
	Ramotshere Moiloa	866.72	4.53	8	6126	3.98	10	498.35	4.46	9
CENTRAL TOTAL		4689.62			36669			2694.24		
Bophirima	Kagisano	147.25	0.77	18	1093	0.71	20	85.54	0.77	18
	Naledi	300.63	1.57	14	2501	1.62	13	174.01	1.56	14
	Mamusa	186.58	0.97	17	1567	1.02	17	105.37	0.94	17
	Greater Taung	249.9	1.3	16	2059	1.34	16	141.77	1.27	16
	Molopo	20.53	0.11	21	172	0.11	21	11.43	0.10	21
	Lekwa-Teemane	147.88	0.77	18	1183	0.77	18	85.04	0.76	19
BOPHIRIMA TOTAL		1052.77			8575			603.16		
Southern	Ventersdorp	136.23	0.71	20	1176	0.76	19	77.92	0.70	20
	Potchefstroom	852.37	4.45	9	6639	4.31	9	501.02	4.49	8
	City of Matlosana	3163.83	16.52	1	25237	16.39	1	1836.40	16.44	1
	Maquassi Hills	567.53	2.96	11	4643	3.01	11	331.01	2.96	11
	Merafong City	1366.33	7.13	6	11164	7.25	5	785.94	7.04	6
SOUTHERN TOTAL		6086.29			48860			3532.30		

Source: Quantec Easy Data, 2013

4.4.6.4 Spatial growth trends in wholesale and retail trade, catering and accommodation

The average annual growth in output between 2002 and 2011 for the Central District Municipality was 5.7%, the highest relative to the other three district municipalities. The Southern and Bojanala District Municipalities experienced average annual growth rates in output of 3.2% and 1.6%, respectively. Output in wholesale and retail trade, catering and accommodation in the Bophirima District Municipality declined at an average annual rate of -1.4% (see Table 4.17).

Table 4.17: Average annual growth in wholesale and retail trade, catering and accommodation output, employment and profit between 2002 and 2011

District municipality	Local municipality	Output growth	Employment growth	Profit growth
Bojanala	Moretele	0.40%	-2.5%	5.05%
	Madibeng	1.70%	-1.5%	5.97%
	Rustenburg	1.10%	-2.3%	5.61%
	Kgetlengrivier	5.40%	1.8%	8.30%
	Moses Kotane	2.60%	-1.6%	7.81%
BOJANALA TOTAL		1.60%	-1.9%	6.08%
Central	Ratlou	7.60%	3.8%	9.94%
	Tswaing	1.50%	-1.9%	5.78%
	Mafikeng	4.80%	1.1%	8.06%
	Ditsobotla	6.80%	3.1%	9.53%
	Ramotshere Moiloa	7.80%	4.0%	10.10%
CENTRAL TOTAL		5.70%	2.0%	8.70%
Bophirima	Kagisano	3.10%	-0.4%	6.68%
	Naledi	-3.00%	-6.1%	3.04%
	Mamusa	0.30%	-2.8%	4.99%
	Greater Taung	-1.00%	-4.2%	4.21%
	Molopo	-2.90%	-5.9%	3.18%
	Lekwa-Teemane	-3.70%	-6.8%	2.63%
BOPHIRIMA TOTAL		-1.40%	-4.2%	1.71%
Southern	Ventersdorp	0.30%	-2.8%	4.93%
	Potchefstroom	-1.10%	-4.2%	4.37%
	City of Matlosana	3.60%	0.0%	7.14%
	Maquassi Hills	9.00%	5.1%	11.00%
	Merafong City	4.20%	0.6%	7.54%
SOUTHERN TOTAL		3.20%	-0.3%	6.92%

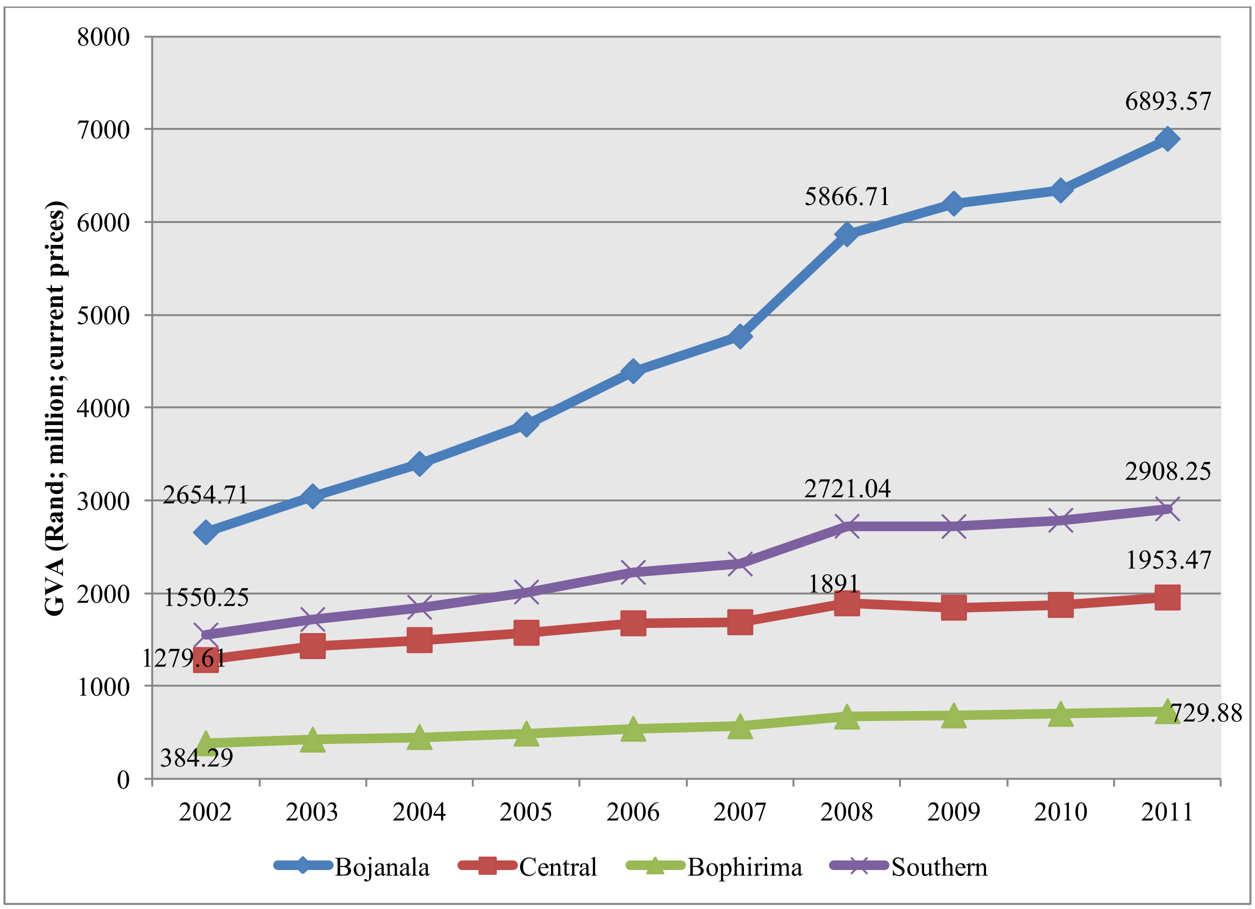
Source: Quantec Easy Data, 2013

With the exception of Naledi, Molopo, Potchefstroom and Greater Taung, positive output growth was experienced in all other local municipalities in the NWP. The most jobs in the sector were created in the Central District Municipality at a rate of 2% in the ten-year period 2002 to 2011. All other district municipalities recorded negative employment growth rates. At the local municipal level, jobs in the sector increased the most in Maquassi Hills (5.1%) Ramotshere Moila (4%) and Ditsobotla (3.1%). The average annual profit growth rate in the Central District Municipality (8.7%) outpaced those of the other district municipalities. Profits in the sector increased the most in Maquassi Hills (11%) and Ramotshere Moila (10.1%)

4.4.7 Spatial contributions to output, employment and profit in transport, storage and communication

4.4.7.1 Spatial trends in transport, storage and communication output

Figure 4.23: Transport, storage and communication output per district municipality between 2002 and 2011

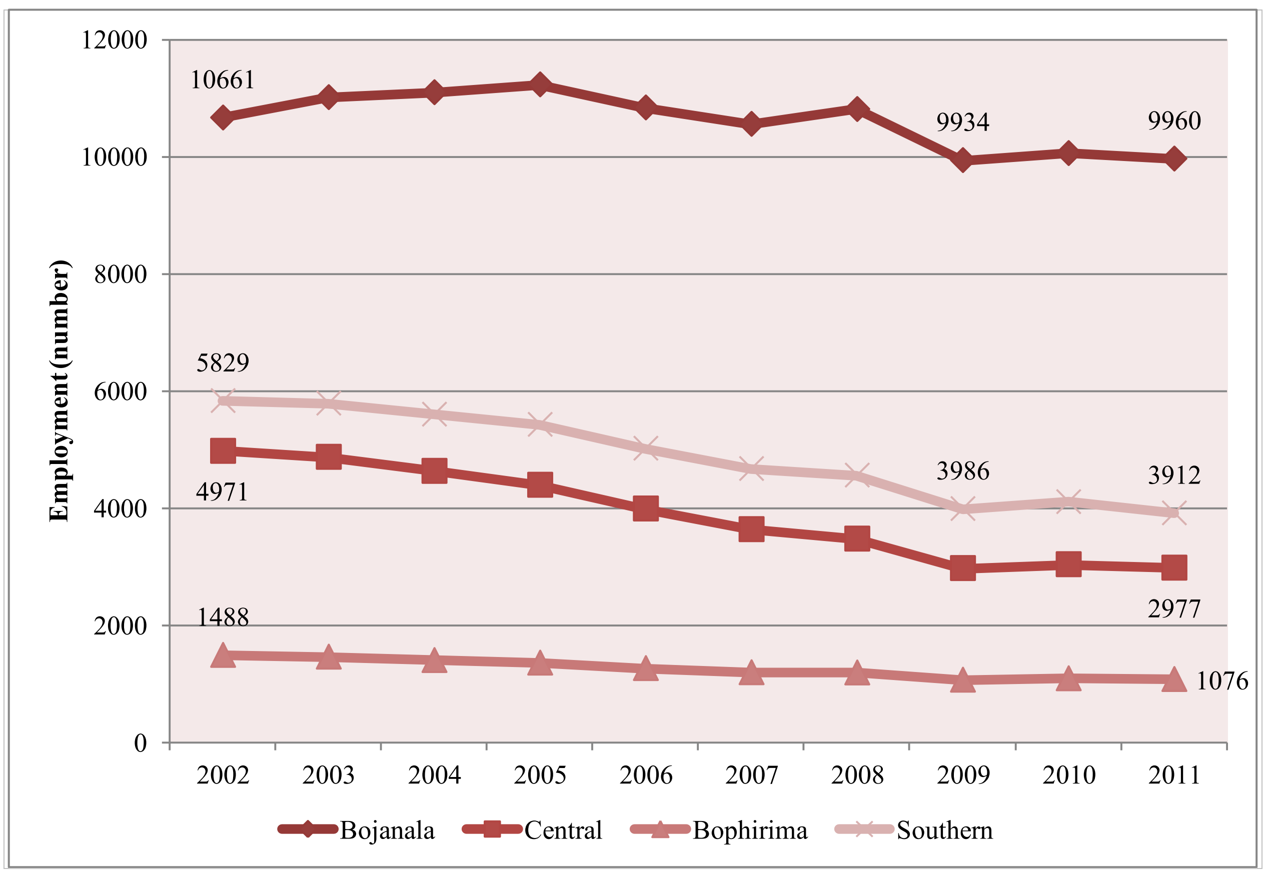


Source: Quantec Easy Data, 2013

Transport, storage and communication output in South Africa in 2011 amounted to R220.05 billion, of which R12.48 billion (5.67%) was produced in the NWP (see Table 4.3). The leading district municipality in terms of transport, storage and communication output was Bojanala, while Bophirima contributed the least throughout the time period 2002 to 2011 (see Figure 4.23). Eighteen (18) of the 21 local municipalities in the NWP produced 45% of the transport, storage and communication output as shown in Table 4.16. Output was concentrated in the Rustenburg local municipality, Madibeng local municipality and City of Matlosana, which together produced 55% of output in the sector.

4.4.7.2 Spatial trends in transport, storage and communication employment

Figure 4.24: Transport, storage and communication employment per district municipality in the NWP between 2002 and 2011

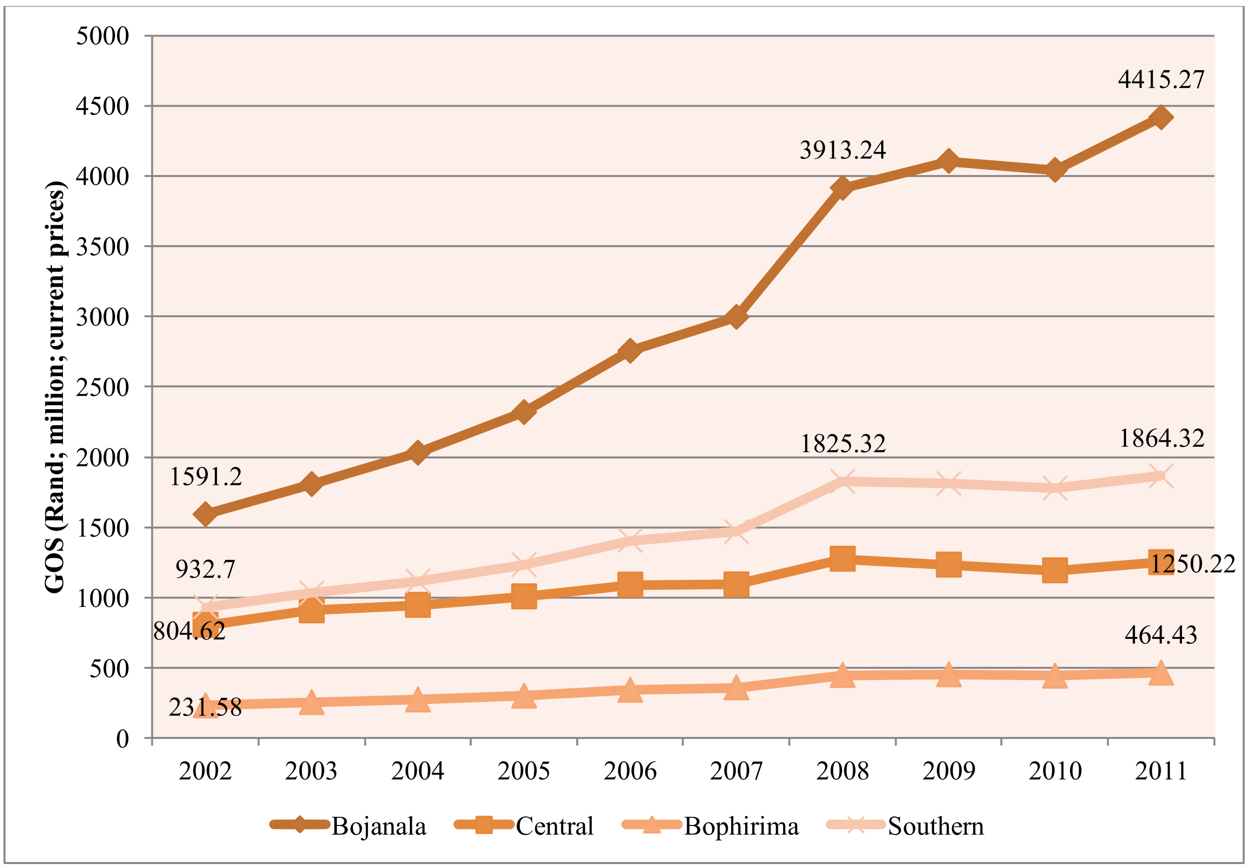


Source: Quantec Easy Data, 2013

Employment in the transport, storage and communication sector was concentrated in Bojanala at district municipal level. 9 960 jobs in the transport, storage and communication sector in the NWP were localised in Bojanala in 2011 (see Figure 4.24). Overall, the NWP contributed 3.2% to national employment in the transport, storage and communication sector in 2011 (see Table 4.4). Employment in the transport, storage and communication sector in 2011 in the NWP was concentrated in Rustenburg (17.45%), Madibeng (16.35%), City of Matlosana (12.73%) and Mafikeng (10.96%), as shown in Table 4.18.

4.4.7.3 Spatial trends in transport, storage and communication profit

Figure 4.25: Transport, storage and communication profit per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

Figure 4.25 shows the gross operating surplus per district municipality in the NWP between 2002 and 2011. Bojanala dominated as the highest profit earning district municipality between

2002 and 2011. In 2011, Bojanala‟s profit (R4.41 billion) was more than double that of any of the other district municipalities. The Rustenburg local municipality was the leading profit earner in the transport, storage and communication sector in 2011. Of the R7.99 billion profit made in the NWP in the transport, storage and communication sector, R1.93 billion (24.2%) accrued to firms in Rustenburg (see Table 4.18).

Table 4.18: Spatial contributions to output, employment and profit in transport, storage and communication in 2011

District municipality	**Local municipality**	**Output**			**Employment**			**Profit**		
		GVA (Rand; million; current prices)	**% share**	**Rank**	**Employment (number)**	**% share**	**Rank**	**GOS (Rand; million; current prices)**	**% share**	**Rank**
Bojanala	Moretele	444.42	3.56	9	1489	6.55	6	277.66	3.47	9
	Madibeng	2221.84	17.8	2	3714	16.35	2	1431.17	17.9	2
	Rustenburg	3012.75	24.13	1	3965	17.45	1	1934.57	24.2	1
	Kgetlengrivier	103.96	0.83	16	174	0.77	16	67.71	0.85	16
	Moses Kotane	1110.6	8.9	4	1751	7.71	5	704.16	8.81	4
BOJANALA TOTAL		6893.57			11093			4415.27		
Central	Ratlou	17.66	0.14	20	114	0.5	20	9.63	0.12	20
	Tswaing	287.16	2.3	11	462	2.04	10	182.59	2.28	11
	Mafikeng	965.52	7.73	5	2490	10.96	4	616.98	7.72	5
	Ditsobotla	537.05	4.3	8	1117	4.92	8	348.75	4.36	8
	Ramotshere Moiloa	146.08	1.17	14	446	1.96	11	92.26	1.15	14
CENTRAL TOTAL		1953.47			4629			1250.21		
Bophirima	Kagisano	146.93	1.18	13	139	0.61	18	93.83	1.17	13
	Naledi	290.55	2.33	10	437	1.93	12	183.25	2.29	10
	Mamusa	42.65	0.34	19	138	0.61	18	26.91	0.34	19
	Greater Taung	73.22	0.59	17	347	1.53	13	46.6	0.58	17
	Molopo	4.32	0.03	21	11	0.05	21	2.53	0.03	21
	Lekwa-Teemane	172.21	1.38	12	327	1.44	14	111.32	1.39	12
BOPHIRIMA TOTAL		729.88			1399			464.44		
Southern	Ventersdorp	61.55	0.49	18	167	0.74	17	39.94	0.5	18
	Potchefstroom	573.83	4.6	6	993	4.37	9	356.1	4.45	6

	City of Matlosana	1600.49	12.82	3	2893	12.73	3	1033.63	12.93	3
	Maquassi Hills	131.07	1.05	15	247	1.09	15	82.19	1.03	15
	Merafong City	541.31	4.34	7	1297	5.71	7	352.46	4.41	7
SOUTHERN TOTAL		2908.25			5597			1864.32		

Source: Quantec Easy Data, 2013

4.4.7.4 Spatial growth trends in transport, storage and communication

Average annual growth rates in transport, storage and communication output, employment and profit are depicted in Table 4.19. Growth in output in the transport, storage and communication sector in the ten-year period between 2002 and 2011 was positive for all district municipalities. The Bojanala District Municipality experienced the highest rate of output growth, i.e. 6.5%. The highest average annual growth in output was recorded in the following local municipalities; Kagisano (18.2%), Kgetlengrivier (9.3%), Moses Kotane (7.9%) and Rustenburg (7.9%). Negative annual growth in output was experienced in Ratlou, Greater Taung, Mamusa, Moretele and Ramotshere Moila. Job creation in the sector was highest in the Kagisano local municipality. Many of the local municipalities experienced negative growth in employment (see Table 4.19). Ratlou was the only local municipality to experience a decline in profit of -.167% in the ten-year period. Kagisano experienced the highest growth in profit (28.94%), employment (10.52%) and output (18.2%) making it the most dynamic centre in the transport, storage and communication sector between 2002 and 2011 in the NWP.

Table 4.19: Average annual growth in transport, storage and communication output, employment and profit between 2002 and 2011

District municipality	**Local municipality**	**Output growth**	**Employment growth**	**Profit growth**
Bojanala	Moretele	-1.50%	-7.03%	6.34%
	Madibeng	6.50%	-0.86%	11.00%
	Rustenburg	7.90%	0.65%	17.57%
	Kgetlengrivier	9.30%	0.98%	19.50%
	Moses Kotane	7.90%	0.89%	17.36%
BOJANALA TOTAL		6.50%	-0.79%	15.80%
Central	Ratlou	-8.30%	-14.93%	-1.67%

	Tswaing	5.30%	-0.97%	14.11%
	Mafikeng	1.50%	-5.43%	8.83%
	Ditsobotla	2.20%	-5.13%	11.67%
	Ramotshere Moiloa	-0.60%	-7.01%	8.13%
CENTRAL TOTAL		1.70%	-5.23%	10.21%
Bophirima	Kagisano	18.20%	10.52%	28.94%
	Naledi	6.90%	-0.72%	16.22%
	Mamusa	-2.30%	-8.72%	6.10%
	Greater Taung	-7.40%	-13.92%	0.13%
	Molopo	3.10%	-2.22%	12.09%
	Lekwa-Teemane	1.90%	-4.20%	10.33%
BOPHIRIMA TOTAL		3.50%	-4.26%	11.00%
Southern	Ventersdorp	2.60%	-4.48%	11.87%
	Potchefstroom	3.20%	-4.19%	11.67%
	City of Matlosana	2.80%	-4.93%	11.98%
	Maquassi Hills	6.60%	-0.29%	15.50%
	Merafong City	3.70%	-4.11%	13.04%
SOUTHERN TOTAL		3.20%	-4.35%	12.25%

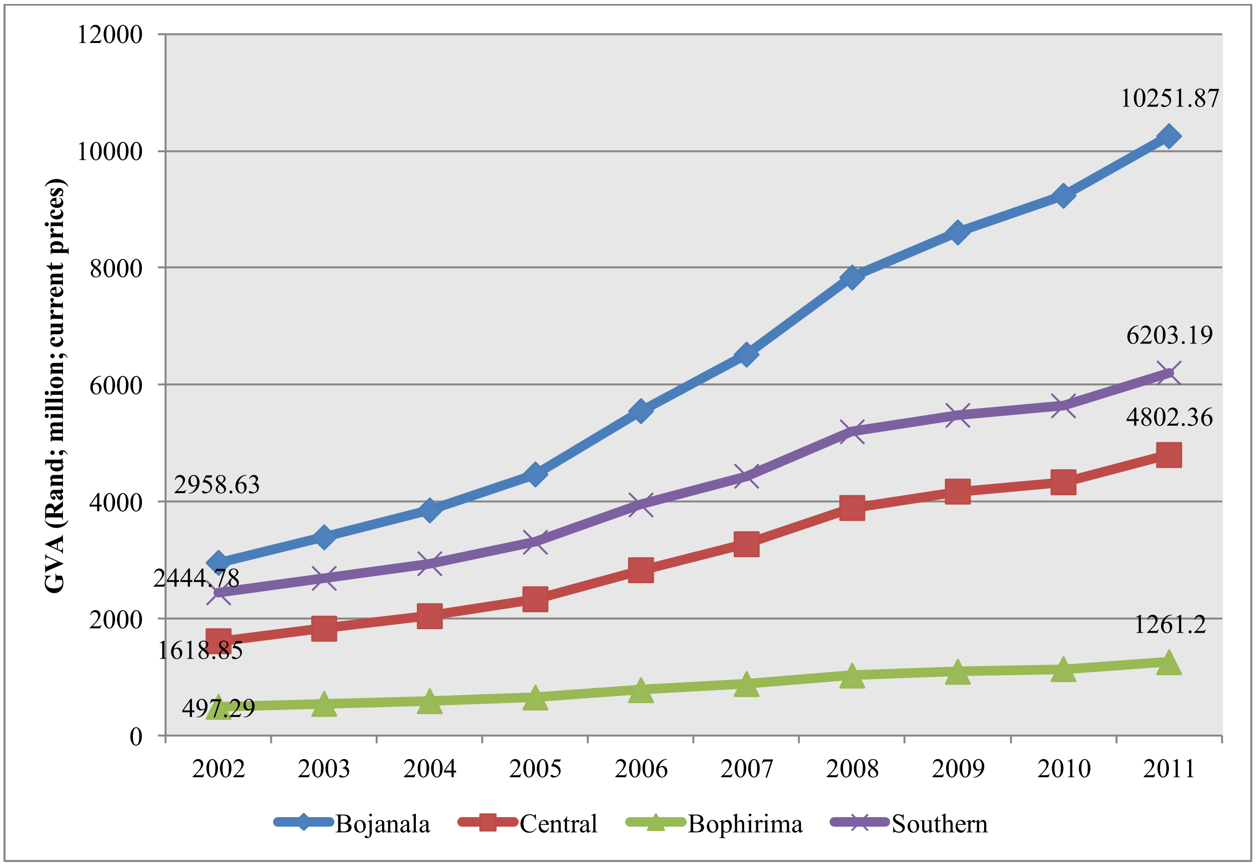
Source: Quantec Easy Data, 2013

4.4.8 Spatial contributions to output, employment and profit in finance, insurance, real estate and business services

4.4.8.1 Spatial trends in finance, insurance, real estate and business services output

The NWP‟s contribution to national output in the finance, insurance, real estate and business services sector was 4.27%. Figure 4.26 shows the output in finance, insurance, real estate and business services in the NWP per district municipality between 2002 and 2011. Finance, insurance, real estate and business services output was significant in the Bojanala District Municipality as it produced 45% of output in the sector in 2011, as depicted in Figure 4.26. Finance, insurance, real estate and business services‟ output increased from R2.95 billion in 2002 to 10.25 billion in 2011 in the Bojanala District Municipality.

Figure 4.26: finance, insurance, real estate and business services‟ output per district municipality between 2002 and 2011

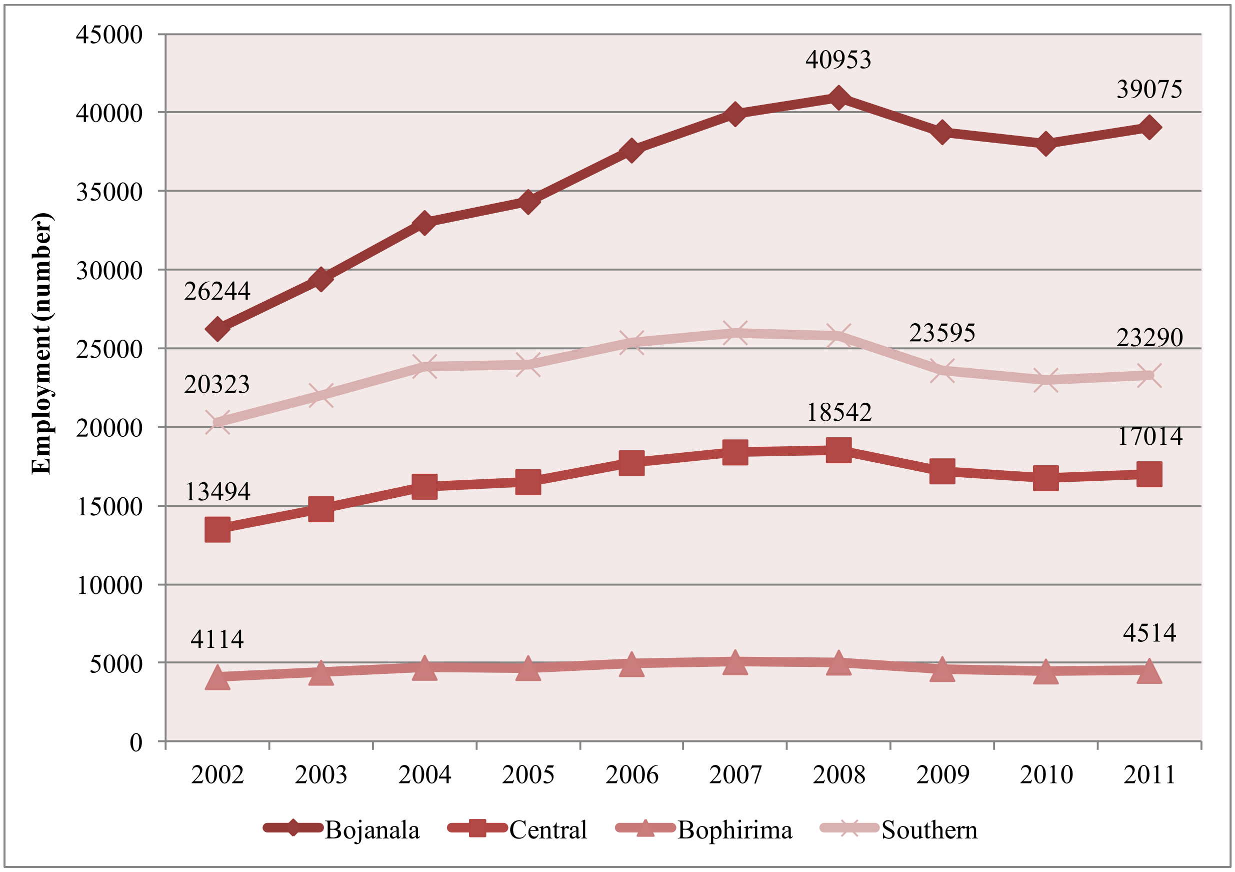


Source: Quantec Easy Data, 2013

Table 4.20 shows the output, employment and profit in the finance, insurance, real estate and business services sector per district and local municipality in the NWP. It also shows the percentage contributions to output, employment and profit per local municipality in 2011. Four of the 21 local municipalities‟ contributions to output were greater than 10% in the finance, insurance, real estate and business services sector; Rustenburg contributed 17.43%, Madibeng 13.84%, Mafikeng 12.19% and City of Matlosana 12.12%.

4.4.8.2 Spatial trends in finance, insurance, real estate and business services employment

Figure 4.27: Finance, insurance, real estate and business services employment per district municipality in the NWP between 2002 and 2011

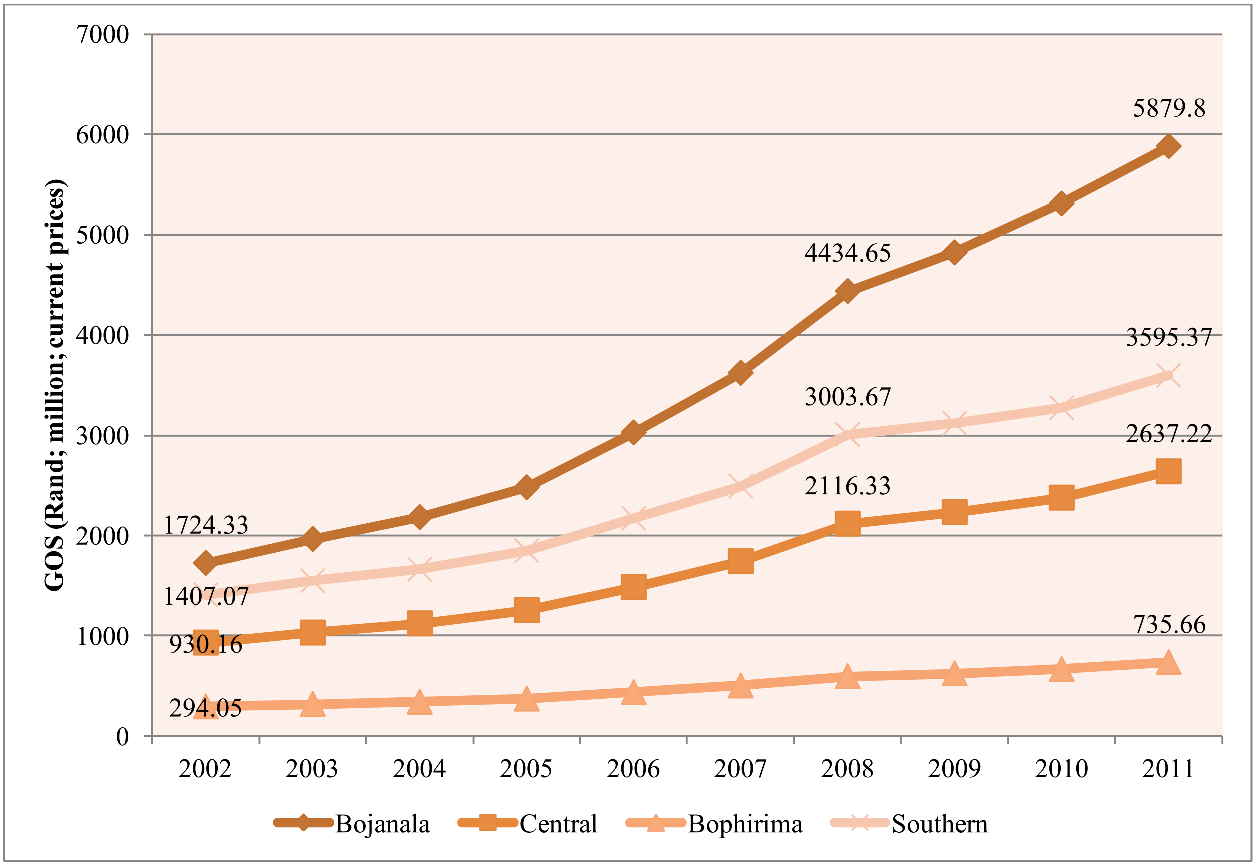


Source: Quantec Easy Data, 2013

Table 4.20 shows the employment in finance, insurance, real estate and business services in the NWP per district municipality and local municipality, respectively. At the district municipality level, 39 075 jobs in the finance, insurance, real estate and business services sector were localised in the Bojanala District Municipality in 2011. The second leading locality of employment in the finance, insurance, real estate and business services sector was the Southern District Municipality (see Figure 4.27). At the local level, similar to trends in other sectors discussed above (Transport, storage and communications; wholesale and retail trade, catering and accommodation), employment was localised in the Rustenburg, Madibeng, City of Matlosana and Mafikeng local municipalities.

4.4.8.3 Spatial trends in finance, insurance, real estate and business services profit

Figure 4.28: Finance, insurance, real estate and business services profit per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

Figure 4.28 shows the district municipalities" contributions to profits in the finance, insurance, real estate and business services sector in the NWP between 2002 and 2011. The greatest proportion of profits, R 5.87 billion (46%), in the finance, insurance, real estate and business services sector accrued to firms in the Bojanala District Municipality in 2011. The Rustenburg local municipality and local municipality of Madibeng accounted for 32.13% of the 46% share of profits accruing to the Bojanala District Municipality in the NWP. City of Matlosana and Mafikeng, respectively, accrued the third and fourth largest proportions of profits respectively, at the local municipal level in the finance, insurance, real estate and business services sector in the NWP 2011 (see Table 4.20).

Table 4.20: Spatial contributions to output, employment and profit in finance, insurance, real estate and business services in 2011

District municipality	Local municipality	Output			Employment			Profit		
		GVA (Rand; million; current prices)	% share	Rank	Employment (number)	% share	Rank	GOS (Rand; million; current prices)	% share	Rank
Bojanala	Moretele	1114.93	4.61	9	3639	4.68	8	580.85	4.52	9
	Madibeng	3343.79	13.84	2	10388	13.35	3	1806.57	14.06	2
	Rustenburg	4211.13	17.43	1	13882	17.85	1	2321.81	18.07	1
	Kgetlengrivier	271	1.12	14	807	1.04	15	152.97	1.19	14
	Moses Kotane	2097.43	8.68	5	4270	5.49	7	1017.59	7.92	5
BOJANALA TOTAL		11038.28			32986			5879.79		
Central	Ratlou	79.77	0.33	20	527	0.68	18	33.45	0.26	20
	Tswaing	211.76	0.88	16	1000	1.29	13	121.81	0.95	16
	Mafikeng	2946.15	12.19	3	9814	12.62	4	1536.24	11.96	4
	Ditsobotla	1465.39	6.06	7	3487	4.48	9	702.41	5.47	8
	Ramotshere Moiloa	449.97	1.86	11	1392	1.79	11	243.32	1.89	11
CENTRAL TOTAL		5153.04			16220			2637.23		
Bophirima	Kagisano	122.19	0.51	18	301	0.39	21	58.27	0.45	19
	Naledi	465.48	1.93	10	1670	2.15	10	303.18	2.36	10
	Mamusa	264.56	1.09	15	588	0.76	17	128.26	1	15
	Greater Taung	367.66	1.52	12	1187	1.53	12	182.38	1.42	12
	Molopo	9.06	0.04	21	345	0.44	20	3.66	0.03	21
	Lekwa-Teemane	112.22	0.46	19	619	0.8	16	59.91	0.47	18
BOPHIRIMA TOTAL		1341.17			4710			735.66		
Southern	Ventersdorp	196.73	0.81	17	396	0.51	19	89.78	0.7	17
	Potchefstroom	1760.05	7.28	6	6249	8.03	5	1011.39	7.87	6
	City of Matlosana	2929.78	12.12	4	10841	13.94	2	1603.25	12.48	3
	Maquassi Hills	341.01	1.41	13	913	1.17	14	166.95	1.3	13
	Merafong City	1403.49	5.81	8	5468	7.03	6	723.99	5.64	7
SOUTHERN TOTAL		6631.06			23867			3595.36		

Source: Quantec Easy Data, 2013

4.4.8.4 Spatial growth trends in finance, insurance, real estate and business services

The average annual growth in output in the finance, insurance, real estate and business services sector, apart from the sharp decline in output experienced in three of the four district municipalities between 2008 and 2009 (see Figure 4.24), remained positive in the 10-year period between 2002 and 2011. The least growth, 3.7%, was experienced in the Bophirima District Municipality in the 10-year period from 2002 to 2011. At local municipal level, output growth was greatest in the Mamusa, Kagisano and Moses Kotane local municipalities. Significant output decline in finance, insurance, real estate and business services output was experienced in the Molopo local municipality (-20% see Table 4.21). Positive employment growth was experienced across all district and local municipalities, with the exception of Molopo (-14.24%). Profit growth was relatively low in this sector relative to other sectors discussed thus far. Both positive and negative growth in profits was experienced in the ten-year period across the municipalities (see Table 4.21).

Table 4.21: Average annual growth in finance, insurance, real estate and business services output, employment and profit between 2002 and 2011

District municipality	**Local municipality**	**Output growth**	**Employment growth**	**Profit growth**
Bojanala	Moretele	7.60%	14.47%	1.91%
	Madibeng	7.30%	10.40%	1.69%
	Rustenburg	5.80%	12.61%	0.86%
	Kgetlengrivier	8.20%	15.21%	1.88%
	Moses Kotane	10.00%	17.23%	3.13%
BOJANALA TOTAL		7.20%	14.05%	1.55%
Central	Ratlou	-4.50%	0.14%	-4.02%
	Tswaing	2.30%	8.80%	-0.95%
	Mafikeng	4.90%	11.22%	0.31%
	Ditsobotla	8.40%	15.37%	2.20%
	Ramotshere Moiloa	5.90%	12.85%	0.93%
CENTRAL TOTAL		5.40%	11.91%	0.57%
Bophirima	Kagisano	10.20%	16.47%	3.12%
	Naledi	2.70%	8.92%	-0.77%
	Mamusa	10.40%	17.53%	3.16%

	Greater Taung	6.20%	13.50%	1.22%
	Molopo	-20.00%	-14.24%	-8.99%
	Lekwa-Teemane	-1.60%	4.76%	-2.39%
BOPHIRIMA TOTAL		3.70%	10.40%	0.12%
Southern	Ventersdorp	4.40%	12.29%	0.09%
	Potchefstroom	5.80%	12.49%	0.93%
	City of Matlosana	3.90%	10.55%	-0.01%
	Maquassi Hills	7.30%	15.21%	1.66%
	Merafong City	1.30%	8.23%	-1.12%
SOUTHERN TOTAL		3.90%	10.73%	0.06%

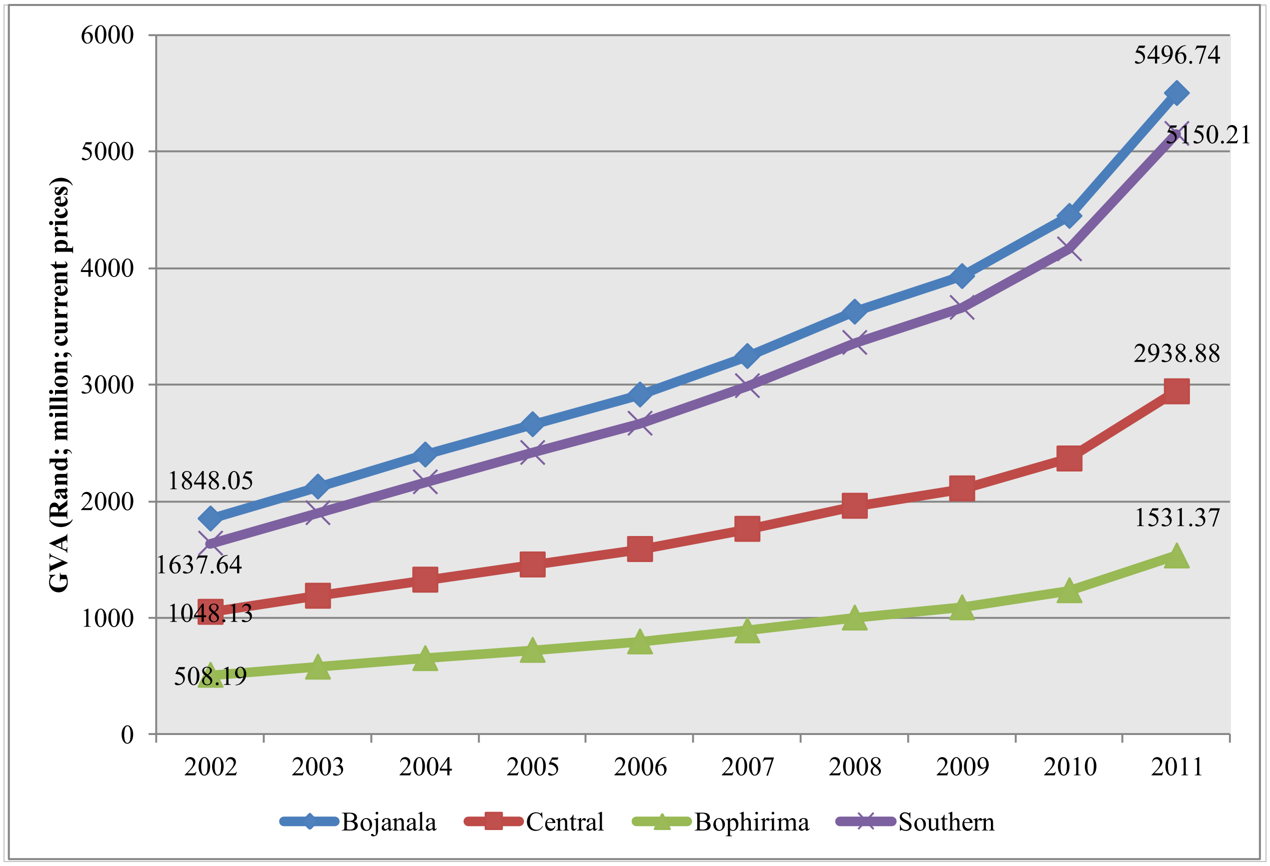
Source: Quantec Easy Data, 2013

4.4.9 Spatial contributions to output, employment and profit in community, social and personal services

4.4.9.1 Spatial trends in community, social and personal service output

The NWP‟s share in community, social and personal services output was 9.07% in 2011 (see Table 4.3). Community, social and personal services output per district municipality in the NWP between 2002 and 2011 is illustrated in Figure 4.29. The main production centres in the NWP at the district municipality level were the Bojanala and Southern District Municipalities. Output increased from R1.84 billion in 2002 to R5.49 billion in 2011 in Bojanala. City of Matlosana and Rustenburg were the main production centres in the NWP for community, social and personal services in 2011. Other important centres were Madibeng and Potchefstroom (see Table 4.22).

Figure 4.29: Community, social and personal services output per district municipality between 2002 and 2011

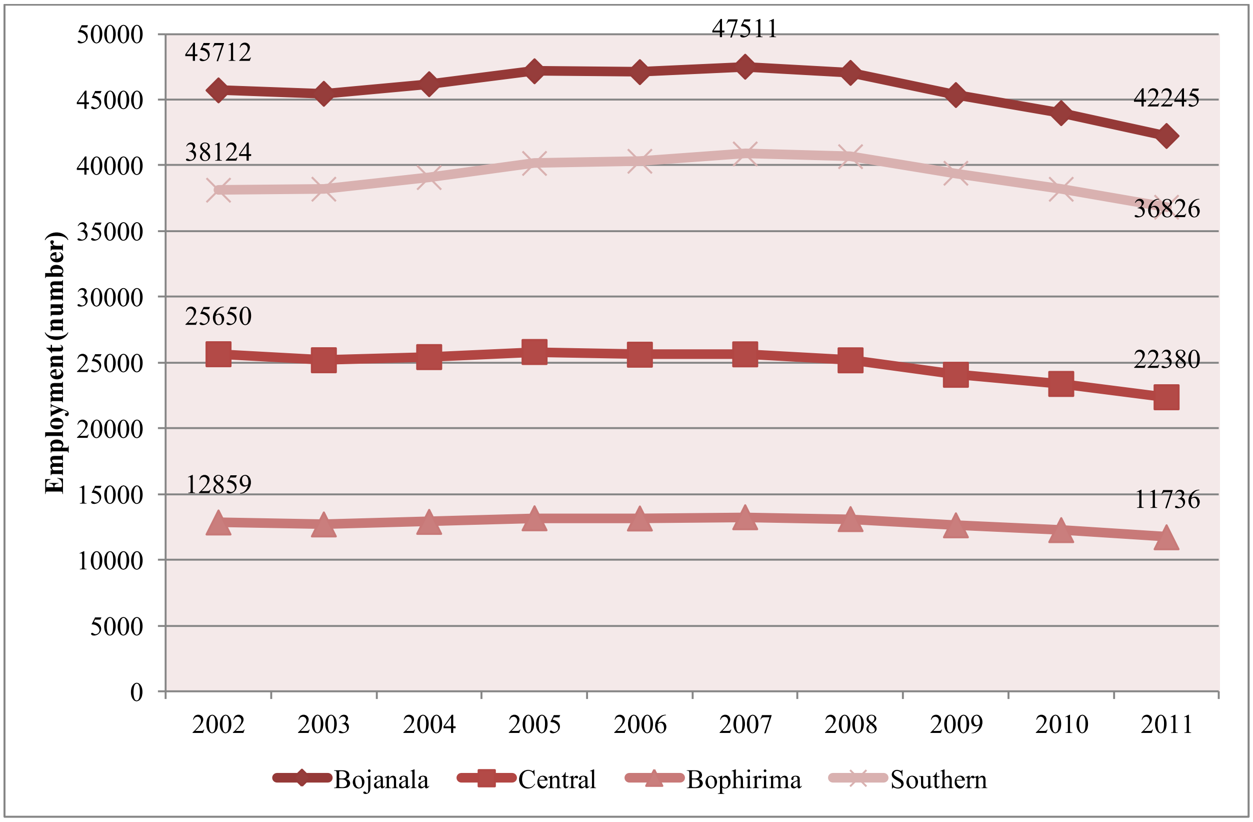


Source: Quantec Easy Data, 2013

4.4.9.2 Spatial trends in community, social and personal services employment

Employment in the community, social and personal services sector was highest in the Bojanala and Southern District Municipalities, as shown in Figure 4.30. The NWP provided 6.15% of employment in the community, social and personal services sector in 2011. The main centres of community, social and personal services employment were Madibeng (11.15%), Rustenburg (14.26%) and City of Matlosana (14.14%), which together provided 39.55% of employment in the community, social and personal services sector in 2011, as shown in Table 4.22.

Figure 4.30: Community, social and personal services employment per district municipality in the NWP between 2002 and 2011

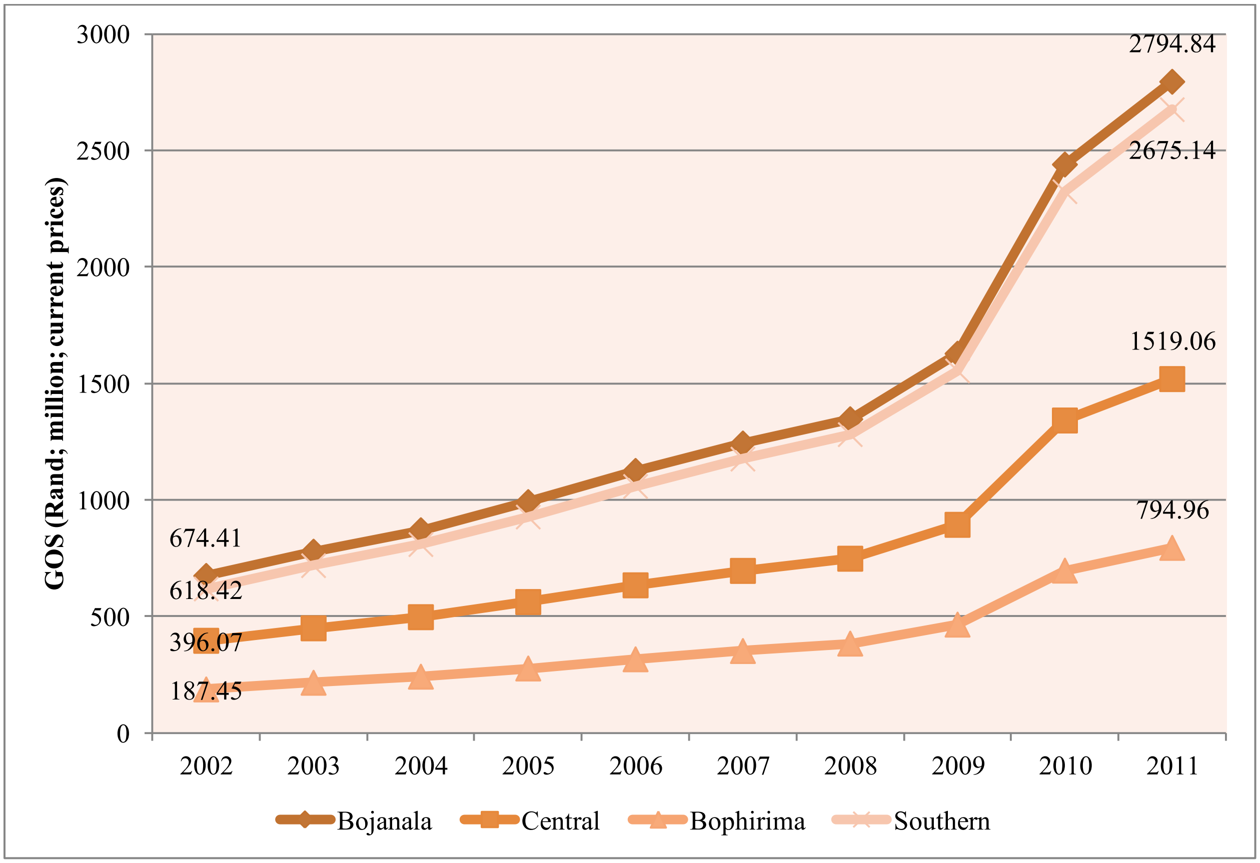


Source: Quantec Easy Data, 2013

4.4.9.3 Spatial trends in community, social and personal services profit

The NWP‟s share in profits in the community, social and personal services sector was 9.38% (see Table 4.5). Profits in the community, social and personal services sector increased in all four district municipalities between 2002 and 2011 (see Figure 4.31). The Bojanala D and Southern District Municipalities have the leading shares of profit in the community, social and personal services sector and together they accounted for 70% of NWP profits in 2011.

Figure 4.31: Community, social and personal services profit per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

At local municipal level, profits in the community, social and personal services sector were highest in the City of Matlosana and Rustenburg. Other main profit centres in the community, social and personal services sector in the NWP in 2011 were Potchefstroom, Madibeng, Mafikeng and Merofong City, as illustrated in Table 4.22.

Table 4.22: Spatial contributions to output, employment and profit in community, social and personal services in 2011

District municipality	Local municipality	Output			Employment			Profit		
		GVA (Rand; million; current prices)	% share	Rank	Employment (number)	% share	Rank	GOS (Rand; million; current prices)	% share	Rank
Bojanala	Moretele	851.1	5.11	9	6508	5.75	8	389.18	5	8
	Madibeng	1687.1	10.13	3	12622	11.15	3	743.01	9.55	4
	Rustenburg	2380.93	14.3	1	16141	14.26	1	1099.97	14.13	2
	Kgetlengrivier	91.18	0.55	20	815	0.72	20	36.61	0.47	20
	Moses Kotane	1045.15	6.28	7	6158	5.44	9	526.07	6.76	7
BOJANALA TOTAL		6055.46			42244			2794.84		
Central	Ratlou	171.69	1.03	18	1136	1	18	85.35	1.1	17
	Tswaing	400.42	2.4	12	3240	2.86	11	173.4	2.23	12
	Mafikeng	1374.08	8.25	5	8288	7.32	5	699.15	8.98	5
	Ditsobotla	857.46	5.15	8	7002	6.19	7	361.46	4.64	10
	Ramotshere Moiloa	405.34	2.43	11	2713	2.4	13	199.69	2.57	11
CENTRAL TOTAL		3208.99			22379			1519.05		
Bophirima	Kagisano	219.23	1.32	16	1439	1.27	17	107.81	1.38	15
	Naledi	343.03	2.06	14	2586	2.28	14	153.69	1.97	14
	Mamusa	226.68	1.36	15	1785	1.58	15	95.15	1.22	16
	Greater Taung	736.73	4.42	10	4611	4.07	10	373.29	4.8	9
	Molopo	29.38	0.18	21	272	0.24	21	10.96	0.14	21
	Lekwa-Teemane	126.3	0.76	19	1044	0.92	19	54.06	0.69	19
BOPHIRIMA TOTAL		1681.35			11737			794.96		
Southern	Ventersdorp	174.47	1.05	17	1504	1.33	16	71.93	0.92	18
	Potchefstroom	1506.68	9.05	4	7905	6.98	6	764.84	9.83	3
	City of Matlosana	2370.56	14.23	2	16001	14.14	2	1122.35	14.42	1
	Maquassi Hills	358.11	2.15	13	2808	2.48	12	155.11	1.99	13
	Merafong City	1299.66	7.8	6	8608	7.61	4	560.91	7.21	6
SOUTHERN TOTAL		5709.48			36826			2675.14		

Source: Quantec Easy Data, 2013

4.4.9.4 Spatial growth trends in community, social and personal services

The average annual growth in output in the four district municipalities was positive in the period between 2002 and 2011. The Southern District Municipality experienced the highest growth, 3.9%, in output in the period 2002 to 2011 (see Table 4.23). The Lekwa-Teemane, Molopo and Kgetlengrivier local municipalities experienced a decline in output in the community, social and personal services sector between 2002 and 2011. Employment growth was negative for all district and local municipalities in the community, social and personal services sector. The sharpest decline in employment in the community, social and personal services sector was experienced in Kgetlengrivier (-17%) and Molopo (-17.2%). Profit growth was above 10% across all district and local municipalities in the NWP between 2002 and 2011.

Table 4.23: Average annual growth in community, social and personal services output, employment and profit between 2002 and 2011

District municipality	**Local municipality**	**Output growth**	**Employment growth**	**Profit growth**
Bojanala	Moretele	5.40%	-8.6%	21.0%
	Madibeng	3.20%	-10.6%	18.4%
	Rustenburg	3.50%	-10.4%	18.9%
	Kgetlengrivier	-3.90%	-17.0%	11.1%
	Moses Kotane	0.60%	-12.5%	15.6%
BOJANALA TOTAL		2.90%	-10.8%	18.3%
Central	Ratlou	0.80%	-12.4%	15.9%
	Tswaing	2.90%	-11.0%	18.5%
	Mafikeng	1.50%	-11.9%	16.5%
	Ditsobotla	4.10%	-9.8%	19.8%
	Ramotshere Moiloa	0.20%	-13.0%	15.2%
CENTRAL TOTAL		2.10%	-11.3%	17.2%
Bophirima	Kagisano	1.50%	-12.1%	16.7%
	Naledi	3.40%	-10.6%	18.9%
	Mamusa	3.40%	-10.5%	19.1%
	Greater Taung	4.30%	-9.4%	19.6%
	Molopo	-4.40%	-17.2%	10.7%

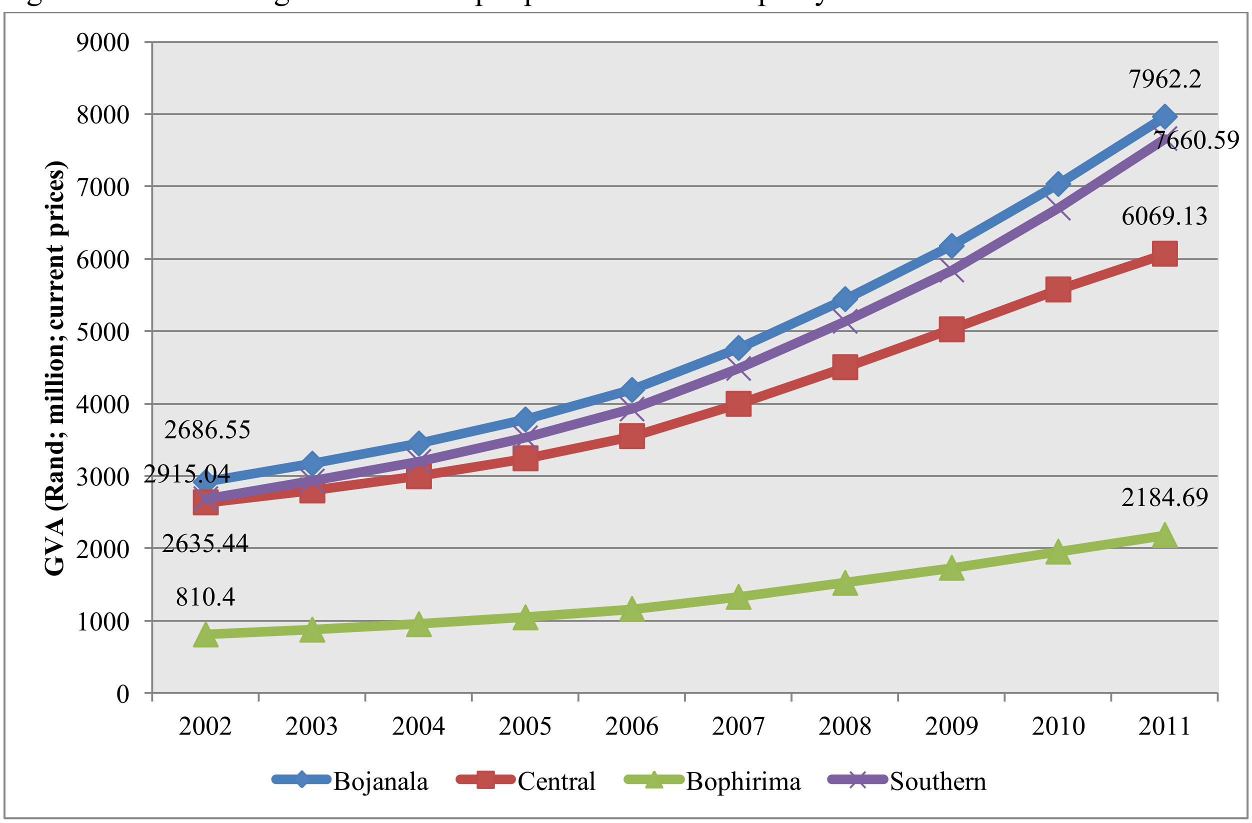
	Lekwa-Teemane	-0.10%	-13.5%	15.1%
BOPHIRIMA TOTAL		2.90%	-0.4%	18.4%
Southern	Ventersdorp	5.60%	-8.7%	21.5%
	Potchefstroom	2.60%	-10.8%	17.8%
	City of Matlosana	3.60%	-10.3%	19.0%
	Maquassi Hills	5.60%	-8.6%	21.3%
	Merafong City	3.60%	-10.7%	19.2%
SOUTHERN TOTAL		3.50%	-10.3%	18.8%

Source: Quantec Easy Data, 2013

4.4.10 Spatial contributions to output, employment and profit in general government

4.4.10.1 Spatial trends in general government output

Figure 4.32: General government output per district municipality between 2002 and 2011

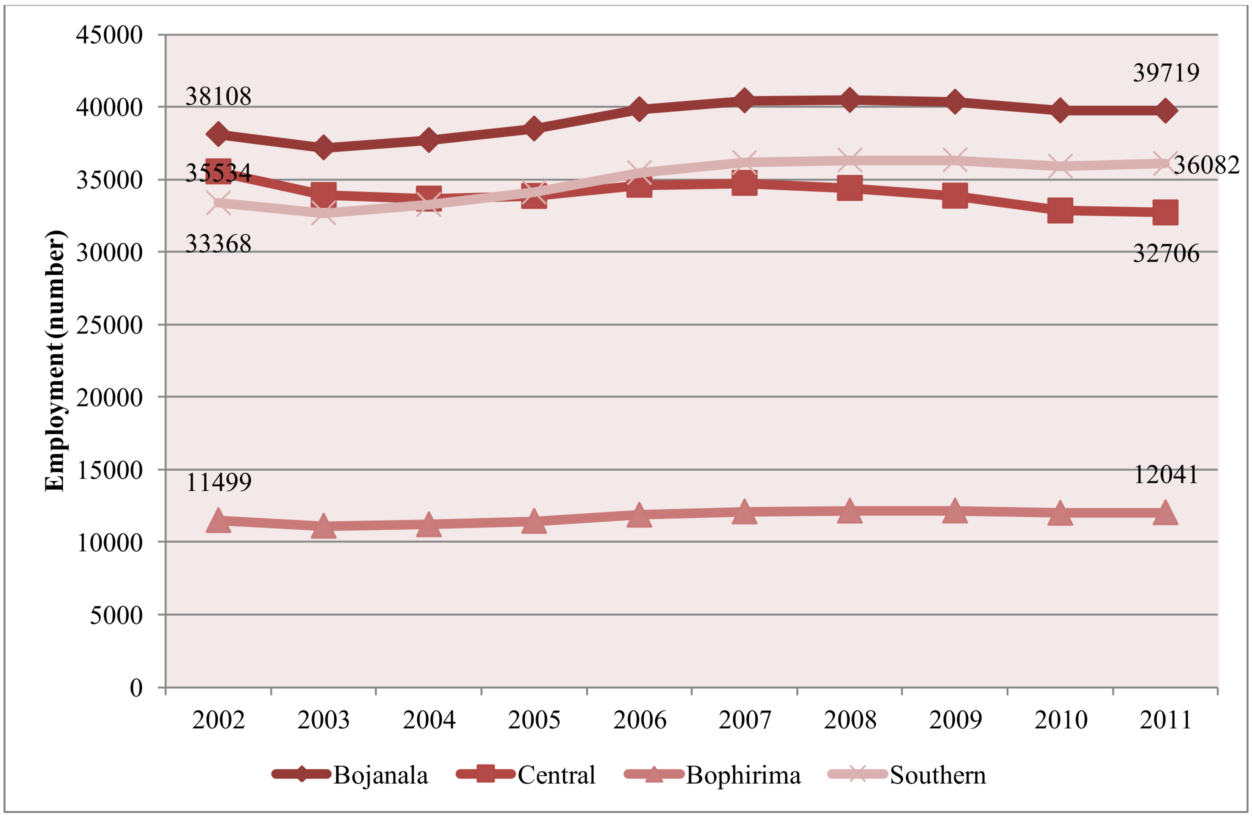


Source: Quantec Easy Data, 2013

The NWP contributed 5.49% to general government output in 2011 (see Table 4.3). The Bojanala and Southern District Municipalities were the leading centres for general government output between 2002 and 2011, as depicted in Figure 4.32. The Central District Municipality ranked third and Bophirima ranked last (see Figure 4.32). Mafikeng contributed the most (16.73%) to general government output in the NWP in 2011 at local municipal level. Other main contributors were Rustenburg (14.62%), Potchefstroom (12.54%) and City of Matlosana (12.2%) (see Table 4.24).

4.4.10.2 Spatial trends in general government employment

Figure 4.33: General government employment per district municipality in the NWP between 2002 and 2011



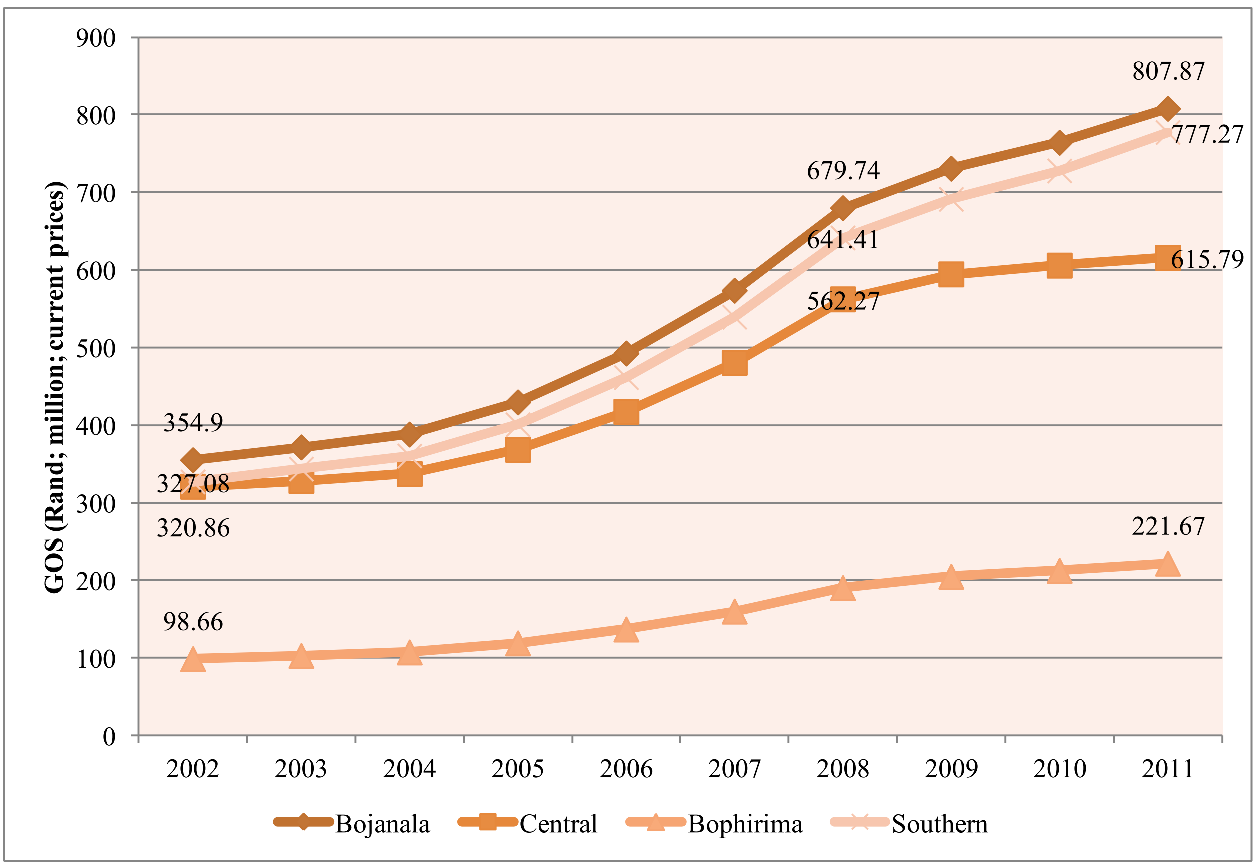
Source: Quantec Easy Data, 2013

The NWP contributed 6.37% to national employment in the general government sector in 2011 (see Table 4.4). This was spread out across the in the Bojanala (33%), Southern (30%) and Central (27%) District Municipalities. The Bophirima District Municipality contributed the least, 12 041 jobs (10%), to provincial employment in the general government sector in 2011 (see Figure 4.33). The main centre of employment for the general government sector in the NWP in 2011 was Mafikeng. The least contributions (less than 1%) to employment in the general government sector were from Kgetlengrivier, Ratlou, Mamusa, Molopo, Lekwa-Teemane and Ventersdorp (see Table 4.24).

4.4.10.3 Spatial trends in general government profit

Following the trends in output and employment in the general government sector, the Bojanala District Municipality was the leading profit earner between 2002 and 2011. The NWP contributed 5.49% to national profits in the general government sector.

Figure 4.34: General government profit per district municipality in the NWP between 2002 and 2011



Source: Quantec Easy Data, 2013

The top five profit-earning centres in the general government sector, Mafikeng, Rustenburg, Potchefstroom and City of Matlosana, accrued 43.45% of profits (see Table 4.24).

Table 4.24: Spatial contributions to output, employment and profit in general government in 2011

District municipality	Local municipality	Output			Employment			Profit		
		GVA (Rand; million; current prices)	% share	Rank	Employment (number)	% share	Rank	GOS (Rand; million; current prices)	% share	Rank
Bojanala	Moretele	1132.89	4.74	8	6519	5.41	7	114.95	3.68	8
	Madibeng	2086.25	8.74	5	11556	9.59	5	211.68	6.77	5
	Rustenburg	3491.02	14.62	2	14297	11.86	3	354.21	11.32	2
	Kgetlengrivier	68.46	0.29	20	452	0.38	20	6.95	0.22	20
	Moses Kotane	1183.58	4.96	7	6894	5.72	6	120.09	3.84	7
BOJANALA TOTAL		7962.2			39718			807.88		
Central	Ratlou	159.82	0.67	17	1020	0.85	16	16.22	0.52	17
	Tswaing	376.26	1.58	13	2228	1.85	13	38.18	1.22	13
	Mafikeng	3994.92	16.73	1	20433	16.95	1	405.34	12.96	1
	Ditsobotla	857.43	3.59	10	4927	4.09	10	87	2.78	10
	Ramotshere Moiloa	680.71	2.85	12	4098	3.4	11	69.07	2.21	12
CENTRAL TOTAL		6069.14			32706			615.81		
Bophirima	Kagisano	281.91	1.18	14	1798	1.49	14	28.6	0.91	14
	Naledi	684.73	2.87	11	2837	2.35	12	69.47	2.22	11
	Mamusa	139.54	0.58	18	826	0.69	18	14.16	0.45	18
	Greater Taung	933.38	3.91	9	5663	4.7	9	94.7	3.03	9
	Molopo	12.89	0.05	21	80	0.07	21	1.31	0.04	21
	Lekwa-Teemane	132.24	0.55	19	837	0.69	18	13.42	0.43	19
BOPHIRIMA TOTAL		2184.69			12041			221.66		
Southern	Ventersdorp	182.29	0.76	16	1029	0.85	16	18.5	0.59	16
	Potchefstroom	2993.14	12.54	3	13087	10.86	4	303.69	9.71	3
	City of Matlosana	2913.82	12.2	4	14598	12.11	2	295.65	9.45	4
	Maquassi Hills	280.9	1.18	14	1499	1.24	15	28.5	0.91	14

	Merafong City	1290.45	5.4	6	5870	4.87	8	130.93	4.19	6
SOUTHERN TOTAL		7660.6			36083			777.27		

Source: Quantec Easy Data, 2013

4.4.10.4 Spatial growth trends in general government

The average annual growth rates in output, employment and profit in the general government sector are shown in Table 4.25. From Table 4.25, it is evident that the Central District Municipality experienced slower output growth rates in the general government sector relative to other district municipalities. Output growth was mostly positive at the local municipality level with the exception of Molopo (-6.6%), Kgetlengrivier (-5.3%), Lekwa-Teemane (-1.2%) and Ratlou (-0.3%; see Table 4.25). Employment growth was positive for three district municipalities. The highest average annual growth rates in employment were experienced in Moretele, Maquassi Hills and Ventersdorp. Profit in the sector was also highest in Maquassi Hills. The following section provides a spatial overview of the sub-sectors.

Table 4.25: Average annual growth in general government output, employment and profit between 2002 and 2011

District municipality	**Local municipality**	**Output growth**	**Employment growth**	**Profit growth**
Bojanala	Moretele	5.50%	3.2%	12.8%
	Madibeng	3.20%	0.6%	10.0%
	Rustenburg	4.00%	1.1%	11.2%
	Kgetlengrivier	-5.30%	-7.4%	1.2%
	Moses Kotane	0.10%	-2.1%	7.0%
BOJANALA TOTAL		3.17%	0.5%	10.3%
Central	Ratlou	-0.30%	-2.6%	6.6%
	Tswaing	2.80%	0.2%	9.9%
	Mafikeng	0.90%	-0.9%	7.9%
	Ditsobotla	4.10%	1.8%	11.2%
	Ramotshere Moiloa	-0.70%	-3.3%	6.1%
CENTRAL TOTAL		1.18%	-0.8%	8.1%

Bophirima	Kagisano	0.80%	-0.8%	7.7%
	Naledi	3.60%	0.6%	10.8%
	Mamusa	3.30%	0.8%	10.4%
	Greater Taung	4.10%	2.1%	11.3%
	Molopo	-6.60%	-9.0%	-0.1%
	Lekwa-Teemane	2.92%	-3.7%	5.6%
BOPHIRIMA TOTAL		2.92%	0.4%	10.0%
Southern	Ventersdorp	6.20%	3.5%	13.4%
	Potchefstroom	3.00%	0.2%	10.1%
	City of Matlosana	3.70%	1.0%	10.8%
	Maquassi Hills	5.90%	3.3%	13.2%
	Merafong City	4.30%	1.6%	11.4%
SOUTHERN TOTAL		3.64%	0.9%	10.8%

Source: Quantec Easy Data, 2013

4.5 Spatial overview of the detailed/sub-sector sectors for the NWP

As indicated in section 4.1.1, the Quantec Database does not provide detailed sector data for the agriculture, forestry and fishing; mining and quarrying; construction; community, social and personal services and general government. As a result, the data for these sectors presented in this section are the same as discussed earlier in the chapter. This section only provides an overview of the performance of the local municipalities in each detailed sector. This is achieved by analysing the output values in 2011 and the share of profits accruing to each local municipality in each detailed sector. In addition, the analysis also includes the employment number per detailed sector per local municipality. The terms detailed sectors and sub-sectors will be used interchangeably throughout this section. The detailed sectors are aggregated and reported under three sub-headings; primary, secondary and tertiary sectors. An appendix (see Appendix A) containing the actual figures used to construct maps in this section is provided. The subsequent section will discuss the shares of output, profit and employment of each sub-sector across all local municipalities in the primary sector.

4.5.1 Primary sector

Figures 4.35 and 4.36 illustrate the output values and the percentage share of profits per detailed sector in the primary sectors across the local municipalities of the NWP in 2011. Figure 4.37 shows the employment numbers per detailed sector in the primary sectors across the local municipalities of the NWP in 2011.

4.5.1.1 Agriculture forestry and fishing

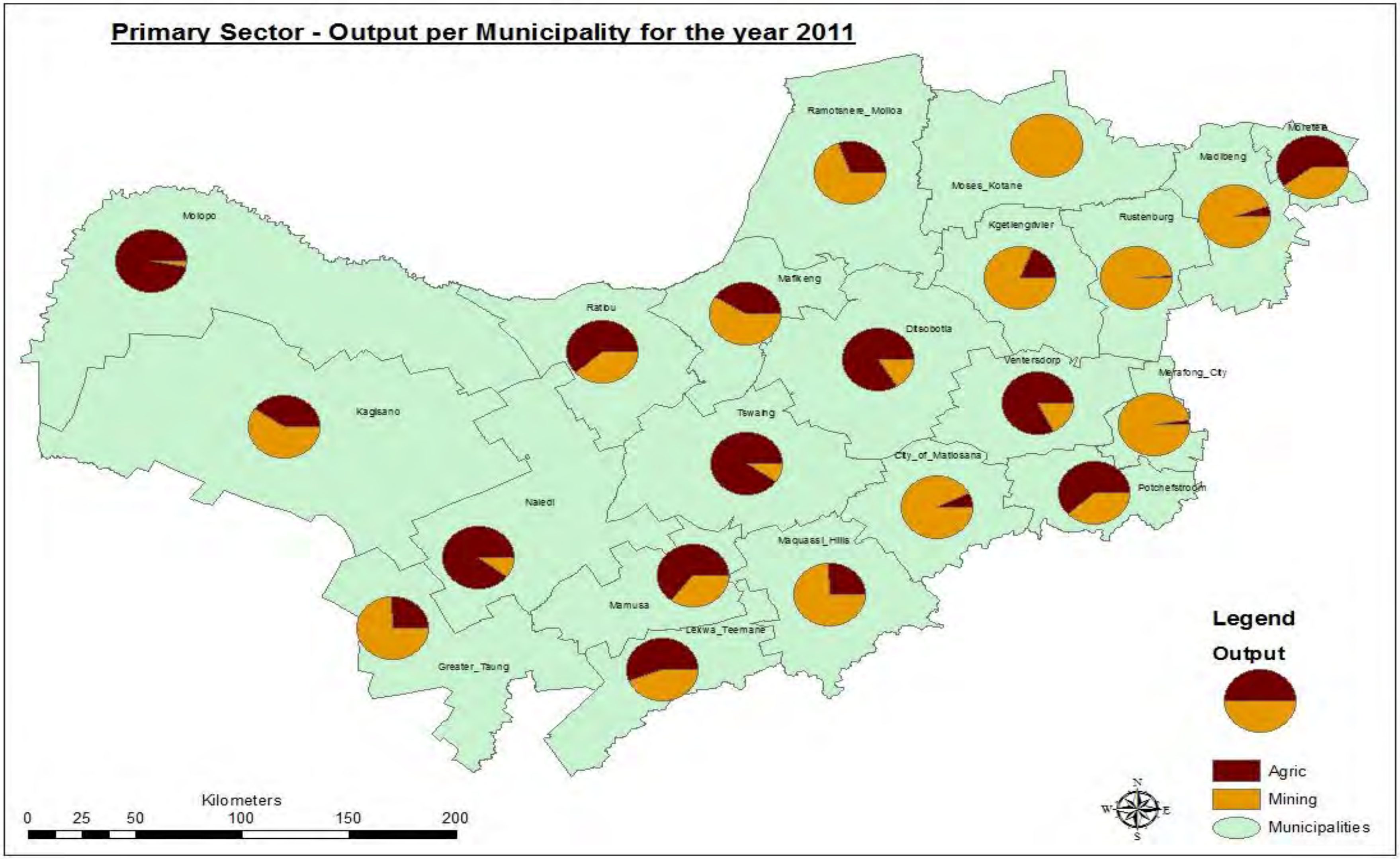
As discussed in section 4.4.1.1, the most significant contributors to agriculture, forestry and fishing output in 2011 were the local municipalities of Madibeng (R530.5 million) and Ditsobotla (R525.1 million; see Figure 4.32). The Greater Taung local municipality contributed the least to agriculture forestry and fishing. Profits in agriculture forestry and fishing were concentrated in the local municipality of Madibeng (11.67%), Ditsobotla local municipality (11.33%) and the Potchefstroom local municipality (9.2%). The following local municipalities contributed less than 1% to manufacturing GOS; Moses Kotane (0.85%) and Greater Taung (0.8%; see Figure 4.36). Employment was concentrated in the local municipalities of Madibeng (4 341), Ditsobotla (3 965) and Potchefstroom (3 393). The local municipalities with the smallest contribution to agriculture, forestry and fishing employment in the NWP in 2011 were Moses Kotane (339) and Greater Taung (333; see Figure 4.37).

4.5.1.2 Mining and quarrying

Mining and quarrying output was highly concentrated in Rustenburg, which contributed R35.31 billion to mining and quarrying output in the NWP in 2011. This was a 52.68% contribution to mining and quarrying output in 2011 (see Figure 4.35). Other local municipalities making relatively high contributions to mining and quarrying output were the Madibeng, Merofong and Moses Kotane, Molopo, Naledi and Ventersdorp local municipalities. Profits in mining and quarrying in the NWP in 2011 were densely concentrated (80%) in three local municipalities, i.e. Rustenburg (57.94%), Madibeng (15.36%) and Merofong city (6.31%) (see Figure 4.36). Mining and quarrying employment in the NWP was highly concentrated in the Rustenburg local municipality (114 557). Other main centres of mining and quarrying employment in NWP in

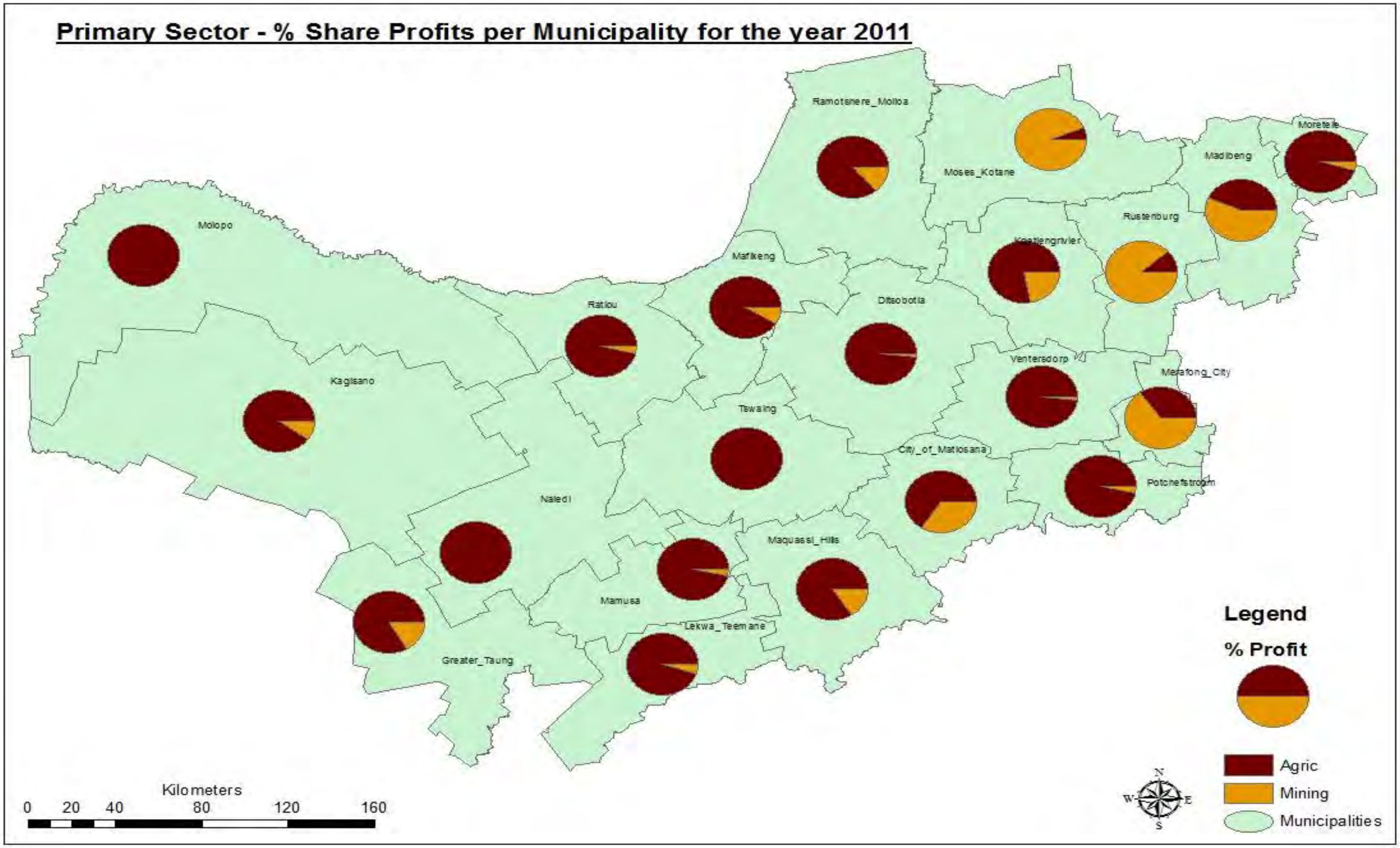
2011 were Merafong City, Madibeng, City of Matlosana and Moses Kotane (see section 4.4.2.2 and Figure 4.37). The local municipalities contributing the least to mining and quarrying employment in 2011 were Tswaing (177), Naledi (57) and Molopo (11). The NWP in 2011 produced 25.6% of the mining and quarrying output and accounted for 85.9% of profits in the sector. The largest employer in the NWP economy across all industries was the mining and quarrying sector, employing 251 385 people (42.3%) in 2011 (Quantec, 2012). The mining sector in South Africa employs approximately 600 000 people indicating that the NWP is a significant contributor to employment in this sector (North West Provincial Government, 2013).

Figure 4.35: Primary sector output per local municipality in the NWP in 2011



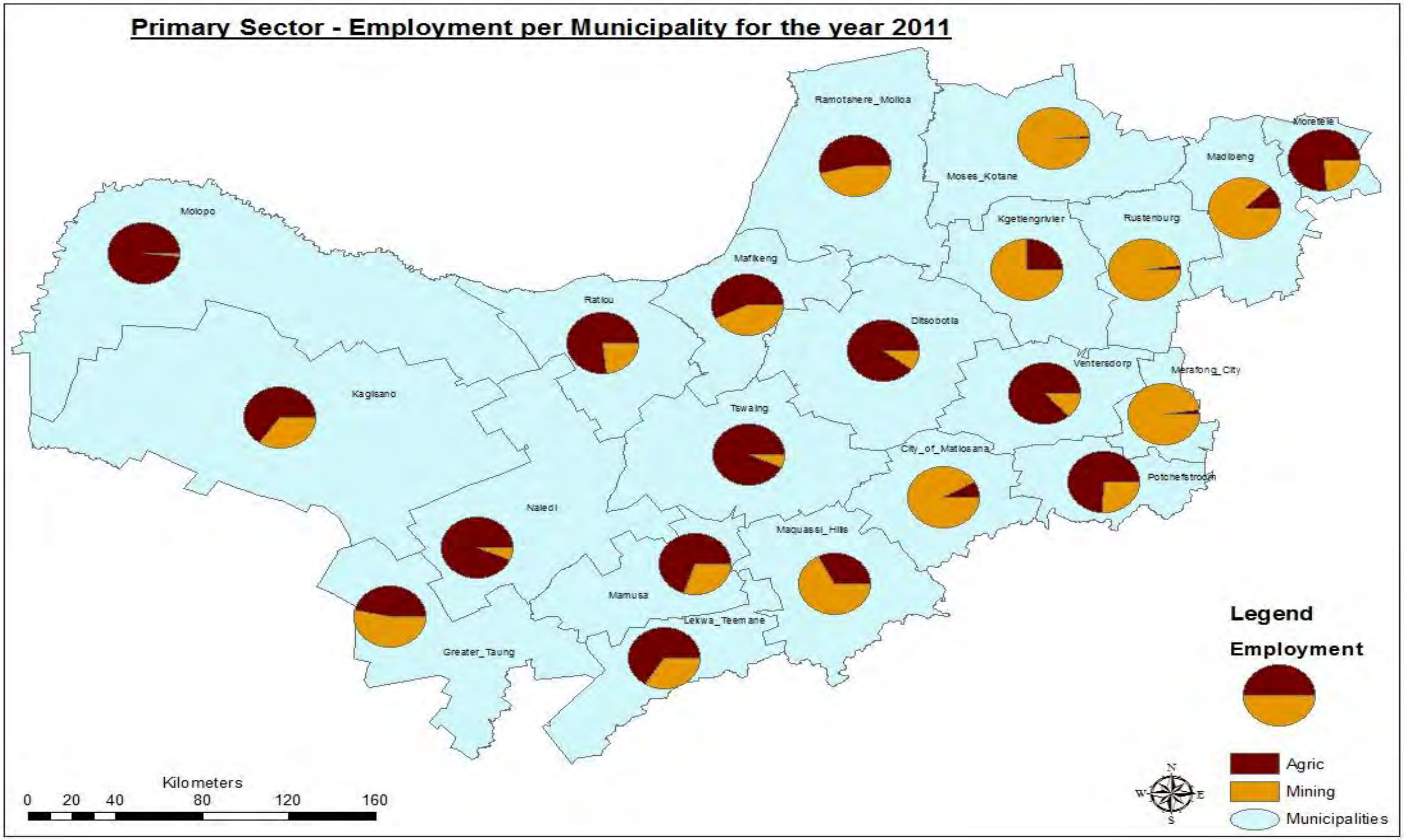
Source: Quantec Easy Data, 2013

Figure 4.36: Primary sector: Share of profits per local municipality in the NWP in 2011



Source: Quantec Easy Data, 2013

Figure 4.37: Primary sector: Employment (number) per local municipality in the NWP in 2011



Source: Quantec Easy Data, 2013

4.5.2 Secondary sector

Figures 4.38, 4.39 and 4.40 illustrate the output values, the percentage share of profits and the employment numbers per detailed sector in the secondary sectors across the local municipalities of the NWP in 2011.

4.5.2.1 Food, beverages and tobacco

Food, beverages and tobacco"s output was the highest in the City of Matlosana (R 372.29 billion) and Rustenburg local municipalities ((R351.64 billion; see Figure 4.38). The least contributions were from the Kgetlengrivier (R25.13 million) and Mamusa (R 19.28 million) local municipalities. Following the trends in output, the Molopo local municipality accrued no profits in this sub-sector. Mamusa accrued the second least share of profits (0.66%) and Kgetlengrivier the third least (0.94%) (see Figure 4.39). The biggest employers and the respective number of people employed were City of Matlosana (1 944), Madibeng (1 506), Ditsobotla (1 460), Rustenburg (1 422) and Mafikeng (1365; see Figure 4.40). These trends can be attributed in part to a large Rainbow Chickens processing plant that is located in Rustenburg to take advantage of the close proximity to markets in Gauteng. As a result Rustenburg contributed significantly to the sub-sector"s output and employment (North West Business, 2013).

4.5.2.2 Textiles, clothing and leather goods

In the textiles clothing and leather goods sub-sector, the Madibeng local municipality produced the highest share of output, i.e. R62.34 million of the R182.21 million produced in the NWP in 2011, as depicted in Figure 4.38. Other important centres of textiles, clothing and leather goods manufacturing were the Moretele, Moses Kotane, Rustenburg, City of Matlosana and Mafikeng local municipalities. Profits in the sub-sector were concentrated in the Madibeng, Moretele and Moses Kotane local municipalities (see Figure 4.39). The following local municipalities made the least contributions to employment (number of jobs) in the sub-sector in 2011; Ratlou (12), Ventersdorp (9), Kgetlengrivier (7), Lekwa-Teemane (6), Mamusa (3) and Molopo (0; see Figure 4.40).

4.5.2.3 Wood, paper, publishing and printing

The local municipality of Madibeng, Moses Kotane, City of Matlosana and Mafikeng were the main contributors to wood, paper, publishing and printing output in the NWP in 2011, as depicted in Figure 4.38. There was no production of wood, paper, publishing and printing in the Molopo local municipality in 2011. The Madibeng and Moses Kotane local municipalities were the largest employers and wage earners in the sub-sector in 2011 (see Figure 4.40).

4.5.2.4 Petroleum products, chemicals, rubber and plastic

Output in the petroleum products, chemicals, rubber and plastic sub-sector in the NWP amounted to R1.67 billion. This was concentrated in Madibeng (R394.53 billion) and Potchefstroom (R296.74 billion). Other main producing regions in the sub-sector were City of Matlosana, Rustenburg and Moses Kotane (see Figure 4.38). The main profit-earning centres for this sub-sector were Potchefstroom, Maquassi Hills and Moses Kotane (see Figure 4.39). Employment in the sub-sector was relatively low in comparison to other sub-sectors. The main employment centres were Potchefstroom and Moses Kotane (see Figure 4.40). The largest chalk and crayon factory in South Africa is located in Potchefstroom.

4.5.2.5 Other non-metal mineral products

Output and profit were concentrated in the Ditsobotla, Mafikeng and Madibeng local municipalities in the NWP. Naledi, Ventersdorp, Tswaing, Lekwa-Teemane, Kgetlengrivier, Maquassi hills, Ratlou, Mamusa and Molopo made the least contribution to output and profit (less than 1 %). Ditsobotla, Mafikeng and Madibeng were the main employers in the other non-metal mineral products sub-sector. On average, these three local municipalities employed 1 137 people in 2011. The processing of mineral ores is a major activity in the NWP. The other non-metal mineral products sub-sector was the second leading contributor (9.1%) to national employment in the NWP in 2011 (see Table 4.4). The sub-sector contributed 7.1% to national output and 7.7 to national GOS in 2011 (Quantec, 2012). The NWP"s heavy industrial capacity is heavily dominated by Ferrochrome production. There are ferrochrome smelting and processing plants at Kroondal (Xstrata Alloys), Rustenburg (Samancor Chrome Mines) and Madibeng (Hernic Ferrochrome) in the NWP.

4.5.2.6 Metals, metal products, machinery and equipment

The leading producing local municipalities in the metals, metal products, machinery and equipment sub-sector were Madibeng, Rustenburg and City of Matlosana. Likewise, the proportions of profits in the sub-sector were highest in these three local municipalities. Steel manufacturing is the main manufacturing activity in the City of Matlosana, although large concentrations of cable suppliers and engineering works also exist in the local municipality (North West Business, 2013). This sub-sector employed the second largest number of people (13 416) in the NWP in 2011. The main employers at the local municipal level were Madibeng, Rustenburg and City of Matlosana. This is owing to the presence of a Bosch plant in the local municipality of Madibeng, which specialises in the production of starters, alternators, braking systems and electronic control units (North West Business, 2013). Other products that are produced in the NWP for the automotive industry are electrical-wiring looms and automotive safety glass.

4.5.2.7 Electrical machinery and apparatus

The production of electrical machinery and apparatus was highly concentrated in Madibeng and Rustenburg (see section 4.4.2.6). Profits were also highly concentrated in these two local municipalities. No production and profits were recorded in the electrical machinery and apparatus sub-sector in the Molopo, Ventersdorp, Mamusa and Ratlou local municipalities (see Figures 4.38 and 4.39). 61% of employment in the sub-sector was localised in Madibeng local municipality (see Figure 4.40).

4.5.2.8 Radio, TV, instruments, watches and clocks

Radio, TV, instruments, watches and clocks output was low in the NWP in 2011. The leading producers in the sub-sector were the Madibeng and Moses Kotane local municipalities. There was no production of radio, TV, instruments, watches and clocks in Molopo, Ventersdorp, Maquassi Hills, Kgetlengrivier, Mamusa and Naledi. 62.13% of profits in the sub-sector accrued to firs in Madibeng, Moses Kotane and City of Matlosana. This sub-sector was the smallest contributor to employment (545 jobs; see Figure 4.40) in the NWP in 2011. Madibeng was the leading employer in this sub-sector, employing 164 people. Ventersdorp, Molopo, Maquassi Hills, Kgetlengrivier, Naledi and Mamusa provided no employment in this sub-sector in 2011. The radio, TV, instruments, watches and clocks sector"s output and contribution to employment were the smallest in the manufacturing sector in the NWP in 2011.

4.5.2.9 Transport equipment

The Madibeng local municipality was the leading producer of transport equipment in the NWP in 2011. Output in Madibeng in the transport equipment sector amounted to R611 million, almost seven times more than the second leading producer, Moretele (R90.98 million). Other main producers were City of Matlosana and Rustenburg. Profits were also densely concentrated in Madibeng (65.65%). All other local municipalities" share of profits was less than 10%. Employment in the transport equipment sector was highly concentrated in the local municipality of Madibeng, which provided 611 jobs (64%). The second leading employer, Moretele local municipality, employed 91 people.

4.5.2.10 Furniture and other manufacturing

The main producers in the furniture and other manufacturing sub-sector were Madibeng, City of Matlosana and the least contributors were Lekwa-Teemane and Mamusa. Profit shares in the sector were highest for firms in the Moretele local municipality (18.18%). Other main profit centres were Madibeng and Rustenburg. The highest employment in the sub-sector was localised in Madibeng, Kgetlengrivier and Moses Kotane (see Figure 4.40).

4.5.2.11 Electricity

The City of Matlosana generated the most electricity output (R468.04 million) in the NWP in 2011. The least contributions to electricity output were from Kagisano, Ratlou and Molopo. The Moretele local municipality was the most profitable centre for electricity generation, accruing

27.6% of profits in the sub-sector in 2011. Merafong City accrued no profits in electricity generation.

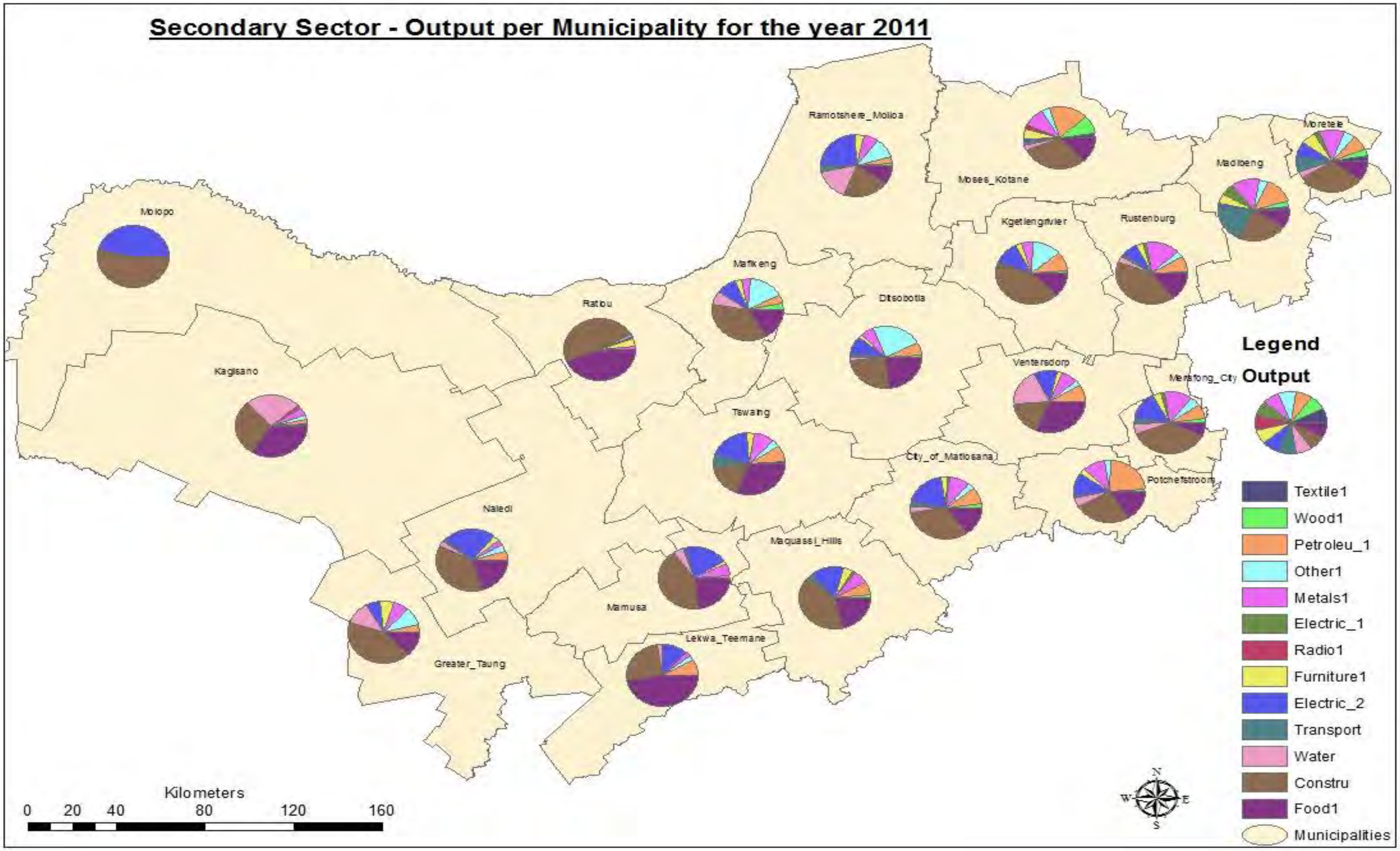
4.52.12 Water

Mafikeng, Rustenburg, Ramotshere Moila, Potchefstroom and City of Matlosana respectively contributed the most to water output in the NWP in 2011, as shown in Figure 4.38. Molopo and Maquassi Hills did not produce any output in this sub-sector in 2011. Profit earning followed the output trends, with Mafikeng, Rustenburg, Ramotshere Moila, Potchefstroom and City of Matlosana respectively accruing the highest proportions of profits in 2011.

4.5.2.13 Construction

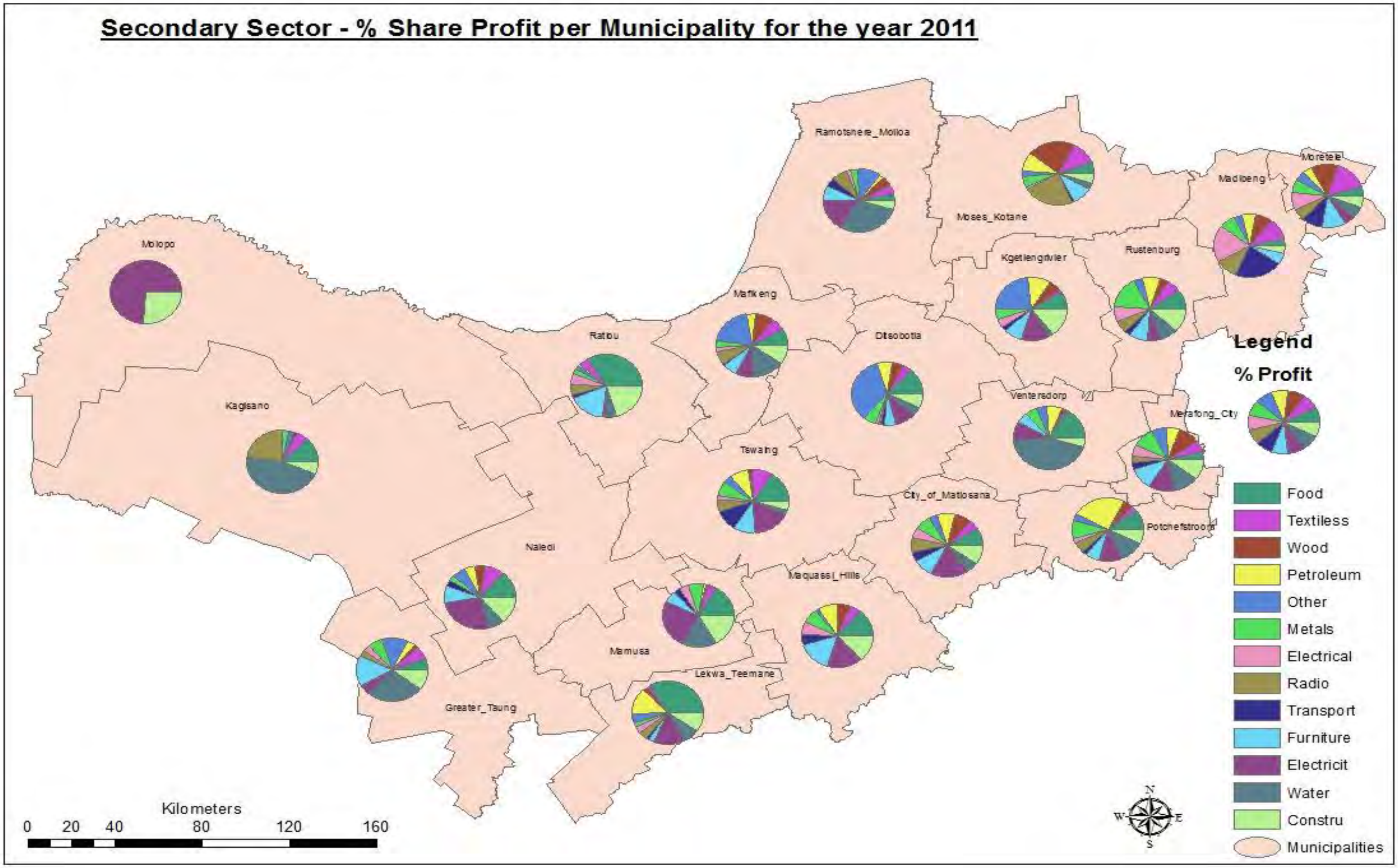
With output values above R500 billion in 2011, Rustenburg, City of Matlosana, Madibeng and Mafikeng respectively were the main contributors to construction output in 2011. These four local municipalities accrued 56.86% of profits in the sub-sector in 2011. The construction sector was by far the largest employer in the NWP in the secondary sector providing 40 724 jobs. Rustenburg, Madibeng and City of Matlosana were the main employment centres in the construction sector in 2011. Molopo and Kagisano employed the least number of people in the NWP construction sector.

Figure 4.38: Secondary sector output per local municipality in the NWP in 2011



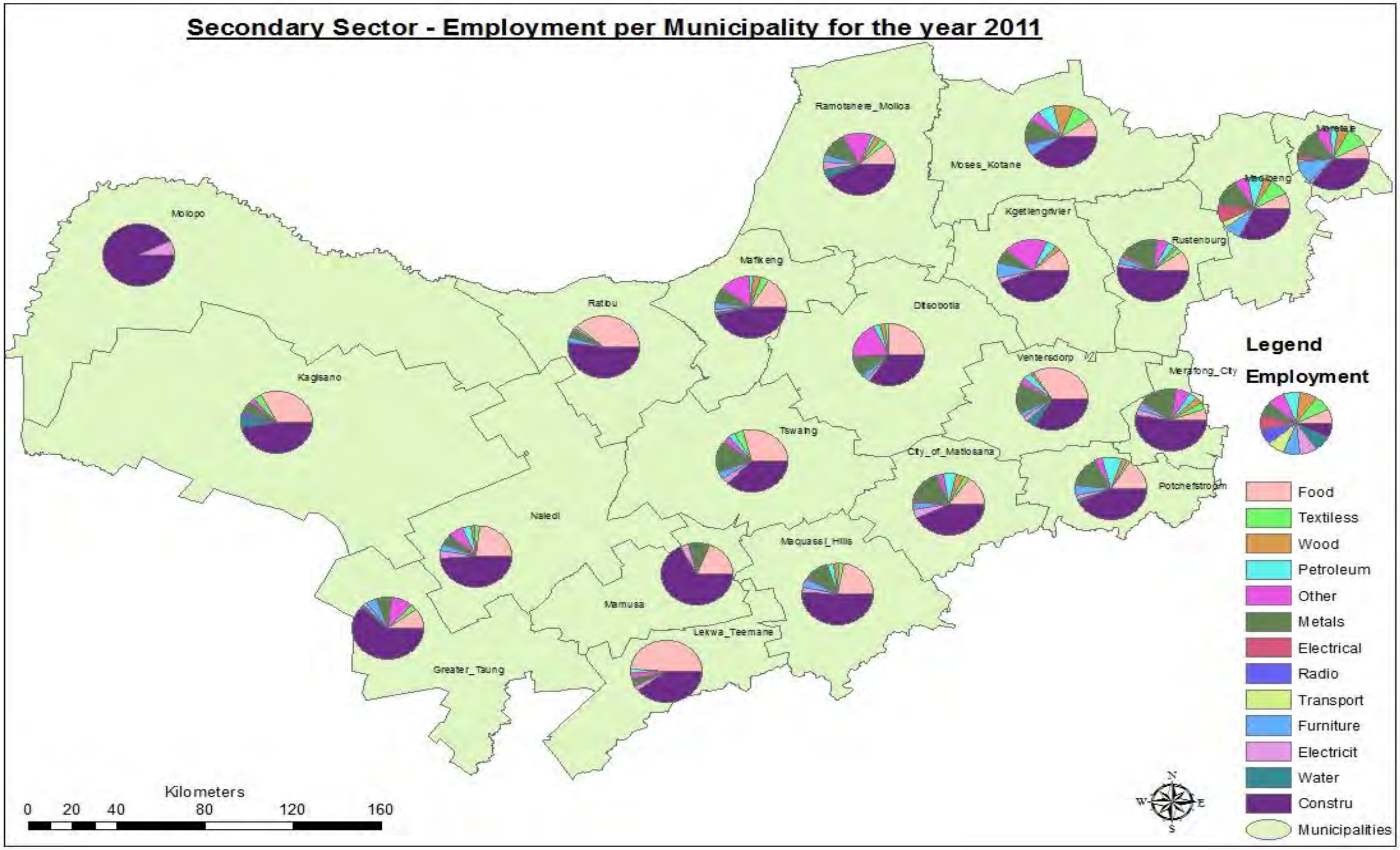
Source: Quantec Easy Data, 2013

Figure 4.39: Secondary sector: Share of profits per local municipality in the NWP in 2011



Source: Quantec Easy Data, 2013

Figure 4.40: Secondary sector: Employment (number) per local municipality in the NWP in 2011



Source: Quantec Easy Data, 2013

4.5.3 Tertiary sector

Figure 4.41 illustrates the output values; Figure 4.42 shows the percentage share of profits; and Figure 4.43 shows the employment numbers per detailed sector in the tertiary sector across the local municipalities of the NWP in 2011.

4.5.3.1 Wholesale and retail trade

The highest contributions to wholesale and retail trade output in 2011 in the NWP originated from City of Matlosana (R 2.97 billion), Rustenburg (R2.32 billion) and Madibeng (R 2.22 billion; see Figure 4.41). Consequently, these three local municipalities were the main profit centres in the wholesale and retail sub-sector. The NWP‟s wholesale and retail trade sub-sector was the largest employer in the tertiary sector in 2011. The main employment centres in the NWP in 2011 were City of Matlosana (25 366), Rustenburg (22 957) and Madibeng (21 089).

4.5.3.2 Catering and accommodation

Catering and accommodation output in the NWP in 2011 had the smallest contribution to tertiary sector output. The main centres of catering and accommodation output were Moses Kotane, Rustenburg, City of Matlosana, Madibeng and Mafikeng. Profits shares were high in Moses Kotane and Rustenburg, as shown in Figure 4.42. Employment in the sub-sector was high in Moses Kotane, Madibeng and Rustenburg.

4.5.3.3 Transport and storage

Transport and storage output in the NWP amounted to R9.72 billion in 2011. The main contributors to transport and storage output and profit were Rustenburg, Madibeng and City of Matlosana. The main employers were Rustenburg, Madibeng and Moses Kotane (see Figures 4.41 and 4.42).

4.5.3.4 Communication

The least contributions to communication output in the NWP originated from the Ratlou (R4.21 million) and Molopo (R208 000) local municipalities. The most profitable centres of communication services provision were Madibeng, Mafikeng, Rustenburg and City of Matlosana. The communication sub-sector contributed the least (2 828) to tertiary sector employment in the NWP. Madibeng (491) was the leading employer, followed by Rustenburg (485), Mafikeng (474) and City of Matlosana (408). Madibeng, Rustenburg, Mafikeng, City of Matlosana and Potchefstroom accrued 63.12% of profits in the sub-sector (see Figures 4.41 to 4.42).

4.5.3.5 Finance and insurance

Finance and insurance output in 2011 in the NWP amounted to R8.64 billion with R1.5 billion of it originating from Rustenburg. The highest and lowest proportions of profit earnings accrued to Rustenburg and Molopo, respectively. Rustenburg employed 1 985 people, while Molopo provided no jobs in the finance and insurance sub-sector. The smallest proportions of profits (less than 1%) in the finance and insurance sub-sector accrued to Tswaing, Kgetlengrivier, Ratlou, Kagisano, Lekwa-Teemane and Molopo (see Figure 4.42).

4.5.3.6 Business services

The business services sub-sector contributed the fourth largest share of output in the NWP"s tertiary sector in 2011. Rustenburg and Madibeng were the main production and profit-earning centres in the sub-sector. These two local municipalities also contributed the most to employment in the sub-sector.

4.5.3.7 Community, social and personal services

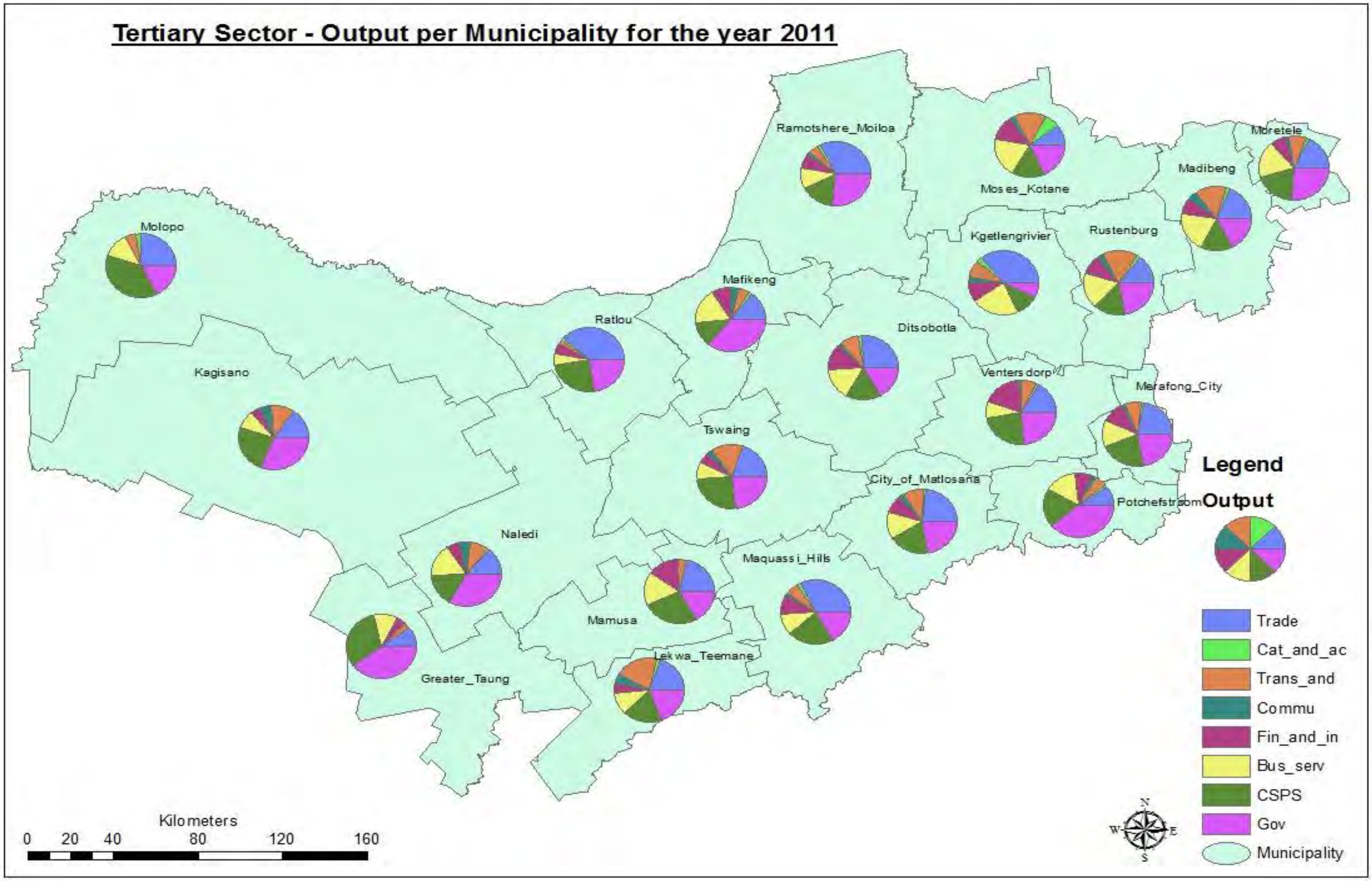
The City of Matlosana and Rustenburg produced the highest community, social and personal services output at the local municipality level in 2011. The City of Matlosana and Rustenburg earned the most profits in the community, social and personal services in 2011. The community, social and personal services sector was the third largest employer in the tertiary sector in the

NWP. Rustenburg and Madibeng, respectively, employed the most number of people. The following local municipalities accrued a less than 2% share in profits in the sub-sector; Mamusa, Kagisano, Ventersdorp, Ratlou, Lekwa-Teemane, Kgetlengrivier and Molopo.

4.5.3.8 General government

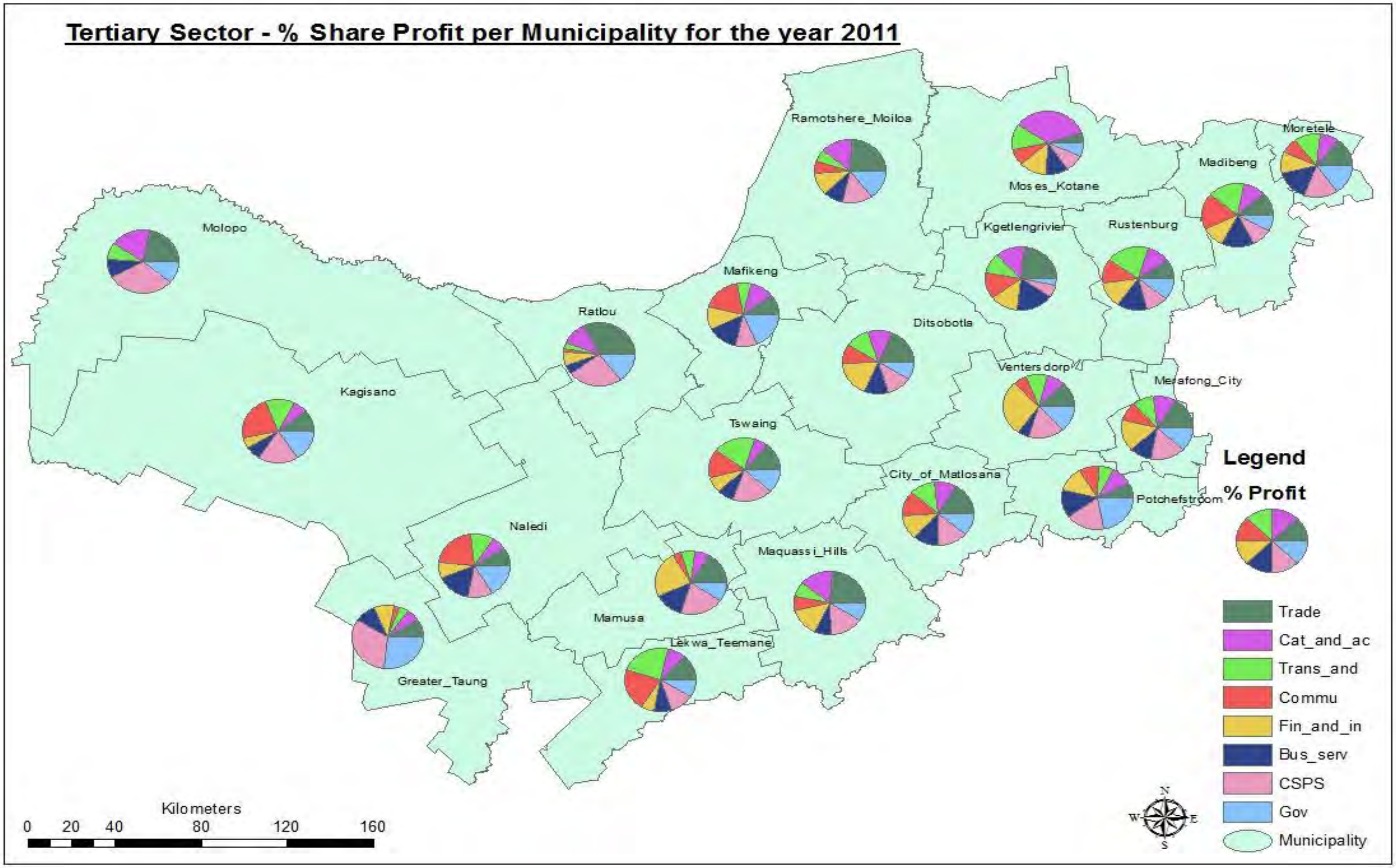
The tertiary sector output in the NWP in 2011 was concentrated in the general government sector. Mafikeng, Rustenburg, Potchefstroom and City of Matlosana were the main centres of output, profit, employment and share (highest) of labour remuneration in 2011 (see Figures 4.41 to 4.43). The following section provides a conclusion of the chapter.

Figure 4.41: Tertiary sector output per local municipality in the NWP in 2011



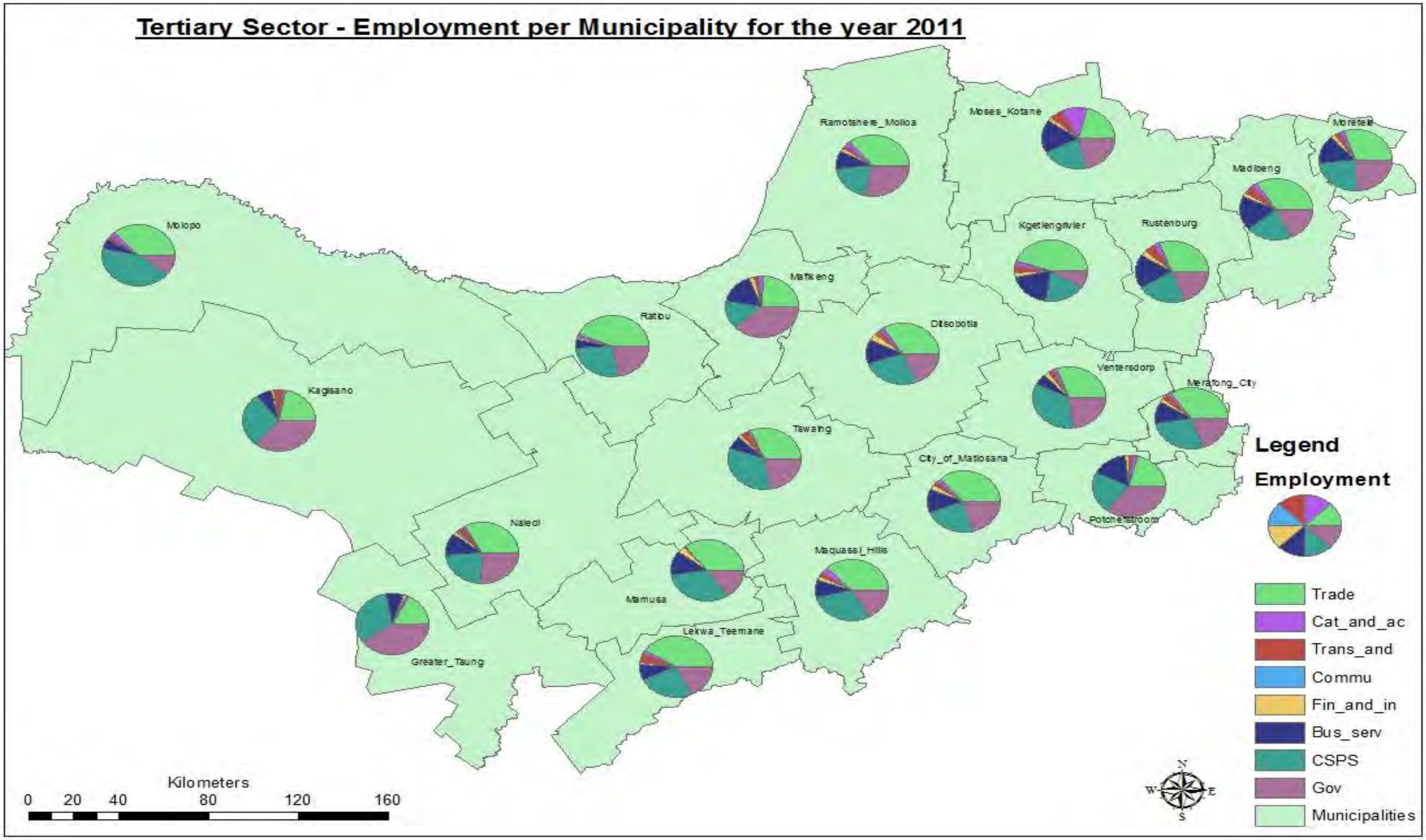
Source: Quantec Easy Data, 2013

Figure 4.42: Tertiary sector: Share of profits per local municipality in the NWP in 2011



Source: Quantec Easy Data, 2013

Figure 4.43: Tertiary sector: Employment (number) per local municipality in the NWP in 2011



Source: Quantec Easy Data, 2013

4.6 Summary

This chapter provided an overview of the economic structure and performance of the NWP to highlight the sectors in which the province‟s comparative advantages lie. It revealed that the mining and quarrying sector was the most important sector in the province in 2011. The NWP in 2011 produced 25.6% of the total output in the mining and quarrying output and accounted for 85.9% of profits in the sector. Additionally, this sector was the largest employer in the NWP economy across all sectors. The mining and quarrying sector in South Africa employed approximately 600 000 people in 2011, of which 251 385 people (42.3%) of these jobs were in the NWP (Quantec, 2012). This indicates that the NWP is a significant contributor to employment, output and profit in the sector (North West Provincial Government, 2013). This is attributed to the fact that the NWP lies directly over a mineral ore deposit belt, which contains the world‟s largest mineral deposits of chrome, gold, vanadium, manganese and platinum group elements (North West Business, 2013; Bafokeng Platinum, 2012). In addition, the major ferrochrome operations in the country are located in Kroondal (Xstrata Alloys), Rustenburg (Samancor Chrome Mines) and Brits (Hernic Ferrochrome) (North West Business, 2013). These operations contribute substantially to employment in the NWP. In the gold mining sector, four major companies operate in Carletonville: AngloGold Ashanti, Gold Fields, Harmony and DRD. Gold Fields‟ Driefontein mine alone employed 15 000 employees in 2010 (North West Business, 2013). The NWP‟s mining sector produces 70% of South Africa and the world‟s platinum, and this is mostly from mines in the Rustenburg region (North West Provincial Government, 2013). Furthermore, the Rustenburg region also produces a third of the NWP‟s gold output (North West Provincial Government, 2013). This further highlights the major contributions of the mining and quarrying sector to output and employment in the NWP, as indicated by the analysis in this chapter. This also highlights the significant comparative advantage in mining and quarrying for the NWP.

The manufacturing sector in the NWP contributed 2.7% of national output in 2011. Profits in manufacturing amounted to 45.9% of total profits in the sector, making it the second most profitable sector after mining and quarrying in the NWP in 2011. 60 096 people were employed in the NWP, making a 4.5% contribution to national employment in the sector. The Bojanala District Municipality was the main centre of manufacturing output, accounting for 78% of output in the NWP. This is attributed to the Madibeng local municipality, which is situated in the Bojanala District Municipality, being the main centre of manufacturing.

Madibeng, Rustenburg, Potchefstroom, City of Matlosana and Mafikeng produce more than half of the manufacturing output in the NWP (North West Business, 2013). The construction (31%); food, beverages and tobacco (15%); Petroleum (10%); Metals (10%); and electricity generation (10%) were the major contributors of total manufacturing output in the NWP in 2011.

Madibeng was the leading producer in the following manufacturing sub-sectors: textiles, clothing and leather goods (R63.4 million), wood, paper, publishing and printing (R85.67 million), petroleum products, chemicals, rubber and plastic (R394.53 million), metals, metal products, machinery and equipment (R356.76), electrical machinery (R192.87 million), radio, TV, instruments, watches and clocks (R27.65 million), transport equipment (R611.27 million) and furniture and other manufacturing (R139.13 million) (Quantec, 2012). Major companies such as Bosch and Bridgestone are located in Madibeng, where they serve as an anchor to the automotive-supply sector (North West Business, 2013). Additionally, Madibeng houses a Bridgestone tyre plant that has seen an increase in employment in recent years after a R700 billion injection to upgrade the plant (North West Business, 2013). Steel manufacturing is the main manufacturing activity in the City of Matlosana, although large concentrations of cable suppliers and engineering works also exist (North West Business, 2013). Potchefstroom mainly focuses on food and beverage production and also has the largest chalk and crayon factory in South Africa. A large Rainbow Chickens processing plant is located in Rustenburg to take advantage of the close proximity to markets in Gauteng (North West Business, 2013).

The processing of mineral ores is a major activity in the NWP. The other non-metal mineral products sub-sector was the second leading contributor (9.1%) to national employment in the NWP in 2011 (see Table 4.3). The NWP contributed 7.1% to national output and 7.7% to national profit in 2011 in this sub-sector (Quantec, 2012). The NWP‟s heavy industrial capacity is heavily dominated by Ferrochrome production. There are ferrochrome smelting and processing plants at Kroondal (Xstrata Alloys), Rustenburg (Samancor Chrome Mines) and Madibeng (Hernic Ferrochrome) in the NWP. The leading producing local municipalities in the metals, metal products, machinery and equipment sub-sector were Madibeng, Rustenburg and City of Matlosana. This sub-sector employed the second largest number of people (13 416) in the secondary sector in the NWP in 2011. The main employers at the local municipal level were Madibeng, Rustenburg and City of Matlosana. This is owing to the presence of Bosch plant in Brits, which is in the local municipality of Madibeng, which specialises in the production of starters, alternators, braking systems and electronic control units (North West Business, 2013). Other products that are produced in the NWP for the automotive industry are electrical-wiring looms and automotive safety glass.

The construction sector contributed the most to output and employment to the secondary sector in the NWP in 2011. The sector employed 40 724 people and contributed R5.31 billion of output. The expansion of existing mines and the establishment of large numbers of new mines in the NWP have been a main drive in the expansion of the construction sector (North West Business, 2013). Secondly, the construction sector in the NWP is of particular importance owing to the large number of cement manufacturers located in the province. Lafarge operates the biggest cement manufacturing plant in SA in Lichtenburg. Other main cement manufacturers, Afrisam and PPC (three plants), also have plants in the NWP (North West Business, 2013). Demand in the construction sector is also driven by the housing and infrastructure industries. Government-led as well as private housing schemes such as Marikana (25km east of Rustenburg), the National Housing Corporation Finance and Impala housing project and Anglo Platinum"s 12 000 housing units in the NWP have ensured an increase in demand in the construction sector long after the 2010 World Cup infrastructure upgrade.

The radio, TV, instruments, watches and clocks sector"s output and contribution to employment was the least in the manufacturing sector in the NWP in 2011. The sub-sector employed 545 people and had GVA amounting to R90.78 million.

In the tertiary sector, the general government sector was the most important sector to the NWP in terms of output. Output in the sector amounted to R23.88 billion in 2011. The wholesale and retail trade, catering and accommodation sector was the most significant employer in the tertiary sector and in the whole province. It employed 153 424 people contributing to national employment in the sector. The close proximity to Gauteng provides access to the domestic market as well as international markets for the firms in the NWP. General government, community, social and personal services and business services were also significant employers in the tertiary sector in the NWP.

4.7 Conclusion

The aim of this chapter was to provide an overview of the structure of the NWP economy. This analysis is an important first step in the cluster identification process as it provides insights into the economic structure of the province. Together with information on inter-industry linkages, which will be discussed in Chapters 5 and 6, these results will provide guidance on the type and locality of clusters that should be promoted in the NWP. Resultantly, this chapter will provide a background and better understanding of the inter-linkages in the clusters that will be identified in Chapter 5. The subsequent chapter presents the results and discussion of the industrial cluster identification in the NWP of South Africa.

CHAPTER 5: IDENTIFYING INDUSTRIAL CLUSTERS IN THE NWP: RESULTS AND DISCUSSION

5.1 Introduction

The previous chapter has demonstrated that the North West Province‟s (NWP) comparative advantage lies mainly in the mining and quarrying sector. This sector contributes significantly to the output, employment and profits of the NWP. This natural competitive advantage for the NWP is attributed to large reserves of mineral ore. In some cases, the largest reserves of mineral ore in the world are found in the NWP (see section 4.3). Overall, the NWP‟s contributions in all other sectors are relatively low in comparison to the mining and quarrying sector.

This chapter focuses on the results of the empirical investigation into the existence of industrial clusters in the NWP to enhance the competitiveness of firms in the province. In particular, industrial cluster formation is aimed at improving the competitiveness of firms in other sectors other than mining and quarrying so as to improve the province‟s overall competitive position. Industrial clusters enhance the competitiveness of firms by improving access to technology, thereby enabling firms to produce sophisticated goods and services and to remain competitive. Additionally, as mentioned in Chapter 2 (see section 2.5), industrial clusters enhance firm competitiveness through the numerous benefits that arise from cooperation and the formation of networks. Firm competitiveness is enhanced through reduced transport and transaction costs, improved efficiency, the availability of education and training programmes as well as the availability of capital.

This chapter provides comprehensive results and discussions on the application of the structural path analysis (SPA) and power of pull (PoP) methods. These methods were applied to a social accounting matrix (SAM) for the NWP of South Africa to identify and prioritise industrial clusters (at a sectoral level) in the province. This study also sets out to enhance the export performance of the industrial clusters. To achieve this, results of a decision support model (DSM) are incorporated into this chapter. The DSM is a scientific model that determines products and services with the highest probability of export success (realistic export opportunities (REOs); see sections 1.3, 5.51 and 5.5.2). The DSM is incorporated into this chapter to help determine whether any of the identified industrial clusters‟ products or services have REOs. The rest of this chapter is set out as follows: Section 5.2 describes the basic elements of a SAM and characterises the 2006 NWP SAM. It provides a description of the accounts in the NWP SAM. Section 5.3 provides a detailed explanation of the methodology used in this chapter. Section 5.4 presents and explains the identified industrial clusters for the NWP. Section 5.5 discusses the export performance of the NWP at an HS 6-digit level. In addition, section 5.5 presents the results of determining whether any of the identified industrial clusters" products and services have REOs according to the DSM and section 5.6 concludes the chapter. The remaining objective, which involves the SAM multiplier analysis, description and interpretation, is discussed in Chapter 6.

5.2 Characterisation of a social accounting matrix

Since a social accounting matrix (SAM) captures the inter-linkages and flow of funds between various entities in an economy, it is an ideal framework to use to identify industrial clusters. A SAM comprises production accounts (activities) commodities, factors of production institutions, households, firms and government (Robinson, Cattaneo & El-Said, 2001). A SAM depicts the circular flow of income that occurs in the economy (Round, 2003). All the accounts in the SAM receive income and demand goods. That is, activities make payments for factors of production, intermediate inputs and indirect taxes and generate income (payments) from the production and sale of output (Robinson *et al*., 2000; Round 2003). The commodity accounts purchase finished goods from activities (producers) and the rest of the world (imports), while paying tariffs for imports (UNDP, 2012) The commodity accounts also sell commodities to the activity accounts (intermediate inputs) and to final demand (households, government, investment, and the rest of the world; see Tables 5.1 and 6.1).

In a SAM, gross domestic product (GDP) at factor cost is derived from the payments by activities to factors of production, or value added (Conningarth Economist, 2007; see section 6.2). GDP at market prices from the income side is calculated as the GDP at factor cost plus indirect taxes and tariffs. GDP at market prices from the expenditure side is the total final demand (consumption, investment and government) plus exports minus imports (Robinson *et al.,* 2000). Table 5.1 illustrates the various elements and the basic structure of a SAM, as discussed above.

Table 5.1: Basic structure of a SAM

			Expenditures							
			Endogenous				Exogenous			
			Activities	Commodities	Factors	Households	Government	Savings and investment	Rest of world	Total
Receipts	Endogenous	Activities		Domestic sales						Activity income
		Commodities	Intermediate inputs			Consumptio n spending	Recurrent spending	Investment demand	Export earnings	Total demand
		Factors	Value added (wages/ rentals)							Total factor income
		Households			Factor payments to households		Social transfers		Foreign remittances	Total household income
	Exogenous	Government		Sales taxes and import tariffs		Direct taxes			Foreign grants and loans	Government income
		Savings and investment				Private savings	Fiscal surplus		Current account balance	Total savings
		Rest of world		Imports payments						Foreign exchange outflow
		Total	Gross output	Total supply	Total factor spending	Total household spending	Government expenditure	Total investment spending	Foreign exchange inflow	

Source: Breisinger *et al.*, 2010

The SAM can be adapted to suit the requirements of the analysis (see section 6.2). In this study, it was more appropriate to use a region-specific or provincial SAM for the NWP, rather than a national SAM, to identify industrial clusters that are specific to the province. The subsequent sections describe the NWP SAM, highlighting various sectors and factors classified under each account. An overview of the various sectors" contribution to output in the province in 2006, based on the detail captured in the SAM is also provided. Additionally, a description of how the NWP SAM was adapted to meet the requirements of the analysis is provided.

5.2.1 Description of the accounts in the NWP SAM

The 2006 SAM for the NWP was compiled by Conningarth Economists (2009) and is available from the Development Bank of Southern Africa (DBSA, 2009). The 2006 SAM is the most recent available SAM for the NWP. This is because "data typically used to build SAMs includes I-O tables of the economy, national accounts, fiscal accounts, trade data, other balance-of-payments information and surveys providing information on the composition of household income and expenditures" (Debowicz, Dorosh, Haider & Raider, 2013: 2). I-O tables are not compiled annually, but in five-year time intervals in comparison to national income and product data that are produced annually (lagged; Robinson & El-Said, 1997). Therefore, SAMs tend to be published less often because of their reliance on census and survey data to provide highly disaggregated data (Harun, Zakariah & Azali, 2012). Censuses and surveys are conducted sporadically, thereby rendering SAMs sporadic as well.

Table 5.2 shows the components of the 2006 SAM for the NWP. The NWP SAM includes a total of 93 accounts, which can be divided into endogenous and exogenous accounts (see section 6.3.2). Transactions in the government accounts, capital accounts and the rest of the world accounts are typically distinguished as exogenous accounts (see Table 5.1). These accounts are determined outside the economic system or constitute to economic policy instruments (Defourny *et al.*, 1984; Round, 2003). The rest of the accounts, which include production (activities and commodities) and private institutions (households and enterprises), are classified as endogenous accounts (see Table 5.1 and section 6.3.2).

Table 5.2: Components of the 2006 SAM for the NWP

Entity	Number of components
Endogenous accounts	
Activities	37
Commodities	37
Labour	3
Capital	4
Land	0
Enterprises	4
Households	3
Exogenous accounts	
Government	1
Capital account	2
Rest of the world	1
Residual	1

Source: Author‟s own compilation

The endogenous accounts include 37 activities, 37 commodities, seven factors of production (3 categories of labour and 4 types of capital) and seven institutions (4 types of enterprises and 3 types of households; see Table 5.2). The exogenous accounts include one government account, two capital accounts, one account for the rest of the world and a residual account. Capital is divided into public, private, combi-taxi and informal enterprises. The labour account for the NWP is aggregated according to the level of skill, i.e. skilled, semi-skilled and unskilled labour.

The NWP SAM captures the economic structures of the province (see section 6.2). The base year of the SAM is 2006. The SAM was compiled with official statistics and in collaboration with the DBSA and the North West provincial government to ensure the best possible summary representation of the provincial economy during that year. The endogenous accounts in the NWP SAM discussed above are listed in Table 5.3.

Table 5.3: Endogenous accounts in the NWP SAM

Activities	**Activities continued**
Agriculture	Building and other construction
Platinum mining	Trade
Gold mining	Accommodation
Other mining	Transport
Meat, fish, fruit, vegetables, oils and fat products	Communication
Dairy products	Insurance
Grain mill, bakery and animal feed products	Real estate
Other food products	Business services
Beverages and tobacco products	General government services
Textiles, clothing, leather products and footwear	Community, social and personal services
Wood and wood products	**Factors**
Furniture	LABSK – Skilled labour
Paper and paper products	LABSS – Semi-skilled labour
Publishing and printing	LABUS – unskilled labour
Chemicals & chemical products (incl. plastic products)	Capital (GOS) public enterprise
Rubber products	Capital (GOS) private business enterprise
Non-metallic mineral products	Capital (GOS) combi-taxi enterprise
Basic metal products	Capital (GOS) informal enterprise
Structural metal products	**Institutions**
Other fabricated metal products	Public enterprise
Machinery & equipment	Private business enterprise
Electrical machinery & apparatus	Combi-taxi enterprise
Communication, medical and other electronic equipment	Informal enterprise
Manufacturing of transport equipment	HHDLOW – Low income households
Other manufacturing & recycling	HHDMID – Medium income households
Electricity	HHDWHI – Wealthy high income households
Water	

Source: Author‟s compilation from Conningarth Economists NWP SAM, 2009

Chapter 4 provided an overview of the spatial economic structure of the NWP. Given that the analysis in this chapter is based on data as captured in the NWP SAM, Table 5.4 shows the ranking of 37 production sectors‟ contribution to GDP at factor cost according to the 2006 NWP SAM. The table illustrates the province‟s economic structure. According to rankings in Table 5.4, platinum mining is the most important sector to the NWP owing to large mining deposits that exist in the province (see section 4.4.2). Other important sectors to the NWP are the general government sector, trade and transport services. The following sectors contributed the least to GDP in the NWP in 2006; paper and paper products, communication, medical and other electronic equipment and other manufacturing and recycling. These patterns depicted in the SAM are similar to the more recent data used in Chapter 4 to provide an overview of the structure of the NWP. This highlights that although the SAM data may be dated (2006 in this case), the structure of the economy and the underlying linkages do not change much over time (see section 5.3).

Table 5.4: Ranking of sectors by GDP at factor cost

Sector	**GDP at factor cost**	**Rank**
Platinum mining	14544.00	1
General government	10397.00	2
Trade	8006.00	3
Transport services	7913.00	4
Insurance	5026.00	5
Real estate	3588.00	6
Activities/services	3455.00	7
Health and social work	3394.00	8
Communications	3082.00	9
Gold mining	2945.00	10
Business activities	2454.00	11
Agriculture	2382.00	12
Other mining	2121.00	13
Accommodation	1414.00	14
Non-metallic mineral products	1357.00	15
Basic metal products	845.00	16
Other construction	840.00	17
Electricity	680.00	18
Buildings	672.00	19
Chemicals and chemical products (incl. plastic products)	592.00	20
Machinery and equipment	441.00	21
Electrical machinery and apparatus	421.00	22
Other fabricated metal products	366.00	23
Beverages and tobacco products	357.00	24
Other food products	291.00	25
Rubber products	269.00	26
Water	190.00	27
Textiles, clothing, leather products and footwear	185.00	28
Furniture	173.00	29
Dairy products	160.00	30
Manufacturing of transport equipment	152.00	31
Grain mill, bakery and animal feed products	147.00	32

Structural metal products	139.00	33
Wood and wood products	106.00	34
Meat, fish, fruit, vegetables, oils and fat products	90.00	35
Publishing and printing	66.00	36
Paper and paper products	51.00	37
Communication, medical and other electronic equipment	42.00	38
Other manufacturing and recycling	36.00	39
Total: North-West	79388.00	

Source: Author"s own compilation from Conningarth Economists NWP SAM, 2009

5.3 Methodology

5.3.1 Structural path analysis

As mentioned in section 3.3.1, the SPA method was chosen as the most appropriate method to identify industrial clusters in the NWP of South Africa. The aim of conducting SPA analysis on the NWP SAM in this chapter is to identify industrial clusters. This is achieved by tracing increased demand for intermediate inputs resulting from the induced (increased) demand for a particular sector"s output. In addition, the analysis traces the induced demand for intermediate inputs on other sectors in the economy, generated by a stimulus in the aforementioned sector.

In this study, the main research question was to identify industrial clusters in the NWP of South Africa (see section 1.5). This was achieved by analysing existing inter-industry linkages in the 2006 SAM for the NWP (see section 5.4). Strong existing inter-industry linkages indicate strong existing links of products and services (functional links; Yingming, 2010; see section 2.2.1) among firms. Once the cluster is established, the ratios of products and services exchanged among industries determine the stability, perfect functioning, efficiency and enhancement of the cluster (Yingming, 2010). The intensity of inter-industry linkages was therefore taken to indicate existing functional links.

SPA enables us to observe the type of linkages that work inside the economy by highlighting the changes in the levels of intermediate flows between sectors (Lima *et al.*, 2005). To demonstrate the linkages in the economy brought about by expenditure in one sector on another, expenditure is illustrated as an influence (Parra & Wodon, 2005). As stated earlier the accounts in the SAM are divided into endogenous and exogenous accounts in order to carry our SPA. This study follows Parra and Wodon‟s (2005) description of the SPA method and applies the method to the 2006 SAM for the NWP to identify industrial clusters. Firstly SPA decomposes SAM multipliers into direct and indirect components and reveals the network through which transmission occurs. This is achieved by revealing the channels through which influence is transmitted in a macro-economic system (Defourny *et al.,* 1984; Rasmussen, 1956; Hirshman, 1958). The backward linkages or diffusion effects are calculated as follows:

$$BL_j = \frac{B_{.j}}{\frac{1}{n}v} \qquad j=1......n \tag{5.1}$$

The forward linkages or the absorption effects are calculated as follows:

$$BL_i = \frac{B_{i.}}{\frac{i}{n}v} \qquad i=1.....n \tag{5.2}$$

If the backward linkages are greater than 1 it implies that a unit change in the final demand of sector *j* will generate an increase above the average in the global activity of the economy (Lima *et al.,* 2005). If the forward linkages are greater than 1 implies a unit change in all the sectors of the final demand will generate an increment above the average in sector *i*. A key sector is the one with both indexes greater than one (Lima *et al.,* 2005).

The second step in SPA is to use to decompose aaccounting multipliers or the global influence in a SAM. Multipliers are decomposed into total influence according to the respective elementary paths flowing from two given poles (Defourny *et al.,* 1984).Given the technical coefficients matrix A_{nxn} any of the endogenous accounts in the 2006 NWP SAM are taken as a pole. Any two poles (endogenous accounts) *i* and *j* are connected by an arc -arc (*i, j)*. The intensity of the inter-industry linkages between *i* and *j* is given by a_{ij} in the A_{nxn} matrix. Consecutive arcs define a path while the length of the path is given by the number of arcs in the paths. An elementary path in SPA analysis is one that does not visit any pole more than once. A path that starts and ends at the same pole is known as a circuit. SPA distinguishes 3 types of influences namely; direct, total and global influences.

The direct influence of *i* on *j* through an elementary path refers to the change in income on sector *j* caused by a unitary injection in sector *i* and this is given by the product of the intensities of all arcs in the path. The direct influence only includes the incomes of poles (sectors) in the elementary paths (Shantong, Ying and Jianwu, 2004). The direct influence is given by:

$$I^{D}_{i\to j} = a_{ki} a_{mk} a_{jm} \tag{5.3}$$

Several interactions usually exist among the different poles (sectors) in the economy. This results in poles in the elementary paths being linked to other poles and paths thus forming circuits. All these interactions amplify the direct influence of the elementary path (Defourny & Thorbecke, 1984). The total Influence of an injection in sector *i* on sector *j* is includes all possible paths of transmitting influence between the two poles in d j. This includes the direct influence through the elementary paths as well as the indirect influences in the path and the circuits. The total influence shows the immediate effects an influence flowing through its path. Using the geometric series argument the total influence can be calculated using equation 5.2 below:

$$I^{T}_{(i\to j)p} = a_{ki} a_{mk} a_{jm} \left[1 - a_{mk} \; a_{km} + a_{fm} a_{kf} \; \right]^{-1} \tag{5.4}$$

The first product of equation (2) is the direct influence along the path *p,* and the second term is called the *path multiplier Mp.* Finally SPA calculates the global influence. The global influence does not follow a specific path in the transmission of an influence as is the case in the direct influence. Instead the global influence includes the total effects, that is induced and feedback effects, of an injection of one unit of either income or output in pole *i* (Defourny & Thorbecke, 1984). This includes total effects on income and output on pole *j.* The global influence is given by equation 5.3:

$$I^{G}_{i\to j} = \sum_{p=1}^{n} I^{T}_{i\to j\;p} = \sum_{p=n}^{n} I^{D}_{i\to j\;p} M_{p} \tag{5.5}$$

The SPA analysis was conducted using SimSIP SAM. It is a Microsoft Excel tool that utilises MATLAB to analyse input-output (I-O) and SAM tables (Parra & Wodon, 2009). Fixed origin analysis was conducted in SimSIP SAM. This option in the analysis analyses all possible paths that originate from a fixed origin. Both the origin and destination accounts were commodity accounts (see section 5.2). In order to identify industrial clusters, tracing the induced effects and elementary paths originating from each commodity (fixed origin) enables the observation of the effects of induced demand on other commodities. That is, SPA traces and decomposes the final effect of a shock along the different sectors as it travels in the economy (see section 3.2.2.7). This involves tracing a shock from the account that receives the initial shock (origin sector) and fully describing the elementary (important) paths used by a shock to travel from an origin account to the destination account (Parra & Wodon, 2009).

Since the SPA method does not determine the optimal number of clusters, the power of pull (PoP) method was used to prioritise the number of potential clusters (see section 3.3.2). The effective promotion of industrial clusters requires prioritisation of the number of industrial clusters (Martin & Sunley, 2003). This is because governments have limited resources to promote economic development efforts. This study prioritises ten industrial clusters using the PoP method. The following section discusses the PoP method.

5.3.2 Power of pull

The power of pull (PoP) method was used to prioritise the number of potential clusters for the NWP in this study. This is essential as the SPA method does not provide any insights into the optimal number of clusters (see section 3.3.2). Prioritising the identified clusters will enhance the effective promotion of industrial clusters. Governments have limited resources, and to ensure the effective utilisation of these limited resources, development projects with the highest potential benefits and chances of success should be targeted. The PoP method helps to achieve this. It defines network effects into a quantifiable criterion that can be used to determine the industrial clusters that should be prioritised (Lou, 2013; see section 3.3.2). The principle behind this method is to focus on sectors that have the ability to „pull" itself and the activities and output of all other sectors. This also includes all sectors connected to it directly or indirectly throughout the economy. This ability of a sector is referred to as the power of pull.

The earliest approach to calculating the power of pull of individual sectors was proposed as an infinite regress problem by Seeley (1949). Following Dietzenbacher‟s (1992) we assume $\mathbf{r}_i$ to a vector of power indicators of the sectors, the indicator vector $\mathbf{r}_{i+1}$ is updated as the sum of backward linkages (columns of the **A** matrix) weighed by the normalized $\mathbf{r}_i$ from the previous iteration. The inputs from a sector with high pulling power receive a larger weight than the inputs from a sector with lower pulling power. The power scores which are also used as the weighting factors are normalised to have an average of 1. The power scores take the form:

$$r_{i+1} = \mathrm{n} r_i^{'} \mathrm{A} / (r_i^{'} \mathrm{Ae}) \quad (5.6)$$

Where n is the total number of sectors, and **e** is the column summation vector ($e_i = 1$ for all i). Estimates of a sector‟s power indicator improve through iterations to infinitum $(i \to \infty)$. Furthermore, according to Dietzenbacher (1992) "the indicator converges to the normalised left hand eigenvector corresponding to the dominant eigenvalue (i.e., the Perron vector) of the input coefficient matrix **A**". The indicator vector can be calculated as $n\mathbf{q}'/(\mathbf{q}'\mathbf{e})$ with:

$$q^{'} = \lambda q^{'} \quad (5.7)$$

Where **q'** is the dominant eigenvalue of the **A** matrix. The elements of $n\mathbf{q}'/(\mathbf{q}'\mathbf{e})$ indicate how powerfully the activities of sectors may pull the activities (thus outputs) of the overall economic network (including themselves), i.e. the Power-of-Pull.

After applying the SPA results ten industrial clusters were identified and prioritised using the PoP method. These clusters were: (i) Communication; (ii) Real estate; (iii) Grain mill, bakery and animal feed products; (iv) Building and other construction; (v) Basic metal products; (vi) Other food products; (vii) Agriculture; (viii) Non-metallic mineral products; (ix) Trade; and (x) Dairy products. The PoP is a sector‟s power to pull all sectors through direct and indirect linkages in the network (Newman, 2008). As a result, the ranking of clusters by PoP may vastly differ from those given by direct measures; intermediate input, commodity output and value added. Direct measures indicate the size or volume of a sector (Lou, 2013). Table 5.5 presents the values of, and rankings by PoP and direct measures, namely intermediate input, commodity output and value added of the ten identified industrial clusters for the NWP.

Table 5.5: Ranking by PoP and direct measures of the ten identified industrial clusters for the NWP in 2006

Sector	PoP		Intermediate input (SAM)		Commodity output (SAM)		Value added (SAM)	
	Value	**Rank**	**Value (Rand million)**	**Rank**	**Value (Rand million)**	**Rank**	**Value (Rand million)**	**Rank**
Communication	2.435	1	5,165	10	8,565	10	3,400	10
Real estate	2.392	2	11,175	2	16,496	4	5,320	7
Grain mill, bakery and animal feed products	2.341	3	2,527	14	2,961	17	434	21
Building and other construction	2.326	4	7,295	4	9,358	8	2,063	12
Basic metal products	2.234	5	3,662	11	4,260	12	598	17
Other food products	2.140	6	238	33	356	32	118	32
Agriculture	2.132	7	5,269	9	8,454	11	3,185	11
Non-metallic mineral products	2.075	8	2,049	16	3,311	15	1,262	13
Trade	2.030	9	10,441	3	21,982	2	11,541	2
Dairy products	1.986	10	1,627	19	1,877	20	249	25

Source: Author‟s own calculations based on Conningarth Economists 2006 NWP SAM (2009) and PoP results

The communication cluster was identified as having the highest PoP in the NWP in 2006. However, it ranked 10th by intermediate input, commodity output and value added, respectively. This indicates that the communication sector is not big, but it is powerful. The high rank on the PoP for the communication cluster implies that its activities strongly pull the activities of other sectors throughout the NWP economy. The real estate cluster‟s PoP ranked second (2nd by intermediate input, 4th by commodity output and 7th by value added). Similarly, the trade cluster ranked ninth by PoP (3rd by intermediate input and 2nd by commodity output and value added, respectively). This shows that both the real estate and trade clusters in the NWP are big and powerful.

The grain mill, bakery and animal feed products cluster further demonstrated that size does not equal power or importance. It ranked third by PoP, 14th by intermediate input, 17th by commodity output and 21st by value added. Similarly, the other food products cluster ranked sixth by PoP (33rd by intermediate input and 32nd by commodity output and value added respectively) and dairy products ranked tenth (19th by intermediate input and 20th by commodity output and 25th by value added). The ten clusters presented in Table 5.5 received the highest rankings for PoP, indicating that these clusters generate the largest economy-wide or network-wide effects than those from the direct accounts of individual sectors.

The PoP method was used in this study to prioritise the number of clusters to focus on in the NWP of South Africa. As the SPA method does not determine the optimal number of clusters, the PoP method was used to prioritise the number of potential clusters. This will ensure the effective promotion of industrial clusters as resources will be directed toward the clusters that have the greatest power of pull in the rest of the economy. These industrial clusters identified for the NWP will be discussed in detail subsequently.

5.4 Industrial clusters identified

The fundamental idea of the aforementioned SPA approach is to observe how cluster formation can enhance the competitiveness of firms in the NWP. This section presents the SPA results for each identified potential cluster (see Table 5.2). SPA is a construct of relationships within the economy. The SPA results enable one to observe the induced effects of an injection in each of the identified clusters on the rest of the economy (see section 3.2.2.7). The analysis shows how, in structural terms, an exogenous demand shock on the origin sector affects the destination sector. Detailed results for the path analysis for the same ten sectors studied above as origin accounts and the ten destination accounts can be found in Appendix B: Tables 1 to 10. The destination sector is the sector that subsequently yields the highest average path multipliers of that injection (see section 5.3.1).

For example, SPA traced the effects of a stimulus in the agriculture cluster, on intermediate demand for the other commodities (the 37 other commodity sectors including itself); the effects of a stimulus in the platinum mining sector, on intermediate demand for the other commodities (the 37 other commodity sectors including itself), and so on for all 37 commodities. Only the intermediate input demand generated was analysed without taking into consideration factors of production, and institutions. As the aim of the analysis is to identify industrial clusters, it is therefore important to analyse the effects of stimuli in commodities on other commodities (see section 5.4). The path multipliers in SPA output show the degree of amplification conferred throughout the elementary paths (inter-industry linkages) by adjacent circuits (i.e. an origin and destination account; Defourny *et al.,* 1984; see section 3.2.2.7). The destination sectors have been chosen on account of the average path multiplier. The results for SPA in any given SAM provide several possible paths (i.e. as illustrated above; for example SPA provides all possible paths between agriculture and the 37 other commodities, including itself). In order to identify the paths for each sector, the average path multipliers were calculated.

The analyses presented in this section relied only on the quantitative results generated by SPA. Graphical representation allows a potentially more straightforward interpretation of this construct (Ngandu *et al.,* 2010). SPA analysed the effects of a stimulus on each of the ten identified clusters (as the origin) on intermediate demand for the other commodities (as destination accounts) (see section 5.3.1). These relationships are illustrated in Figures 5.1 to 5.10. Figures 5.1 to 5.10 correspond to Appendix B"s Tables 1 to 10. Therefore, the global influence between the sectors depicted in Figure 5.1 corresponds to the SPA results in Appendix B"s Table 1; Figure 5.2 corresponds to Appendix B"s Table 2 etc. Figures 5.1 to 5.10 showcase the 10 industrial clusters for the NWP of South Africa.

The thickness of the lines (represented by the edge weight; Column 8 in Appendix B Tables 1 to 10) connecting the industry sectors in the figures represents the strength of the connection between the corresponding industry sectors. The lines represent the inter-industry linkages between the sectors. The absence of a line between sectors shows that no inter-linkages exist between those sectors. The thickness of the line represents the relative volume of flow or strength of the inter-linkages along the path. The thickest lines represent the greatest volume of flow, while the thin lines represent the least relative volume of flow along the path. It is important to note that the thickness is not related to income magnitudes. Rather, the importance of the path relates to both its influence and the path multiplier of adjacent circuits (Ngandu *et al.,* 2010).

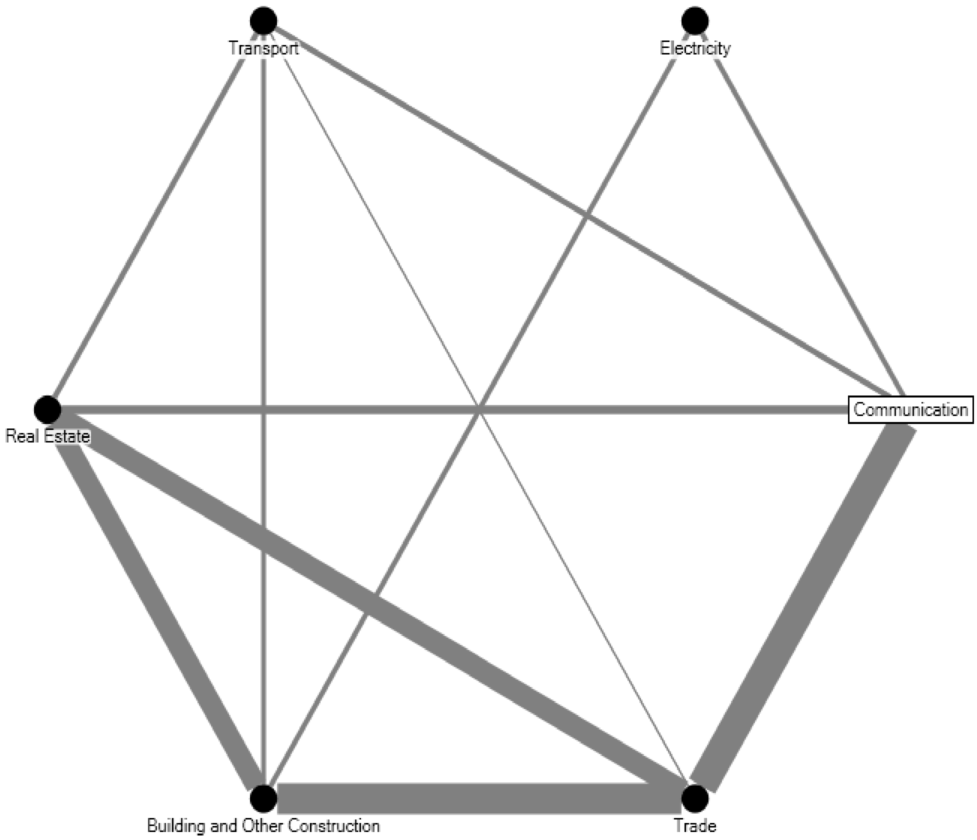
5.4.1 Communication cluster

Figure 5.1 shows the movement of the influence generated by an injection in the communication sector. The destination sector selected on the basis of yielding the highest average path multipliers from the injection is the building and other construction sector. The communication cluster comprises six sectors (2 secondary and 4 tertiary sectors), namely communication, trade, building and other construction, real estate, transport and electricity sectors, as illustrated in Figure 5.1. An examination of the weight on the edges (i.e. induced inter-sectoral transactions) in the graph (the cluster) indicated in Figure 5.1 reveals a particularly strong connection between four sectors, i.e. communication, trade, real estate and building and other construction.

Appendix B: Table 1 shows the SPA results for the communication cluster. From Appendix B Table 1, it is evident that there are no direct paths between the communication and building and other construction sectors as there is no path linking the two sectors without any other poles. The global influence (0.018; column 3) of communication on building and other construction is exercised indirectly (column 9). The highest effects are induced through the trade (17.3%) and trade and real estate sectors (12.1%) (Columns 3 and 8).

From these results, the most important sector in transmitting influence between the communication and building and other construction sectors is real estate. This sector was the most important sector as it appeared the most times (22 times) in the elementary paths between the two sectors shown in Appendix B: Table 1 (column 4). Figure 5.1 shows that the efficacy of an injection into the communication sector is relatively weak when we consider the number of sectors that benefit. That is, only five sectors will benefit from induced demand increases in the communication sector. However, the cluster generates a 72.5% (column 9) accumulated total global influence in the economy (see Appendix B: Table 1). In addition, an injection into the communication cluster would generate the most economy wide effects in terms of PoP, as illustrated in Table 5.5.

Figure 5.1: Communication cluster: Structural path to all commodity sectors in the NWP



The communication sector produced the 10th largest share of output in the NWP in 2011 (see Table 4.3). The sector‟s contribution (2.7%), to employment in the NWP was less significant (see Table 4.4; Quantec, 2013). The communication sub-sector contributed the least to tertiary sector employment in the NWP in 2011. Output, employment and profit centres of the communication sub-sector were Madibeng, Mafikeng, Rustenburg and City of Matlosana (see section 4.5.3.4). Figure 5.1 (thick line) shows that the building and other construction sector is a significant transmitter of influence in the communication cluster. The NWP‟s share of output in the construction sector in 2011 was 4.41% (Quantec, 2013). At the local municipal level, the major contributors to construction output in the NWP in 2011 were Rustenburg, City of Matlosana, Madibeng and Mafikeng. Construction in the NWP is of particular importance owing to the large number of cement manufacturers located in the province. Additionally, demand in the construction sector in the NWP has been sustained by government and private housing schemes long after the 2010 World Cup infrastructure upgrade (see sections 4.4.5.1 and 4.5.2.13).

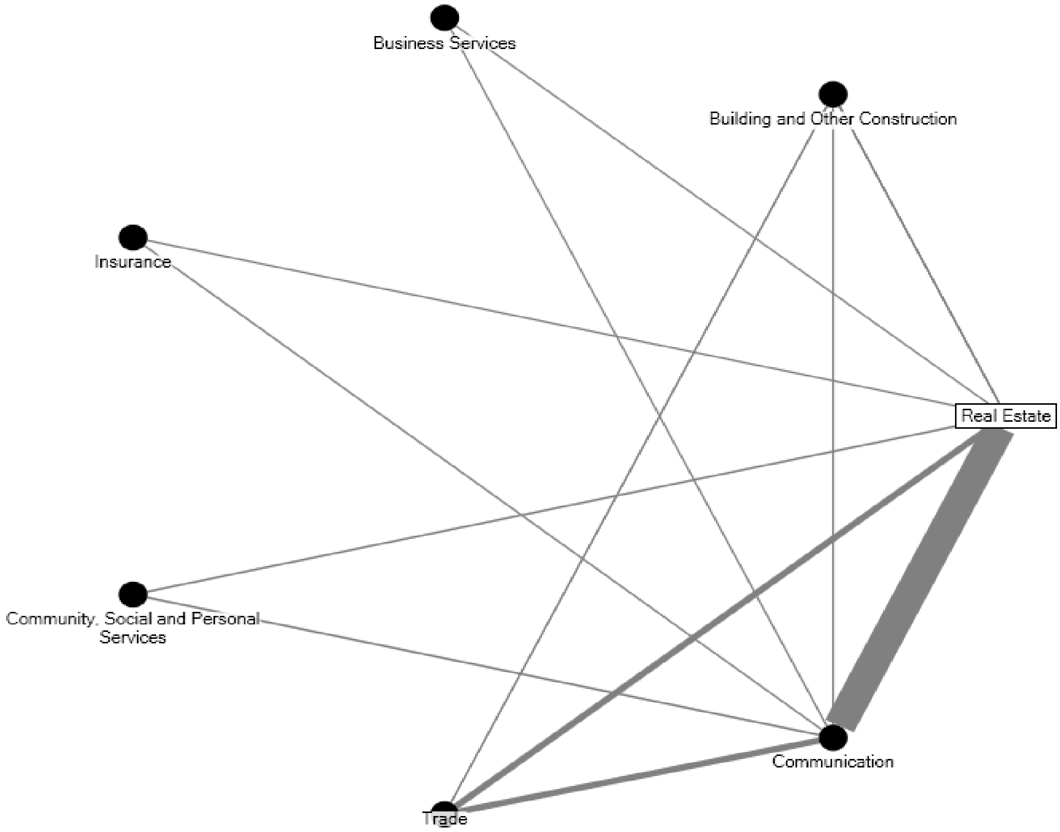
5.4.2 Real estate cluster

Figure 5.2 and Appendix B: Table 2 show the SPA results for the real estate cluster. From Table 5.4, it is evident that a significant portion of the global influence – 0.098 of the real estate sector on the communication sector – is transmitted through a direct path. 64.2% of the influence of an injection in the real estate sector directly affects the communication sector. This indicates that the direct paths are significant in transmitting the global influence.

Path analysis reveals that six sectors benefit from the expansion of the real estate sector. The sectors benefitting the most are the communication and trade sectors. The real estate cluster comprises seven sectors. A stimulus in the real estate cluster generates an accumulated proportion of 86.6% of the global influence in the NWP economy. However, it generates less elementary paths compared to the communication cluster (see Appendix B: Tables 1 and 2). The three sectors with the weakest effect in the cluster are business services, insurance and community, social and personal services.

The real estate sector is classified under the finance, insurance, real estate and business services sector. The NWP"s finance, insurance, real estate and business services sector contributions to output, employment and profit were not significant. The NWP"s contributions to output, employment and profit in the sector ranked 14th, 17th and 18th respectively (Quantec, 2012; see section 4.3). Finance, insurance, real estate and business services sector output, employment and profit were concentrated in the Rustenburg, Madibeng, Mafikeng and City of Matlosana local municipalities in 2011 (Quantec, 2012; see section 4.8). However, when considering direct measures in a SAM, intermediate input, commodity output and value added of the real estate sector ranked second, fourth and seventh, respectively (see section 5.3.2 and Table 5.5). These direct measures indicate that the real estate sector is relatively large.

Figure 5.2: Real estate cluster: Structural path to all commodity sectors in the NWP

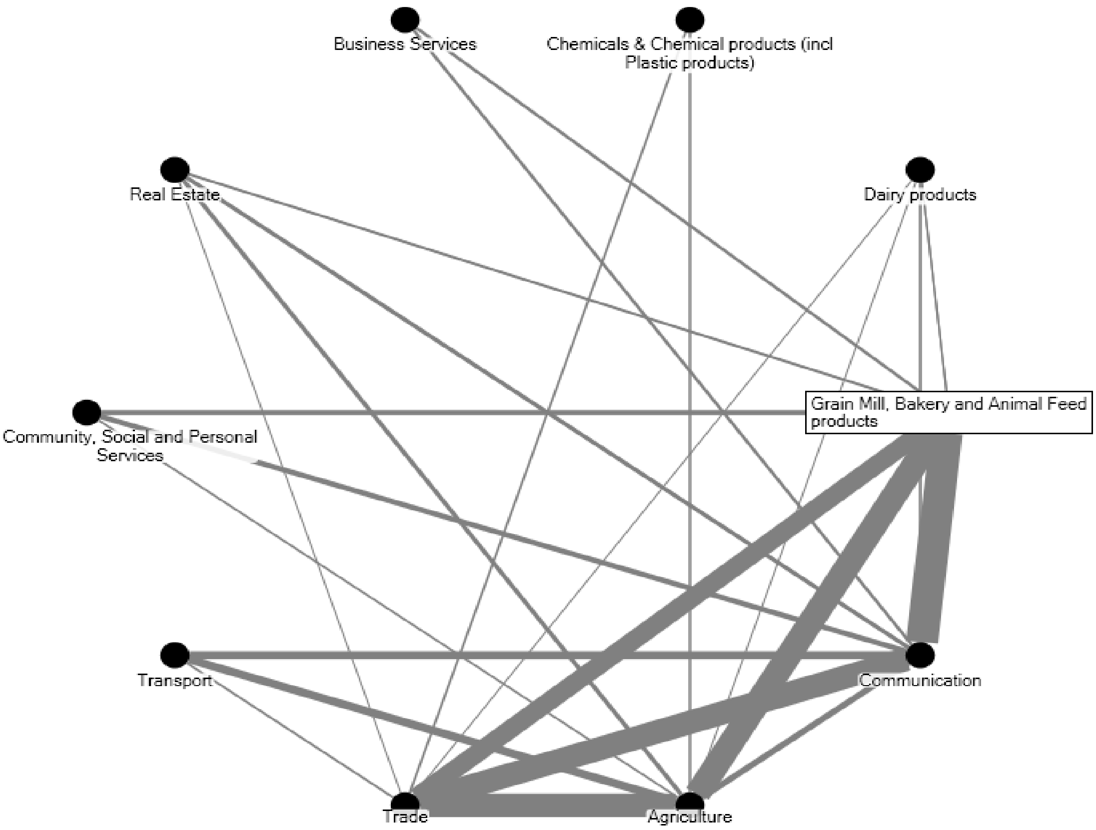


5.4.3 Grain mill, bakery and animal feed products cluster

An injection into the grain mill, bakery and animal feeds products sector, hereafter referred to the grain mill cluster, directly transmits a 12% increase in production in the communication sector. This elementary path accounts for the largest percentage of the global influence. The global influence of an injection in this cluster is 0.025 (see Appendix B: Table 3). The grain mill cluster comprises 10 sectors in the primary, secondary and tertiary sectors. This illustrates that many production activities benefit from an injection in the grain mill cluster; therefore the numerous elementary paths in Appendix B: Table 3.

The strongest inter-industry linkages in the cluster are observed between (i) grain mill and communication, (ii) grain mill and agriculture, (iii) trade and agriculture, and (iv) grain mill and trade (see Figure 5.3). The most important sectors in transmitting influence in the grain mill cluster are communication, agriculture and trade, respectively. The weakest poles in the cluster (with the least number of inter-industry linkages) are chemicals and chemical products and business services. A significant proportion of the global influence of grain mill on communication is transmitted through indirect paths. Less than 5% of the global influence is transmitted through a direct path (see Appendix B: Table 3).

Figure 5.3: Grain mill, bakery and animal feed products cluster: structural path to all commodities



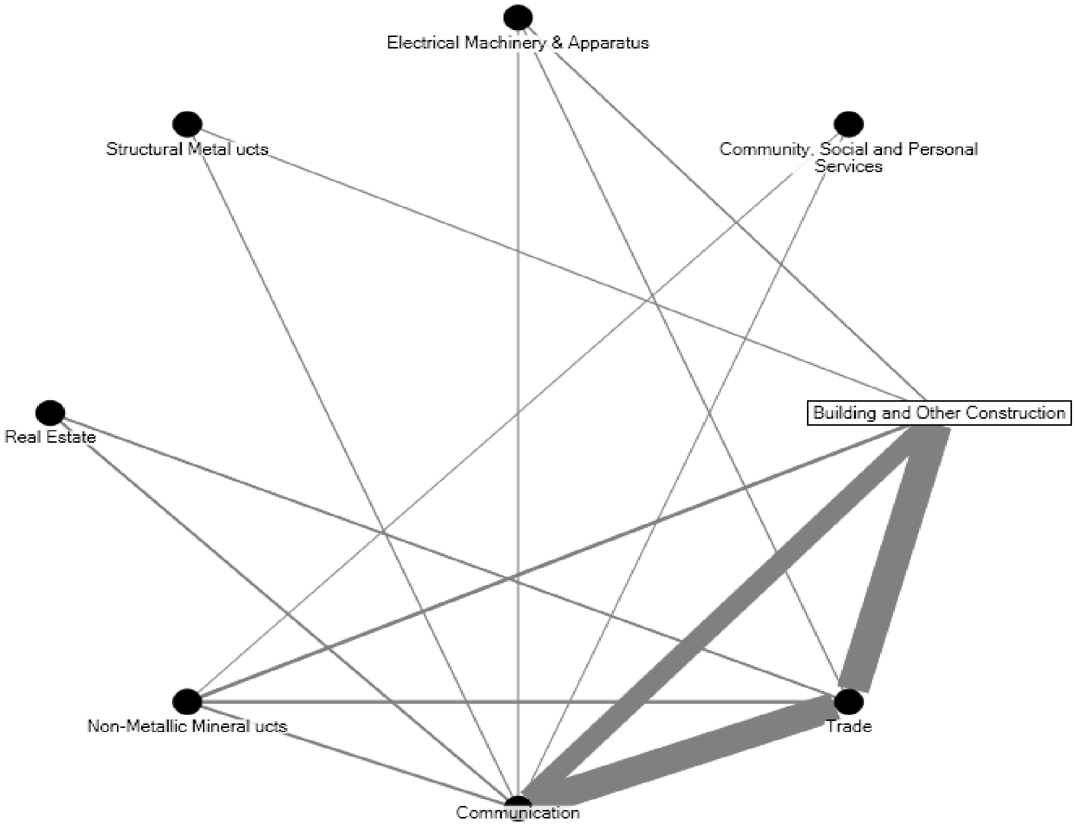
The food, beverages and tobacco sector under which the grain mill sector is classified ranked highly as a profit-earning sector in the NWP in 2011. The NWP accrued 36.7% of the profits in the sector and ranked fourth (Quantec, 2012; see section 4.2.3). The sector ranked 18th and 11th with respect to contributions to output and employment. Food, beverages and tobacco output was highest in the City of Matlosana and Rustenburg local municipalities (see section 4.5.2.1). The biggest employers were City of Matlosana, Madibeng, Ditsobotla, Rustenburg and Mafikeng (see section 4.5.2.1.). These trends can be attributed in part to a large Rainbow Chickens processing plant that is located in Rustenburg to take advantage of the close proximity to markets in Gauteng resulting in Rustenburg contributing significantly to the sub-sector"s output and employment (North West Business, 2013). The grain mill sector ranked 14th, 17th and 21st according to direct measures in the NWP SAM; intermediate input, commodity output and value added, respectively (see section 5.3.2 and Table 5.5). These direct measures indicate that the grain mill sector is relatively small.

5.4.4 Building and other construction

The building cluster comprises eight sectors as illustrated in Figure 5.4. This cluster comprises secondary and tertiary sectors. The strongest inter-industry linkages exist between the building and other construction, trade and communication sectors. These inter-industry linkages transmit 20.1% of the global influence of the building and other construction sector on communication. Appendix B: Table 4 illustrates that inter-industry linkages in the top three elementary paths between building and other construction and communication (direct influence: 13.5%: see Appendix B: Table 4 column 8) were less significant in comparison to indirect effects (39.4%: column 9). The global influence of an injection in building and other construction on communication is 0.043. The communication sector is the most significant transmitter of influence in the cluster as shown by the most number of linkages with the other sectors in the cluster (see Figure 5.4). The sectors transmitting the least influence in the cluster were the community, social and personal services, structural metal products and real estate sectors.

The NWP‟s share of output in the construction sector in 2011 was 4.41% (see section 4.3.1; Quantec, 2012). At the local municipal level, the major contributors to the construction sector in the NWP in 2011 were Rustenburg, City of Matlosana, Madibeng and Mafikeng (see section 4.5.2.13). The presence of large number of cement manufacturers such as Lafarge in the Ditsobotla local municipality, Afrisam and PPC (three plants) accounts for the large contributions to output and employment in construction in the NWP (North West Business, 2013). Additionally, demand in the construction sector has been driven by the housing and infrastructure industries (see sections 4.4.5.1 and 5.4.4). According to the direct measures of the SAM, the building and other construction sector ranked fourth, eighth and 12th respectively (see Table 5.5).

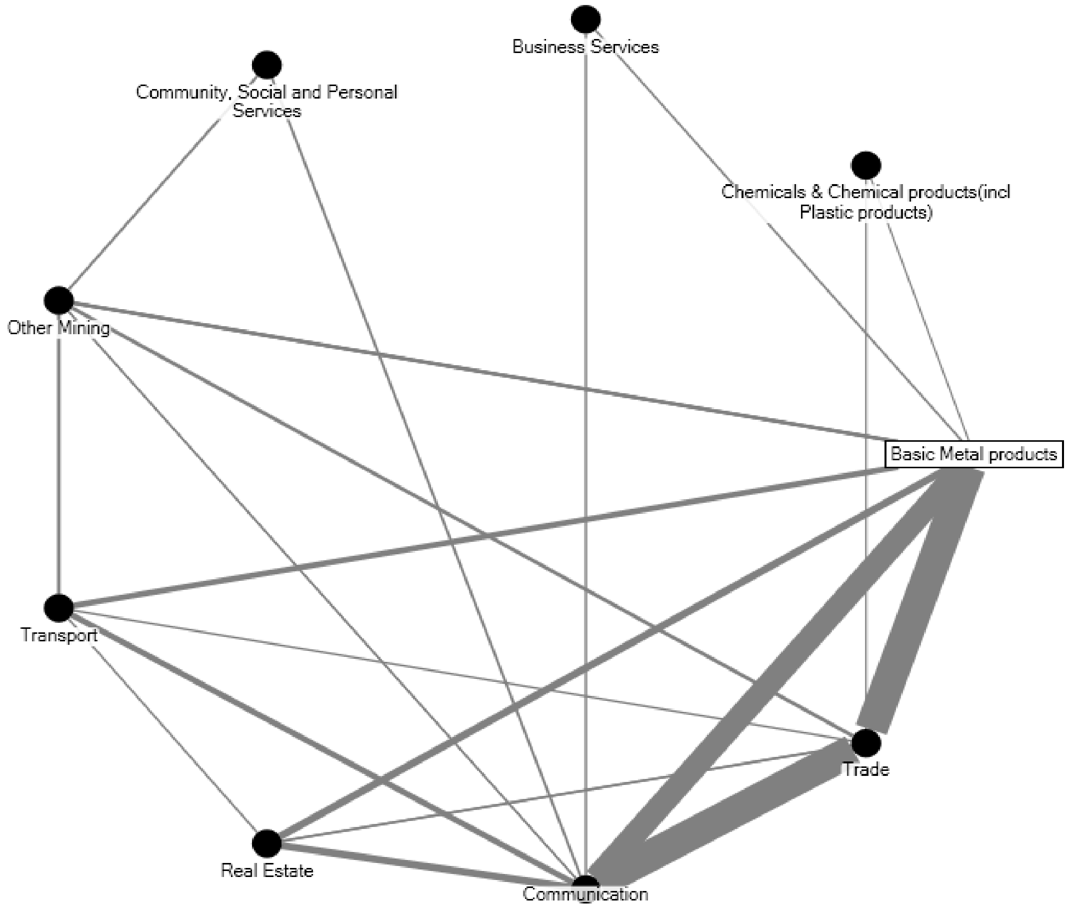
Figure 5.4: Building and other construction products cluster: Structural path to all commodities



5.4.5 Basic metal products cluster

Figure 5.5 shows the structural paths between the basic metal products cluster and all commodities. The trade sector was the most significant transmitter of influence in the basic metals products cluster. Nine sectors across the primary to tertiary sectors make up the basic metal products cluster. We can observe that many production activities benefit in the paths of an injection in this cluster. Other important elementary paths in the cluster include real estate, transport and other mining. The global influence of an inducement in the production activities in the basic metal products sector on communication was 0.037. Only 18.1% of the global influence was transmitted through direct paths (see Appendix B: Table 5). This indicates the significance of indirect paths in this cluster.

Figure 5.5: Basic metal products cluster: Structural paths to all commodities



The leading producing and profit earning local municipalities in the metals, metal products, machinery and equipment sub-sector were Madibeng, Rustenburg and City of Matlosana. Steel manufacturing is the major activity the City of Matlosana, although large concentrations of cable suppliers and engineering works also exist in the local municipality (North West Business, 2013). This sub-sector employed the second largest number of people in the NWP in 2011 (Quantec, 2012; see section 4.5.2.6 and Table 4.4). The main employers at the local municipal level were Madibeng, Rustenburg and City of Matlosana. This is owing to the presence of a Bosch plant in the local municipality of Madibeng, which specialises in the production of starters, alternators, braking systems and electronic control units (North West Business, 2013). Other products that are produced in the NWP for the automotive industry are electrical wiring looms and automotive safety glass.

5.4.6 Other food products cluster

Figure 5.6: Other food products: Structural path to all commodity sectors

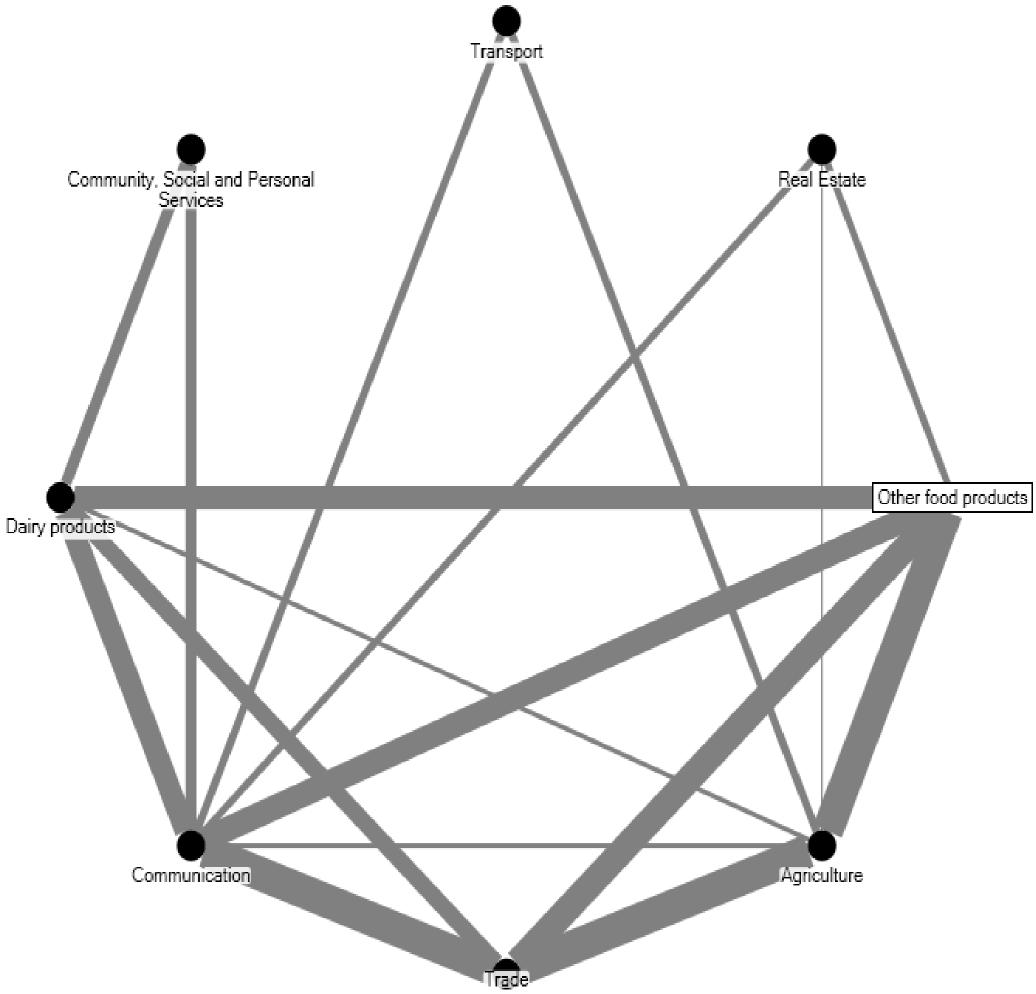


Figure 5.6 illustrates the additional production induced on the demand for communication sector inputs by stimuli in the other food products sector. The direct paths of transmitting the global influence are not significant. Only 15% of the accumulated proportion of the global influence is transmitted through direct paths (see Appendix B: Table 6). Figure 5.6 clearly illustrates that the sectors benefiting the most from an expansion of the other food products sector were agriculture, trade, communication and dairy products. Inter-industry transactions between these sectors and the other food products sector were significant as shown by the edge weights in Figure 5.6. From the figure it is evident that an injection in the other food products cluster is effective in generating high inter-industry linkages (number of thick lines) and additional production in the other sectors in the cluster. Several production activities benefit both directly and indirectly from an injection in the other food products sector. This is because the other food products utilise inputs from the agriculture and dairy products sectors

and sell its output to other sectors and institutions in the economy through the trade sector. The communication sector is utilised to advertise the products of the other food products sector.

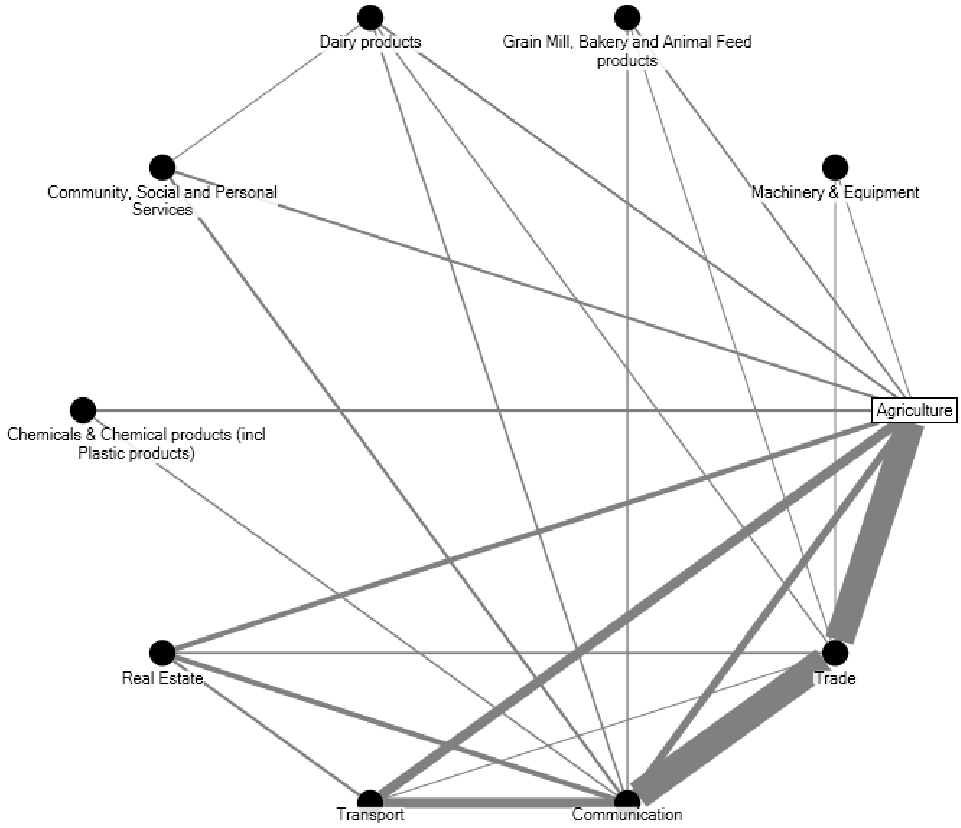
The other food products sector in the NWP is small. It ranks 33rd on intermediate inputs, 32nd on commodity output and value added, respectively (see Table 5.2). Food, beverages and tobacco production, employment and profit were concentrated in the City of Matlosana, Madibeng, Ditsobotla, Rustenburg and Mafikeng (see section 4.5.2.1).

5.4.7 Agriculture cluster

The core structure of the agriculture cluster comprises ten industries as shown in Figure 5.7. The most significant elementary path for the transmission of the global influence in the agriculture cluster was an indirect path through trade and communication. This path transmitted 18.9% of the global influence on the communication sector from an injection in the agriculture sector. The direct influence on the communication sector from stimuli in the agriculture sector amounted to 12.9% (see Appendix B: Table 7).

Other significant indirect elementary paths in the agriculture cluster were through the transport and communication sectors and the real estate and communication sector, respectively. These two elementary paths transmitted a global influence of 6.4% and 5.1% respectively (see Appendix B: Table 7). The agriculture cluster comprises several elementary paths between the ten sectors. Figure 5.7 illustrates that this cluster comprises several inter-industry linkages. The cluster is strongly connected to the trade sector. The trade sector is the most important sector to transmit influence in the cluster (see Appendix B: Table 7). The domination of trade sector in this cluster suggests that developments in this cluster are transmitted through activities within the trade sector.

Figure 5.7: Agriculture cluster: Structural path to all commodity sectors in the NWP



The NWP"s agriculture, forestry and fishing sector contributed 7.2%; the third largest share of output in 2011. In contrast, at national level, the agricultural sector"s contribution to output ranked 17th (see section 4.3.1 and Table 4.3). As discussed in section 4.4.1, the most significant contributors to agriculture, forestry and fishing output, employment and profit in 2011 were the local municipalities of Madibeng, Ditsobotla and Potchefstroom, respectively. The Greater Taung local municipality contributed the least to agriculture forestry and fishing (see Table 4.3). These trends can be attributed to the climatic characteristics of the NWP. The Greater Taung local municipality is situated in the western regions of the NWP. This region is dry and therefore cattle and game ranching is more common (North West Business, 2013). The central, eastern and north-eastern regions of the NWP receive good rainfall and therefore are the main agricultural regions. The local municipality of Madibeng is situated in the north-east, while the Ditsobotla local municipality is situated in the central region of the NWP. These regions are suitable for the cultivation of a variety of crops, including wheat and maize (North West Business, 2013).

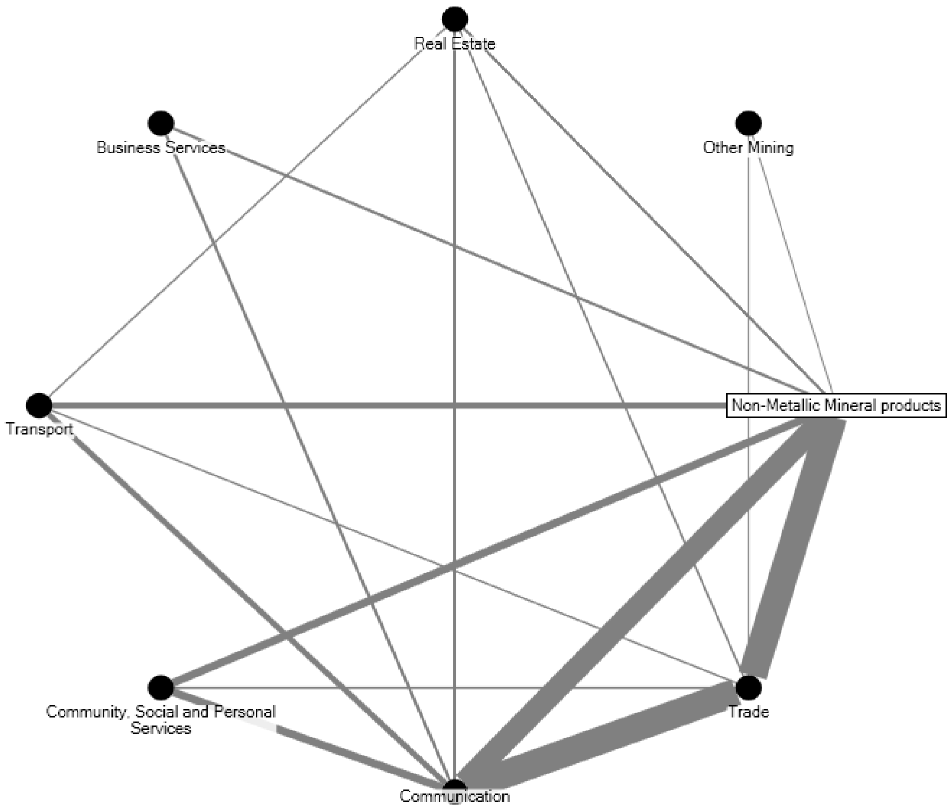
The trade sector was a significant contributor to output and employment in the NWP in 2011 (see section 4.3.1 and 4.3.2). The sector"s contributions to output and employment were 5% and 5.8%; ranking eighth and seventh, respectively. The significance of the trade sector output in the NWP (see section 4.3.1) and in the cluster indicates that a significant proportion of agriculture output is sold unprocessed through the trade sector. This could also be an indication of ownership ties, where large wholesale trade firms control the downstream food production chain.

5.4.8 Non-metallic mineral products cluster

The non-metallic mineral products cluster comprises eight sectors, namely non-metallic mineral products; other mining; real estate; business services; transport; community, social and personal services; communication; and trade. The destination sector, selected on the basis of yielding the highest average path multipliers from the injection, is the communication sector. The global influence of the non-metallic mineral products sector on the communication sector was 0.0038 (see Appendix B: Table 8; column 3). The highest proportion – 19.7% of this global influence – was exercised indirectly through the trade and communication sectors (Column 9). The accumulated proportion of the direct paths (the path linking the two sectors without any other poles) between the non-metallic mineral products sector on the communication sector amounted to 25.7%. The trade sector was the most important sector in transmitting influence in the cluster. It appeared the most times in the elementary paths between the two sectors shown in Table 5.10 (column 4). Figure 5.8 shows that the efficacy of an injection into the non-metallic mineral products cluster is relatively weak when we consider the number of sectors that benefit. There are only seven sectors that will benefit from induced demand increases in the non-metallic mineral products cluster.

The non-metallic mineral products cluster has the potential to generate significant economy-wide impacts as illustrated by the PoP results in Table 5.5. In addition, the NWP"s contributions to the various sectors in the cluster are significant, thereby indicating the important role that this cluster can play. In terms of output, the NWP"s contributions to other non-metal mineral products output (7.1%) ranked fourth; employment (9.1%) ranked second and profit (7.7%) ranked seventh. Other non-metal mineral products output, profit and employment were concentrated in the Ditsobotla, Mafikeng and Madibeng local municipalities in the NWP (see section 4.5.2.5). This indicates that efforts to stimulate cluster formation in this sector should be focused in these regions. The NWP has a heavy industrial capacity that is heavily dominated by ferrochrome production. The country‟s major ferrochrome operations, located in Kroondal (Xstrata Alloys), Rustenburg (Samancor Chrome Mines) and Madibeng (Hernic Ferrochrome), contribute substantially to employment in the NWP (North West Business, 2013).

Figure 5.8: Non-metallic mineral products cluster: Structural path to all commodity sectors in the NWP

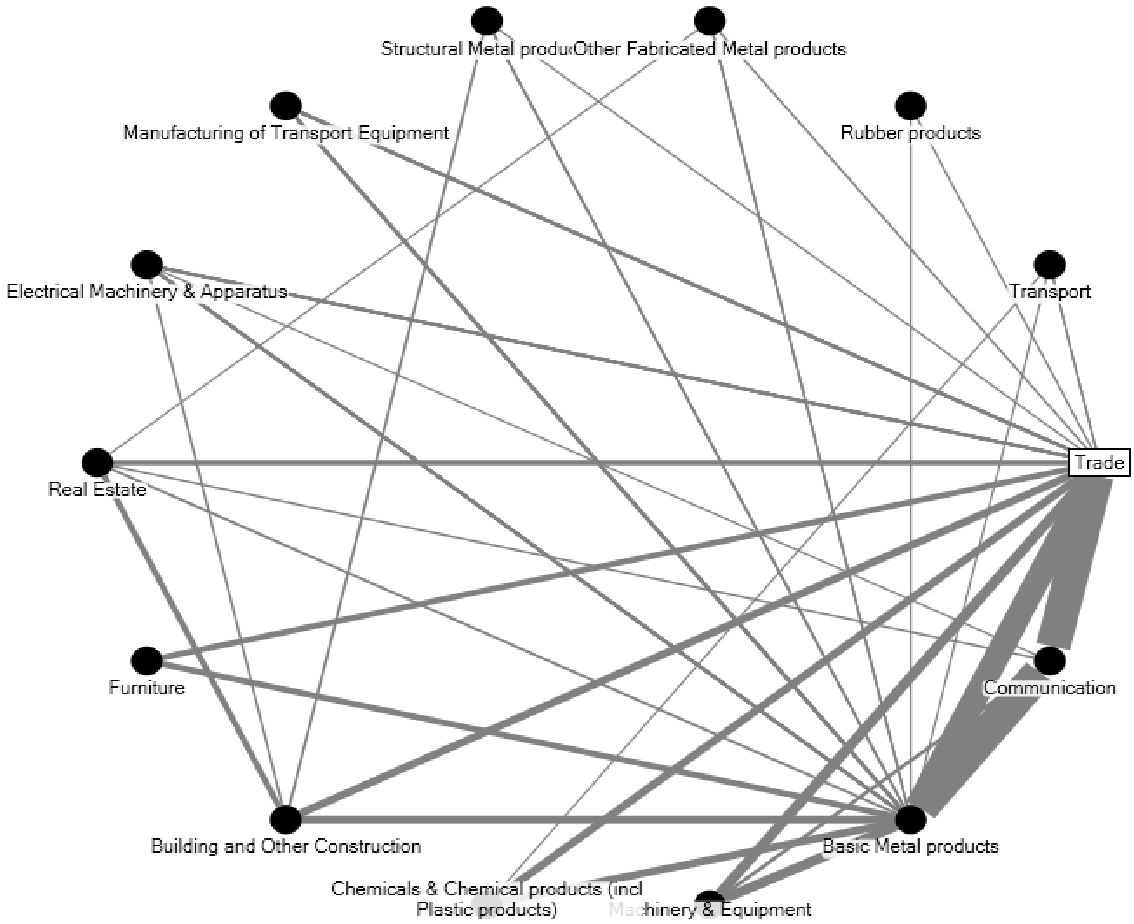


In order to assess the NWP‟s contributions to other mining sector, the mining and quarrying sector is analysed. The NWP‟s contributions to mining and quarrying ranked first with respect to output (42.6%), employment (42.3%) and profit (85.9%) (see section 4.3). This is attributed to the fact that the NWP lies directly over the world‟s largest mineral belt that contains deposits of chrome, gold, vanadium, manganese and platinum group elements (North West Business, 2013; Bafokeng Platinum, 2012). The community, social and personal services sector contributed the fifth largest proportions of employment and profit (6.2% and 9.4%) respectively in the NWP (see sections 4.3.1; 4.2.3; and 4.3.3).

5.4.9 Trade cluster

Appendix B: Table 9 and Figure 5.9 show the SPA results for the trade cluster. The destination sector selected on the basis of yielding the highest average path multipliers from the injection in the trade sector was the basic metal products sector.

Figure 5.9: Trade cluster: Structural path to all commodity sectors in the NWP



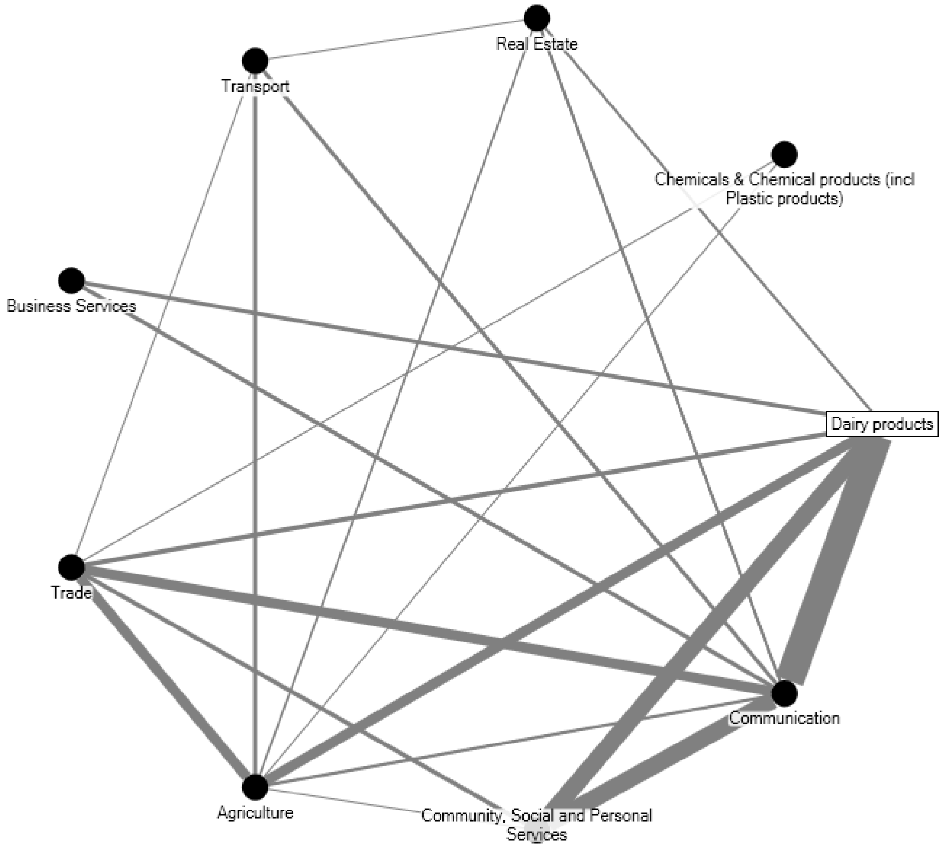
From Appendix B: Table 9 it is evident that the most significant elementary path between trade and basic metal products was an indirect path. 14.2% of the global influence of an injection in the trade sector was transmitted to the basic metals sector through the communication sector. The direct influence of an injection in the trade on basic metal products was 10%. Appendix B: Table 9 shows that the indirect paths are more significant in transmitting influence than direct paths in the trade cluster. The trade cluster comprises fourteen sectors (see Figure 5.9). This shows that the efficacy of an injection into the Trade sector is strong when we consider the number of sectors that benefit; i.e. fourteen sectors will benefit from induced demand increases in the trade sector. The trade cluster generates a 64% (Column 9) accumulated total global influence in the economy (see Appendix B: Table 9).

The NWP contributed 5%, 5.8% and 5% respectively to wholesale and retail trade output, employment and profit in 2011 (see sections 4.1.1 to 4.3.3 and Tables 4.3 to 4.5). The highest contributions to wholesale and retail trade output and employment in 2011 in the NWP originated from City of Matlosana, Rustenburg and Madibeng (see section 4.5.3.1). Consequently, these three local municipalities were the main profit centres in the wholesale and retail sub-sector. The NWP"s wholesale and retail trade sub-sector was the largest employer in the tertiary sector in 2011. The NWP"s close proximity to Gauteng provides access to the domestic market as well as international markets for the firms in the NWP, thereby making trade a significant economic activity in the NWP.

5.4.10 Dairy products cluster

The dairy products cluster was identified as the 10th industrial cluster yielding the most economy-wide effects for the NWP. The core structure of the dairy products cluster comprises 9 industries as shown in Figure 5.10. The most significant elementary path for the transmission of the global influence in the dairy products cluster was a direct path through the communication sector. This path transmitted 18.7% of the global influence of an injection in the dairy products sector. The direct elementary paths transmitted an accumulated proportion of 23.2% of the global influence in the cluster (see Appendix B: Table 10). This indicates that both the direct and indirect paths are significant for transmitting influence in the cluster. The dairy products cluster comprises several indirect elementary paths between the nine sectors (see Figure 5.10 and Appendix B: Table 10). This suggests that firms in these industries in the dairy products cluster have multiple inter-industry transactions in the region. The formation of an industrial cluster can develop close association between the firms in these industries and thereby improve competitiveness. From Appendix B: Table 10, it is evident that the most important sector in transmitting influence between the dairy products and communication is agriculture. Agriculture is the most important sector as it appears the most times in the elementary paths between the two sectors.

Figure 5.10: Dairy products cluster: Structural path to all commodity sectors in the NWP



As mentioned in Section 4.4.1.1, the western regions of the NWP are dry and therefore cattle and game ranching is more common (North West Business, 2013). The central, eastern and north-eastern regions of the NWP receive good rainfall and therefore are suitable for the cultivation of a variety of crops, including wheat and maize (North West Business, 2013). From the analysis of the economic performance of the NWP, the dairy products sector can be classified under the food, beverages and tobacco sector. Food, beverages and tobacco output was highest in the City of Matlosana and Rustenburg local municipalities (see section 4.5.2.1). The biggest employers and the respective number of people employed were City of Matlosana, Madibeng, Ditsobotla, Rustenburg and Mafikeng (see section 4.4.2.1). The business services sub-sector contributed the fourth largest share of output in the NWP"s tertiary sector in 2011. Rustenburg and Madibeng were the main production and profit-earning centres in the sub-sector. These two local municipalities also contributed the most to employment in the sub-sector (see section 4.5.3.6). To assess the NWP"s contribution output and employment in the dairy products and grain mill, bakery and animal feed products sectors, we analysed the performance of the food, beverages and tobacco sector. The NWP"s contribution to output in the food, beverages and tobacco sector in 2011 ranked 18th (see section 4.3). In comparison to the agriculture contribution to output, the food, beverages and tobacco sector‟s share of output was less significant. This may imply low levels of value addition of agriculture output in the NWP. The proceeding section determines whether any of the identified potential clusters have REOs according to the DSM.

5.5 Industrial clusters vs. realistic export opportunities

5.5.1 The decision support model methodology: Identification of REOs for products

This section demonstrates in part that the competitiveness of firms and trade promotion of the clusters‟ products enhances inter-firm relations and networks spanning industry and international boundaries. As mentioned in section 1.3, the South African government through its trade promotion agency, the DTI, is utilising scientific models to identify and prioritise products and markets for export promotion. The DSM is one such model. The DSM involves a sequential filtering process with four filters to identify product and export market combinations with the most REOs for a particular country. Figure 5.11 illustrates the sequence of the filters in the DSM[15].

The model is based on the assumption that, for any exporting country, all countries (markets) in the world are potential markets for all its products (Cuyvers, 2004). Filter 1 of the DSM analyses countries (potential markets) based on political and commercial risk. In addition, the macro-economic size and growth of the countries are assessed. These factors are assessed to determine countries that have general potential based on these criteria. Countries that lack potential are eliminated from the analysis (Cuyvers, Steenkamp & Viviers, 2012). Filter 2 of the DSM assesses the various product categories for the remaining countries. The filter assesses product-country combinations using two criteria, namely import growth and import market size. The product – country combinations should be at least growing and/or be of adequate size to enter filter 3 of the model. Product – country combinations that are not meeting the selection criteria are eliminated from the analysis.

[15] For an in-depth description of the DSM (for products and services) methodology and its applications, refer to Cuyvers and Viviers (2012).

Filter 3 assesses the ease of market entry in the remaining countries. This is achieved by analysing two categories of entry barriers, namely the degree of concentration and trade restrictions (Cuyvers, De Pelsmacker, Rayp & Roozen, 1995; Cuyvers, 1997, 2004). Filter 4 of the model categorises and prioritises the REOs identified thus far. The final categorisation of REOs in Filter 4 is based on (i) the relative market share and (ii) the size and growth of imports of the different markets as shown in Table 5.6 (Cuyvers *et al.,* 2012). These criteria are the basis of the cell classifications of the product – country combinations. The columns of the Table 5.6 show South Africa‟s relative market share (compared to the top six competitors). South Africa‟s market share is classified as small, intermediately small, intermediately high or high. The rows categorise the product – country combinations according to the import size and growth based on the analysis in filter 2 (Cuyvers, Steenkamp & Viviers, 2012). A REO classified in cell 7, for example means that the demand in that market is growing over both the short- and the long term, but South Africa has an intermediately small market share in that market.

Table 5.6: Final categorisation of product REOs

	South Africa‟s relative market share			
	Small	Intermediately small	Intermediately high	High
Large product market	Cell 1	Cell 6	Cell 11	Cell 16
Growing (short- & long-term) product market	Cell 2	Cell 7	Cell 12	Cell 17
Large product market with short-term growth	Cell 3	Cell 8	Cell 13	Cell 18
Large product market with long-term growth	Cell 4	Cell 9	Cell 14	Cell 19
Large product market with short- and long-term growth	Cell 5	Cell 10	Cell 15	Cell 20

Source: Cuyvers, Steenkamp and Viviers, 2012

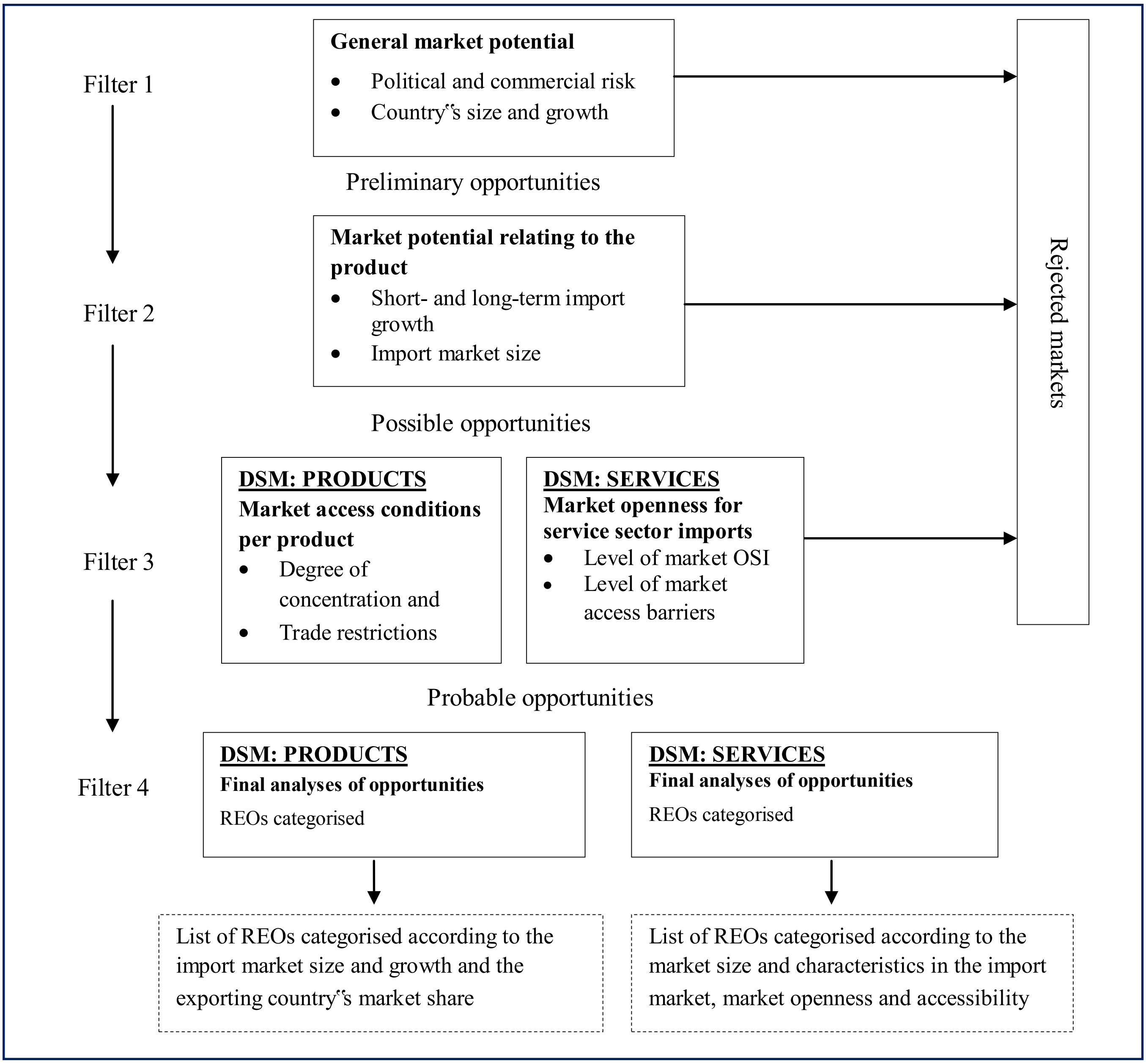
The products are also ranked according to the sum of the export potential values (US dollar thousand) in all countries in which the product was identified as an export opportunity for South Africa. Potential export values for each REO are calculated to provide a better indication of the size of the export opportunities relative to one another than merely looking at the number of opportunities (Cuyvers, Steenkamp & Viviers, 2012).

5.5.2 The decision support model methodology: Identification of REOs for services

The DSM for products only analyses the export opportunities for products, with no consideration for the export opportunities of the services sector (Grater, 2011). As a result, a DSM for services was developed to identify export opportunities for the South African economy in the services sectors. The DSM for services uses the first two filters of the DSM for products as the basis on which countries and products are eliminated, respectively (Grater & Viviers, 2012). The same assumptions of the DSM for products are made in the DSM for services. That is, for any particular country, all countries in the world are considered as potential markets (see section 5.5.1). However, not all the filters of the DSM for products could be applied to services. The DSM for services methodology had to be adjusted by changing filters 3 and 4, owing to limited data availability for trade in services (Grater, 2011; see Figure 5.11).

Filters 1 and 2 are applied exactly the same as the DSM for products, but using data for services. Filter 3 of the DSM for services proceeds to analyse two indicators of openness to services trade. Firstly, filter 3 analyses the service - country combinations based on the openness for services or demand for services in the importing country. The openness for services or demand for services refers to the level of access in a services importing market. It is a ratio of imported services to the total services used in the specific market (Grater, 2011). This proxy demonstrates whether a market is easy to access (Grater *et al.,* 2012). The second indicator is the market-access barriers for services. This is given by the percentage of market access for services according to a country‟s GATS schedule of commitments to open its borders to trade in services (Grater, 2011). The fourth filter of the DSM for services does not eliminate any more services - country combinations, but clusters the results according to sectors, countries and regions as well as the current import values for each combination to create a perception of the size of the market.

Figure 5.11: Sequence of filters in the DSM for products and DSM for services



Source: Cuyvers *et al.,* 2012; Grater, 2011

Table 5.7: Outlay of the cell classification for the DSM for services

Cell classification	Cell description	Cell classification continued	Cell description
1	Large market indicating low market openness and low market access	11	Large market indicating high market openness but low market access
2	Market with short and long term growth, with low market openness and low market access	12	Market with short and long term growth, indicating high market openness but low market access
3	Large market with short term growth, indicating low market openness and low market access	13	Large market with short term growth, indicating high market openness but low market access
4	Large market with long term growth, indicating low market openness and low market access	14	Large market with long term growth, indicating high market openness but low market access
5	Large market with short and long term growth, indicating low market openness and low market access	15	Large market with short and long term growth, indicating high market openness but low market access
6	Large market with low market openness but high market access	16	Large market with short and long term growth, with high market openness and high market access
7	Market with short and long term growth, with low market openness but high market access	17	Market with short and long term growth, with high market openness and high market access
8	Large market with short term growth, indicating low market openness but high market access	18	Large market with short term growth, indicating high market openness and high market access
9	Large market with long term growth, indicating low market openness but high market access	19	Large market with long term growth, indicating high market openness and high market access
10	Large market with short and long term growth, indicating low market openness but high market access	20	Large market with short and long term growth, indicating high market openness and high market access

Source: Grater, 2011

The results are also grouped into a cell structure that differentiates the opportunities according to the market size and growth for that specific services sector and the level of market openness and market accessibility shown in Table 5.7. This provides the user with a classification of the results in order to make decisions more easily. For example, an export opportunity classified in cell 20 where the market is large and growing, and the market is very open and accessible, will be easier to act upon, than an export opportunity in cell 1 where the market may be large, but the market is not very open and accessible. More strategic planning will be needed to enter into such a market. The results lists as well as the cell classification can be used by the government and exporting firms in South Africa to devise appropriate export strategies for each services-country combination.

5.5.3 Identified industrial clusters with REOs

Both the DSM for products and the DSM for services provide a list of export products and services identified as export opportunities (REOs) in all countries for a particular export country. These models also provide the lists as well as the number of countries to which the product or service can be exported. This number represents the number of countries to which the product can be exported as an REO. For each potential export market, the DSM provides a list of products that a particular country has REOs. Additionally, the DSM for products provides a potential export values for each REO to give a better indication of the size of the export opportunities relative to one another than merely looking at the number of opportunities (Cuyvers, Steenkamp & Viviers, 2012). Both the DSM for products and the DSM for services were applied for South Africa in 2010 (Steenkamp, 2011; Grater, 2011) using UNCOMTRADE data.

In order to determine whether any of the clusters‟ products have REOs according to the DSM, the following steps were taken. Since the DSM results are at a country level, the exports of the NWP firstly had to be analysed. The NWP‟s total export data for the period 2003 to 2007 was obtained from Quantec (2013). Products with exports for at least three of the five years were selected for further analysis. This was done in order to ensure that the NWP has the capacity to export the products identified as having REOs. All other products with export values for less than three years were excluded from further analysis. Secondly, the selected products (NWP‟s export products with a positive export value for at least three years) were matched to the DSM for products results for South Africa with a revealed comparative advantage (RCA) greater than one. The RCA is given by the formula:

$$RCAj = \left(\frac{X_{SA,j}}{X_{World,j}} \right) / \left(\frac{X_{SA,tot}}{X_{World,tot}} \right); \qquad (5.8)$$

Where $X_{SA,j}$ is South Africa‟s exports of product *j*,
$X_{SA,tot}$ is South Africa‟s total exports of all products,

$X_{World,j}$ is the world"s exports of product j and

$X_{World,tot}$ is total world exports of all products (Balassa, 1965; Krugell & Matthee, 2009:461).

The RCA value that is larger than 1 indicates that South Africa has a sufficient share in trade in these products to gain a comparative advantage and is therefore relatively specialised in that product (Balassa, 1965). Lastly, the remaining REOs with an RCA greater than 1 were matched to the product clusters according to the corresponding HS codes (see Table 5.8).

The SAM uses aggregated sector data, classified under Standard Industrial Classification (SIC). The 2010 DSM for products used product-level data classified according the WTO"s Harmonised System (HS) classification of products for trade of transportable goods. The DSM for services uses data for services classified under the United Nation"s Extended Balance of Payments Services (EBOPS) and CPC classification, which covers the production, consumption and trade of all goods and services. The differences in the data in the DSM for products and the DSM for services and the SAM warrant for conversion into the same classification to enable comparison of the data. Table 5.8 shows the corresponding HS chapters, EBOPS and CPC classifications associated with the ten identified clusters. The corresponding descriptions and heading of each classification are provided in Appendix C: Tables 1 to 3.

Table 5.8: Identified industrial clusters: Corresponding HS chapters, EBOPS and CPC

Cluster	Corresponding HS 2 chapter	Corresponding EBOPS codes	Corresponding CPC codes
Communication[S]	N/A	245 - 247	N/A
Real estate[S]	N/A	N/A	821 - 822
Grain mill, bakery and animal feed products[P]	11, 23	N/A	N/A
Building and other construction[S]	N/A	249 - 251	N/A
Basic metal products[p]	72-81	N/A	N/A
Other food products[P]	08 - 10, 17 - 19	N/A	N/A
Agriculture[P]	01, 06, 08	N/A	N/A
Non-metallic mineral products[P]	25 - 40, 68 - 71	N/A	N/A
Trade[S]	N/A	N/A	741 - 742, 748 - 749
Dairy products[P]	04	N/A	N/A

Source: Compiled by author

Footnote

s-Services

p-Products

×-N/A

5.5.3.1 Identified industrial cluster products with REOs

Table 5.9 shows the top five potential export opportunities per product cluster for the NWP. The non-metallic mineral products cluster contained the most number of REOs relative to all the other clusters. The REOs for the non-metallic mineral products cluster include the second largest REO for South Africa in terms of potential export value. The product HS271011 – Aviation spirit had a potential export value of US$12.1 million and ranked as the second largest REO for South Africa. This indicates that the NWP‟s non-metallic mineral products cluster can take advantage of the potential export value in this cluster. In the basic metal products and the non-metallic mineral products clusters, the products HS 710239 – Diamonds (jewellery) worked but not mounted or set and HS 740311 – Copper cathodes and sections of cathodes unwrought ranked third and fourth according to the highest export potential value for South Africa to all countries. This implies that South African and in particular NWP firms have potential to take advantage of export opportunities worth US$11.7million and US$9.9million, respectively, for these two products. The grain mill, bakery and animal feed products cluster has one product with REO; HS 110313 – Maize (corn) grouts or meal. This product has an export potential value of US$12.6 million and export opportunities to nine countries. The dairy products and other foods clusters did not have any products with REOs with an RCA greater than 1 of the DSM for products. Appendix D, Table 1 contains all other products with REOs for each cluster.

Table 5.9: Top 5 potential export opportunities per product cluster for the NWP

Cluster	Corresponding HS 2	HS 2	HS 6-digit product category	Product ranking according to potential export values	Product ranking according to number of export opportunities	Potential export value (US$ thousands)	Number of countries for which the product is selected
Grain mill, bakery and animal feed products	11, 23	11	110313 – Maize (corn) grouts or meal	784	812	$12,691	9
Basic metal products	72-81	74	740311 –Copper cathodes and sections of cathodes unwrought	4	519	$9,904,077	19
		72	720241 –Ferro-chromium, >4% carbon	24	513	$2,227,206	19
		73	731210 –Stranded steel wire/cable/etc., no electric insulation	107	47	$413,000	39
		73	730840 –Props etc. for scaffold, shuttering, pits, iron/steel	113	79	$398,120	36
		73	730799 –Fittings, pipe or tube, iron or steel, nes	128	306	$358,940	26
Other food products	08 - 10, 17 – 19	N/A	N/A	N/A	N/A	N/A	N/A
Agriculture	01, 06, 08	06	060210 –Cuttings and slips, not rooted	505	251	$57,629	27
		06	060390 –Cut flowers and flower buds for bouquets, dried, etc.	804	708	$10,745	13
		06	060240 –Roses	857	707	$5,840	13
		01	010420 –Goats, live	963	954	$4	1
Non-metallic mineral products	25 - 40, 68 – 71	71	710231 –Diamonds (jewellery) unworked or simply sawn, cleaved	6	849	$7,500,043	8
		71	711031 –Rhodium unwrought or in powder form	18	850	$2,592,926	8
		71	711019 –Platinum in semi-manufactured forms	27	512	$1,849,013	19
		40	401120 –Pneumatic tyres new of rubber for buses or lorries	35	134	$1,391,740	32
		71	711021 –Palladium unwrought or in powder form	38	825	$1,208,851	9
Dairy products	04	N/A	N/A	N/A	N/A	N/A	N/A

The DSM for product results also provides insights into the countries where South Africa has high export potential for the product. Table 5.10 shows the top 10 potential export markets and three top products per market. Firms in the identified NWP clusters can enhance their export performance by utilising the results of the DSM by taking advantage of these export opportunities. The countries that hold high export potential for the products of the NWP include the United States, Japan, China, Germany, the United Kingdom, India, Canada, Belgium, Italy and the Netherlands. The products among the top 10 with the highest export potential include automobiles, aviation spirit, diamonds, bituminous coal, copper ores, nickel, aluminium, parts of seats and coal (see Table 5.10). The full list of services REOs provided in Appendix D: Table 1 can be explored to enhance the export performance of the identified industrial cluster products taking into account the potential export values and the number of opportunities.

Table 5.10: Top 10 potential export markets and three top products per market

Country	**Potential export value for South Africa of the REOs identified for the NWP (US$ thousands)**
United States	**$46 182 081**
870323 –Automobiles, spark ignition engine of 1500-3000 cc	$10 704 206
710239 –Diamonds (jewellery) worked but not mounted or set	$6 044 885
271011 –Aviation spirit	$2 333 627
Japan	**$2 599 675**
270112 –Bituminous coal, not agglomerated	$4 542 522
260300 –Copper ores and concentrates	$2 172 167
711011 –Platinum unwrought or in powder form	$1 283 548
China	**$18 535 325**
260300 –Copper ores and concentrates	$1 473 534
870323 –Automobiles, spark ignition engine of 1500-3000 cc	$1 074 816
750210 –Nickel unwrought, not alloyed	$955 988
Germany	**$15 829 678**
271011 –Aviation spirit	$1 637 182
870323 –Automobiles, spark ignition engine of 1500-3000 cc	$853 217
750210 –Nickel unwrought, not alloyed	$850 487
United Kingdom	**$13 867 334**
270799 –Coal tar distillation products nes	$2 171 031
710231 –Diamonds (jewellery) unworked or simply sawn,	$2 000 247

cleaved	
270112 –Bituminous coal, not agglomerated	$667 899
India	**$9 029 116**
710231 –Diamonds (jewellery) unworked or simply sawn, cleaved	$2 176 369
270119 –Coal except anthracite or bituminous, not agglomerate	$1 543 164
271011 –Aviation spirit	$968 758
Canada	**$8 469 649**
870323 –Automobiles, spark ignition engine of 1500-3000 cc	$3 381 686
940190 –Parts of seats	$804 150
842139 –Filtering or purifying machinery for gases nes	$477 878
Belgium	**$8 077 996**
710231 –Diamonds (jewellery) unworked or simply sawn, cleaved	$981 708
710239 –Diamonds (jewellery) worked but not mounted or set	$757 323
870323 –Automobiles, spark ignition engine of 1500-3000 cc	$516 293
Italy	**$7 895 138**
271011 –Aviation spirit	$772 646
270112 –Bituminous coal, not agglomerated	$519 775
870421 –Diesel powered trucks weighing < 5 tonnes	$430 100
Netherlands	**$6 119 337**
270112 –Bituminous coal, not agglomerated	$775 304
271011 –Aviation spirit	$657 123
284410 –Natural uranium, its compounds, mixtures	$645 120

Source: Steenkamp, 2011

5.5.3.2 Identified industrial cluster services vs. DSM for services

The analysis of the service clusters did not include the NWP provincial service exports. This is because there is no data on provincial exports of services. Therefore, in this section, the analysis determined the service clusters with REOs according to the results of the DSM for services. Table 5.9 shows the identified industrial cluster services with REOs. Only the communication and building and other construction clusters had services with REOs according to the DSM for services. These clusters both have two services with REOs. REOs in the communication cluster exist in EBOPS Chapters 3.2 communications services – telecommunication services and 3.1 communications services –postal and courier services. These two services have REOs to 19 and six countries respectively. Resultantly, these services ranked sixth and 31st respectively in terms of the number of opportunities. Similarly, the building and other construction cluster‟s REOs were in two services, namely EBOPS Chapters 4.2 construction services – construction in the compiling economy; and 4.1 construction services – construction abroad. These REOs have export opportunities to 15 and seven countries, respectively. Resultantly, construction services – construction in the compiling economy ranked as the eighth REO; while construction services – construction abroad ranked 36th. All other service clusters did not have REOs according to the DSM for services. The full list of services REOs provided in Appendix D: Table 2 can be explored to enhance the export performance of the identified industrial cluster services taking into account the total import values and the number of opportunities per service.

Table 5.9: Identified industrial cluster services with REOs

Cluster	**REOs: Service code and description***	**Number of countries (opportunities)**	**Service ranking according to REOs**
Communication	3.2 Communications Services - Telecommunication services	19	6
	3.1 Communications Services - Postal and courier services	9	31
Real estate	N/A	N/A	N/A
Building and other construction	4.2 Construction Services - Construction in the compiling economy	15	8
	4.1 Construction Services - Construction abroad	7	36
Trade	N/A	N/A	N/A

Source: Grater, 2011

5.6 Summary and conclusion

This chapter discussed the results of applying the SPA and PoP methods to identify and prioritise industrial clusters in the NWP of South Africa. The effective promotion of industrial clusters requires prioritisation of the number of industrial clusters. This study prioritised ten industrial clusters using the PoP method. This is the first study, to our knowledge, to use the PoP method to prioritise the number of potential clusters. The ten identified industrial clusters are (i) communication, (ii) real estate, (iii) grain mill, bakery and animal feed products, (iv) building and other construction, (v) basic metal products, (vi) other food products, (vii) agriculture, (viii) non-metallic mineral products, (ix) trade, and (x) dairy products.

The communication cluster was identified as having the highest PoP for the NWP. This is shown by the frequency of the communication sector as a destination sector for the other clusters. The communication sector was the destination sector in eight of the 10 clusters. The communication cluster comprises six sectors. The efficacy of an injection into the communication sector is relatively weak as only five sectors will benefit from induced demand increases in the communication sector. Output, employment and profit centres of the communication sub-sector were Madibeng, Mafikeng, Rustenburg and City of Matlosana.

The agriculture cluster was identified as the seventh industrial cluster with the highest PoP for the NWP. The core structure of the agriculture cluster comprises ten industries. The cluster is strongly connected to through the trade sector. The domination of trade sector in this cluster suggests that developments in this cluster are transmitted through activities within the trade sector. The most significant contributors to agriculture, forestry and fishing output, employment and profit in 2011 were the local municipalities of Madibeng, Ditsobotla and Potchefstroom, respectively. These trends can be attributed to the climatic characteristics of the NWP. The trade sector was a significant contributor to output and employment in the NWP in 2011. The significance of the trade sector output in the NWP and in the cluster indicates that a significant proportion of agriculture output is sold unprocessed through the trade sector. This could also be an indication of ownership ties, where large wholesale trade firms control the downstream food production chain.

The non-metallic mineral products cluster comprises eight sectors. The trade sector was the most important sector in transmitting influence in the cluster. The efficacy of an injection into the communication sector is relatively weak when we consider the number of sectors that benefit. Other non-metal mineral products" output, profit and employment were concentrated in the Ditsobotla, Mafikeng and Madibeng local municipalities in the NWP.

The trade cluster was identified as the ninth industrial cluster for the NWP. The indirect paths were the most significant in transmitting influence than direct paths in the trade cluster. The trade cluster generated the most efficacies as it comprised fourteen sectors; the number of sectors that benefit from stimuli in the trade sector. This is the highest number of sector in a clusters compared to all other identified potential clusters. The highest contributions to wholesale and retail trade output, employment and profit in 2011 in the NWP originated from City of Matlosana, Rustenburg and Madibeng. The NWP‟s wholesale and retail trade sub-sector was the largest employer in the tertiary sector in 2011. The NWP‟s close proximity to Gauteng provides access to the domestic market as well as international markets for the firms in the NWP, thereby making trade a significant economic activity in the NWP.

The analysis in this chapter has illustrated that the most important centres at the local municipal level across all clusters were Madibeng, Rustenburg, City of Matlosana, Mafikeng and Ditsobotla. This indicates that efforts to stimulate cluster formation in this sector should be focused in these regions. This chapter further demonstrated that firms in the identified industrial clusters can increase export performance by utilising the results of the DSM. This was achieved by matching the NWP‟s current exports, to the DSM for products results. The DSM results used were those with an RCA greater than one. Additionally, service clusters were matched to the REOs according to the DSM for services. The non-metallic mineral products and basic metal products clusters had the most number of REOs relative to all the other clusters. In terms of services, only the communication and building and other construction clusters had services with REOs according to the DSM for services. These cluster both had two services with REOs. All other service clusters did not have REOs according to the DSM for services.

It is concluded that the competitiveness of firms in the NWP can be enhanced through cluster formation. Ten industrial clusters identified in this chapter generate the widest economy-wide effects in the NWP. Furthermore, the export performance of firms in the NWP can be enhanced by incorporating the results of the DSM for products and DSM for services to identify cluster products with REOs.

The following chapter discusses the multiplier analysis in the NWP SAM to highlight the effects of the industrial clusters on the regional economy of the NWP.

CHAPTER 6: EVALUATION OF INDUSTRIAL CLUSTER FORMATION ON THE NWP ECONOMY USING SAM MULTIPLIER ANALYSIS AND AN EXPLORATION OF THE CLUSTERS' REOS

6.1 Introduction

The need for policy-makers to understand the sectoral, regional, temporal and social effects of policy or external shocks has driven advances in economic modelling to address this challenge. Economists have come up with methods that can assist national and regional governments to make informed decisions on economic development programmes (Honkatukia, 2013). As stated in sections 2.6 and 2.8 of this study, empirical evidence of industrial cluster failures exists. It is therefore important to provide policy-makers with insight into the possible economic and social impacts of economic development policies (Miguel-Velez & Perez-Mayo, 2010). Several models that can provide such insights exist.

Social accounting matrices (SAMs) can be useful to calibrate a broad class of models to demonstrate the social and economic effects of different policies. This chapter focuses on the use of SAMs to develop simple economy-wide multipliers to illustrate the effects of industrial cluster formation on the economy of the NWP. The chapter is structured as follows: section 6.2 presents an aggregated SAM table illustrating the identified industrial clusters and related sectors" contributions to the NWP economy. Section 6.3 describes the SAM multiplier analysis, while section 6.4 provides a graphical presentation of the multiplier analysis for the NWP clusters identified in Chapter 5. Section 6.5 uses SAM multipliers to assess the supported activity generated by the ten identified potential clusters for the NWP. The export potential, according to the DSM, of the identified industrial clusters is explored in section 6.6. Section 6.7 concludes the chapter.

6.2 An aggregated SAM table for the NWP clusters and related sectors

Chapter 5 revealed the ten identified industrial clusters for the NWP. It also highlighted the sectors included in each cluster (see section 5.4). This section presents an aggregated SAM table of the identified potential clusters for the NWP and all the related sectors (sectors included in each cluster). The aim is to quantify the intermediate and final demand linkages identified in the cluster map[16] in a SAM. As mentioned in section 2.5.5, clustering increases the likelihood of the division of labour and specialisation among firms that were likely to be fierce local rivals in the absence of the cluster (Schmitz, 1995). Division of labour and specialisation among firms enables them to utilise specialised machinery and achieve higher utilisation rates (Marshal, 1920). Additionally, it allows firms to specialise in areas in which their competitive advantage lies. This results in the firms in the cluster outsourcing specialised tasks from other firms in the cluster. Firms are therefore able to specialise in activities they are more efficient in, thereby making them more productive and efficient (Madsen, Smith & Dilling-Hensen*,* 2004; see section 2.5.3). This also increases the firms" intermediate and final demand linkages. In this section, these intermediate and final demand linkages will be traced in an aggregated SAM table for the NWP clusters and related sectors.

However, the SAM does not provide detailed information on the absolute size and importance of these linkages. Instead, this has been provided in Chapter 5, section 5.4, under the SPA results. The strength of the SAM is that it can quantify the absolute size of many of these linkages. Table 6.1 shows the customised and aggregated SAM for the ten identified potential clusters for the NWP and other supporting sectors. The SAM is a balanced set of accounts (see sections 3.4.1 and 5.2). For every sector, the sum of its purchases, including value added (the column total), is equal to the sum of its sales (the row total), which equals the value of gross output. This enables the identification of the active interdependencies among firms. These can be in the form of vertical or horizontal relationships (see section 2.5.5). Vertical relationships can exist between producers of certain components and their users; that is, between component parts producers and the firms using these component parts as intermediate inputs (Schmitz, 1999). Such relationships can either be hands-off or obligatory (Sako, 1992). Horizontal interdependency includes sharing orders and equipment (see section 2.5.5).

Table 6.1 has some negative values, which represent balancing items. For example, the negative values in the *Trade* and *Transport* columns represent the Trade and Transport margins. Margins commodities are the costs incurred by producers and importers to receive goods and services. They facilitate the flows of other commodities from producers (or importers) to users (Rossouw, 2007). According to McDonald, Thierfelder and Robinson

[16] The cluster map shows all the sectors included in each cluster.

(2007), commodities can be purchased from domestic activities. In this case, the transaction comprises producer prices, domestic trade and transport margins. Alternatively, commodities can be imported, in which case the transaction is valued exclusive of international trade and transport margins. The commodity accounts make payments to suppliers (domestic or foreign) for the trade and transport services needed to import the commodities and any commodity-specific taxes (McDonald *et al.*, 2007). Therefore, margins are necessary to adjust the valuation of the supply of products from basic to purchasers‟ prices.

The R-*29,830* in the Exports column is the "*Balance on the current account*" item, which may be negative. Finally, the *Change in inventories* column may also be negative. Changes in inventories (or stocks) are the difference between additions to and withdrawals from inventories. In national accounts, they consist of three changes in: (i) stocks of outputs that are still held by the units that produced them prior to their being further processed, sold, delivered to other units or used in other ways; stocks of products acquired from other units that are intended to be used later for intermediate consumption or for resale without further processing. (ii) Work in progress, which are goods being processed, but not yet delivered to the user at the end of the accounting period. Finally, (iii) strategic stocks managed by government authorities (food, oil, stocks for market intervention).

From Table 6.1, the grey box on the top left hand corner of the table represents the purchases and sales between the clusters‟ sectors and supporting industries. The grey shaded rows represent the destination of sales of sectors included in the ten potential clusters. The grey shaded columns also represent the cluster sectors‟ sources of purchases. For each sector, the value of gross output is equivalent to the sum of sales (row total). Alternatively, the sum of a sector‟s purchases and value added (column total) gives the value of gross output. Appendix E: Table 1 shows the descriptions of the abbreviations used in Table 6.1. For example, the agriculture sector‟s major domestic purchases were chemical and chemical products (R1.02 billion), grain mill, bakery and animal feed products (R868.5 million) and transport (R791.4 million). The major domestic sales for the agriculture sector were to grain mill, bakery and animal feed products (R2.03 billion) and dairy products (R745.5 million). The SAM shows that the clusters and related sectors paid wages amounting to R25.3 million.

In addition, the SAM also shows the exports and imports of the clusters and supporting sectors. The total imports of intermediate goods across all clusters and supporting industries were R73.8 million and total exports were R45.8 million. The aggregated SAM also provides insights into the total output that the clusters and related sectors produce (SAM estimate of the total gross cluster output). This is achieved by summing up the gross output for the clusters and related sectors. From Table 6.1, the SAM estimate of the total gross cluster output is R211.6 million of which R61 million is value added. The gross output for the NWP for all sectors is R556.6 million. This implies that the clusters and related sectors" output represents 38% of the total output. The clusters and related sectors contributed 38% to total output in the NWP without the clusters actively functioning. The clusters" contribution to output will increase once the clusters are initiated. This will be illustrated in section 6.5. The following section proceeds to describe the SAM multiplier analysis. Multiplier analysis gives some indication of the contributions of each sector to various indicators such as production, value added, capital and labour in relation to the structure of the economy. In addition, multiplier analysis shows the possible resultant effects of an exogenous shock on the functional (factoral) and institutional distributions of income as well as on the structure of output.

Table 6.1: SAM table for the North West Province (2006) highlighting the industrial clusters and other important related sectors (ZAR millions)

	AGRI	BASICMET	BUILD	BUS	CHEM	CSPS	DAIRY	ELEMACH	ELE	FURN	GRAIN ETC	INSU	MACH & EQUIP	MAN TRANS	NMET	OFMET	OFOOD	OMINE	REAL	RUBBER	STRUMET	TRAD	TRANS	Other intermediate demand	Total intermediate demand	Exports (Rest of RSA)	Exports (RoW)	Change in inventory	Other final demand	Total output
AGRI	0	4	0	0	62.5	44.2	745.4	0	0	0	2,026.50	0	0	5.4	0	0	91.7	6.9	0	0	0	0	0.4	1,695.80	*4,682.90*	3,346.20	1,122.00	-216.1	1,973.60	*10,908.70*
BASICMET	13	1,031.80	226.3	0	76.9	48.2	0.3	622.3	0	44.2	0.2	0.3	1,013.80	243.1	42.4	270	0.1	91.3	15.5	43.5	115.2	18.6	17.8	1,074.20	*5,009.00*	0	362.1	347.4	289.6	*6,008.00*
BUILD	67.8	0	2,171.40	2	0	103.2	0	0	198.6	0	0	16.1	0	0	0	0	0	270.1	1,803.20	0	0	293.2	138.2	1,442.70	*6,506.30*	489	0	6,366.00	180.3	*13,541.60*
BUS	7.4	94.7	145.1	101.1	150.7	1,250.50	85.9	220.4	9.7	18.9	77.3	494.6	22.6	5.4	175.9	18.6	1.4	0	1,441.50	95	12.2	1,771.50	473.2	710.5	*7,384.30*	1,317.10	122.3	-1,120.80	183.8	*7,886.70*
CHEM	1,024.60	250.9	543.2	22.3	1,148.00	282.3	32.9	254.1	40.1	139.2	18.5	64.9	84.2	50.3	188.1	84.2	9	223.4	401	448.1	10	701.8	2,007.40	776.7	*8,805.40*	70.6	63.8	-711.2	2,107.90	*10,336.50*
CSPS	99.7	0	0	18.5	183.4	0	156.9	127.9	1.4	35.4	52.3	35	0	0	202.4	22.3	0.7	1,088.10	958.9	92.5	6.4	159.3	295.9	8,980.70	*12,517.80*	4,001.60	1,453.90	-1,083.40	5,552.10	*22,441.90*
DAIRY	462	0	0	10.4	57.3	127.2	395	0	5.2	0	110.9	0.1	0	0	1.7	0	54.2	0	24.9	0	0	54.3	16.9	308.4	*1,628.70*	0	0	-64.3	614.4	*2,178.80*
ELEMACH	1.8	0	466.7	0.3	1.6	16.8	0.2	286.7	0.1	1.3	0.1	1.5	303.1	36.2	0.7	10.5	0	294.1	131.1	0.2	1.1	20.7	76.3	1,786.50	*3,437.30*	11.3	467.7	-41.7	1,472.30	*5,346.90*
ELE	47.5	276.5	14.3	0.7	42.1	109.8	11.2	17.1	68	8.8	22.5	20.5	5.4	2.1	28.5	4.5	0.2	447.1	178.9	38.5	12.2	104.6	110	1,884.50	*3,455.50*	533.3	0	-329.8	808.4	*4,467.50*
FURN	0	0	24.8	15.3	3	189.2	0.2	0	0.3	96.2	0.1	53.5	0	0	0	0	0	0	173.7	0	0	139.1	34.1	41.5	*771*	62.4	18.3	574.1	24.5	*1,450.40*
GRAIN ETC	868.5	0	0	2	10.8	24	7.4	0	1.3	0	20.9	0	0	0	0.3	0	10.2	0.6	4.7	0	0	10.2	3.2	174.8	*1,139.00*	303.6	1,661.70	-382.6	1,474.00	*4,195.70*
INSU	62.4	25.1	110.6	9.7	12	35.6	7.9	28.9	23.1	3.2	13.6	133.8	55.9	8.7	18	6.8	2.8	0	1,615.00	7.8	3.9	197.8	37.1	85.1	*2,504.80*	3,223.40	259.5	115.9	4,734.70	*10,838.30*
MACH & EQUIP	331.4	36.1	86.5	1	115.4	86.3	11.2	20.6	44.1	6.8	6.3	1	580.1	5.6	81.9	45.7	3.1	0	31	26.4	5.6	77.8	13.2	184.7	*1,801.90*	517.9	901.1	7,678.30	26.6	*10,925.90*
MAN TRANS	361.9	25.1	0	3.9	8.3	1,003.10	0	0	0.4	0	0	19.3	7.8	679.3	0	0.6	0	323.8	18.3	0	0	116.6	421.9	1,830.30	*4,820.60*	681.9	157.2	2,812.20	4,726.30	*13,198.10*
NMET	12.9	5.6	1,367.80	0.2	30.6	53.3	3.7	40.6	25	15	2.1	0.7	9.9	10.6	372.3	4.9	1	0	384	0.7	32.1	26.4	60.3	149.4	*2,609.10*	611.8	710.4	400.9	185.5	*4,517.70*
OFMET	10.1	109.4	0	1	46.5	86.4	7.2	42.5	13.2	10.3	4.1	2.5	341.7	21.5	16.2	16.7	2	168.4	103.5	19.7	3	15.5	29	1,910.10	*2,980.50*	12	86.5	-324.7	215.8	*2,970.10*
OFOOD	227.8	0	0	2.1	11.7	26	40.4	0	4.3	0	22.7	0	0	0	0.3	0	11.1	0	5.1	0	0	11.1	3.5	185.1	*551.4*	130.2	182.5	-926.7	564.2	*501.7*
OMINE	27.2	1,121.10	164.1	0	155.8	23.7	4.6	9.2	246.9	0.4	3.5	0	10.4	32.3	340.8	4.9	0.5	392.2	0	11.4	18.2	0	14.2	195.2	*2,776.80*	506.8	3,988.30	18,792.20	0.4	*26,064.30*
REAL	134.8	113.9	14.6	88.6	38.4	0	12.2	55	75.7	7.5	16.8	1,301.80	26.2	7.3	28.8	4.2	0.7	6.6	1,749.60	18.1	10.7	2,109.30	1,638.40	154.1	*7,613.50*	2,389.80	93.5	-999.4	12,137.90	*21,235.30*
RUBBER	79.1	0	0	0.8	2.6	553.4	0.1	3.1	10.3	3.7	0	7	0	0	0.2	1.2	0	164	1.5	19.4	0.8	57	204.3	541.3	*1,649.70*	42.2	136.6	-13.1	294.3	*2,109.70*
STRUMET	1.4	0	493	0	0	4	0	23.4	0.9	0	0	0	11	0.8	0	0	0	0	58.2	0	31.5	9.2	0.9	16.7	*650.9*	14.4	53.7	178.9	8.3	*906.2*
TRAD	47.9	10.1	1,042.40	44.8	10.2	291.1	9.6	17	4	1.2	12.1	38.8	3.1	0.6	10.4	2.7	0.1	49.7	392.6	4.2	0.6	957.9	381	969.2	*4,301.50*	2,025.00	5,516.10	-2,219.90	1,769.10	*11,391.80*
TRANS	791.4	253.5	0	59.8	185.5	134.9	5.4	47	20.2	4.9	6.1	76.7	7.4	1.5	264.7	2.4	0.1	2,660.40	55.8	16.2	4.3	1,192.20	129.3	1,030.90	*6,950.50*	5,100.20	3,085.80	746	2,298.90	*18,181.40*
Other intermediate demand	633	34.1	348.6	169.4	171.6	1,762.40	94.6	139.2	122.3	335.6	116.1	355.6	17.2	33.9	98.8	14.5	51.9	197.3	1,689.60	101.3	8.5	2,486.10	818.3	8,426.20	*18,226.10*	6,661.60	52,505.30	-1,199.70	15,278.30	*91,471.60*
Total intermediate demand	*5,313.70*	*3,391.90*	*7,219.50*	*553.7*	*2,525.00*	*6,255.90*	*1,632.40*	*1,955.10*	*915.3*	*732.6*	*2,532.70*	*2,623.80*	*2,499.70*	*1,144.50*	*1,872.50*	*514.7*	*240.8*	*6,384.00*	*11,237.50*	*943.1*	*276.2*	*10,530.20*	*6,924.90*	*34,554.80*	*112,774.60*	*32,052.30*	*72,948.20*	*28,378.60*	*56,921.30*	*303,075.00*
Wages	881.9	356.4	1,178.00	1,230.80	401.1	5,295.10	107.5	250.2	313.3	143.7	188.7	2,153.90	294.6	99.4	639.3	121.1	50.5	2,600.80	1,743.70	135.4	60.2	5,332.10	1,801.80	10,020.70	*35,400.20*	30,462.20	301.5	0	3,560.50	*69,724.40*
Other value added	2,089.90	425.3	873.3	2,384.90	478.7	5,306.10	128.3	298.6	554.8	171.5	225.2	4,173.50	351.6	118.6	762.9	144.5	60.2	4,662.00	3,378.60	161.5	71.8	5,823.20	3,049.10	17,230.40	*52,924.50*	11,657.70	2,329.50	0	12,712.70	*79,624.40*
Imports (Rest of RSA)	1,428.50	287.4	2,951.00	3,068.50	3,330.30	2,885.90	113.5	1,255.20	2,469.50	309.2	923.1	721.1	2,588.60	4,620.60	559.2	1,187.90	1.5	2,791.50	2,045.20	197	122	5,053.10	2,788.30	14,554.40	*56,252.60*	-29,830.20	0	0	165.6	*26,588.10*
Imports (RoW)	529.6	1,003.00	25.5	258.8	2,676.50	293.9	46.7	872	54.4	9.8	189.4	398.1	4,561.40	6,769.20	244.6	794.6	115.4	8,767.80	45.7	388.4	303.4	25	3,796.80	9,529.50	*41,699.30*	0	28,925.30	-904.9	29.8	*69,749.60*
Other intermediate inputs	665.2	544	1,294.30	390	925.1	2,405.10	150.2	715.8	160.2	83.6	136.6	767.8	630	445.8	439.3	207.3	33.3	858.3	2,784.60	284.3	72.6	-15,371.70	-179.5	5,581.70	*4,023.70*	0	0	0	3,872.40	*7,896.10*
Total inputs	*10,908.70*	*6,008.00*	*13,541.60*	*7,886.70*	*10,336.50*	*22,441.90*	*2,178.80*	*5,346.90*	*4,467.50*	*1,450.40*	*4,195.70*	*10,838.30*	*10,925.90*	*13,198.10*	*4,517.70*	*2,970.10*	*501.7*	*26,064.30*	*21,235.30*	*2,109.70*	*906.2*	*11,391.80*	*18,181.40*	91,471.60	303,075.00	44,342.00	104,504.50	27,473.80	77,262.30	556,657.60
Values R million.																													556,657.60	

Notes: See Appendix E for descriptions of the abbreviations

Source: Conningarth Economists, 2009

6.3 SAM multipliers

SAM multiplier analysis can be traced back to the 1970s with studies such as Pyatt and Thorbecke (1976), Pyatt and Round (1979), Hayden and Round (1982), and Defourny and Thorbecke (1984). These studies mainly focused on analysing the effects of government policy to reduce poverty and inequality by observing household and income multipliers. A SAM shows the circular flow of income in an economy in a square matrix format (see section 5.2; Ciaschini & Socci, 2007). The underlying structure of a SAM includes structural and/or behavioural specifications for the various groups of transactions (Round, 2003). In particular, the SAM specifies the structural changes of relative prices (see section 3.4.12). SAM multipliers also determine and illustrate the total income effects on different household groups that arise from an exogenous shock (policy-determined or external). This implies that the analysis gives some indication of the possible resultant effects of an exogenous shock on the functional (factoral) and institutional distributions of income as well as on the structure of output. SAM multipliers account not only for the direct and indirect effects, but also for the induced effects on factor and household incomes and activity outputs due to the (Keynesian) income-expenditure multipliers (Robinson, 1989; Adelman & Robinson, 1989).

6.3.1 Traditional or simple multiplier analysis

Traditional multiplier analysis or "first cut ex-ante analysis" in a SAM captures the generation of income by activities by producing commodities. It maps the income payments to the different factors of production, the distribution of factor and non-factor income payments to households and the subsequent spending of income by households on commodities (Round, 2003; Breisinger, Thomas & Thurlow, 2010). These patterns of payments are manifested in the structural features and interdependencies of the SAM. The patterns of payments are modelled analogously to the input structure of the activities in a SAM model based only on inter-industry transactions for that particular economy (Round, 2003). Traditional multiplier analysis gives some indication of the contributions of each sector to various indicators such as production, value added, capital and labour in relation to the structure of the economy. Traditional SAM multipliers measure the effects of production linkages only.

6.3.2 Application of the technique of SAM multiplier analysis

The matrix of column coefficients given by **A**, from a SAM, is the basis for most economic analysis and modelling (see Equation 1). The **A** matrix is the intermediate-input coefficients or the technical coefficients (computed from the "use" matrix) or the Leontief input-output coefficients (Breisinger *et al.,* 2010*)*. The technical coefficients show the total amount of product *i* (domestically produced and imported) used as input in the production of one monetary unit of industry *j*"s output (Sargento, 2009). The coefficients for primary factors are „value added" coefficients and give the distribution of factor income. Column coefficients for the commodity accounts represent domestic purchases and import shares, while those for the various final demanders provide expenditure shares (Robinson *et al*., 2000; see section 5.2). The Leontief multiplier matrix in the SAM and its elements usually show the direct and indirect requirements of an industry output per unit of final demand for products (Leontief, 1965; Ciaschini *et al.,* 2007).

According to Defourny and Thorbeck (1984), the first step in transforming a SAM into a multiplier model is to partition accounts into endogenous and exogenous accounts (see Table 5.1). As mentioned in section 5.2 Transactions in the government accounts, capital accounts and the rest of the world accounts are typically distinguished as exogenous accounts (see Table 5.1). These accounts are determined outside the economic system or constitute to economic policy instruments (Defourny *et al.*, 1984; Round, 2003). The rest of the accounts, i.e. production (activities and commodities) and private institutions (households and enterprises) are classified as endogenous accounts (see Table 5.1 and section 5.2). Multipliers are derived by computing the column shares (column coefficients in the SAM) to represent the structure of the economy and the shares of each sector.

SAM multiplier analysis determines the equilibrium total outputs and incomes y consistent with any set of injections x. The endogenous row accounts can then be written as a series of linear identities and the system can be solved to give:

$$\begin{aligned} y &= Ay + x \\ &= 1 - A^{-1} x \\ &= M_{Ax} \end{aligned} \qquad (6.1)$$

Where M_A is the SAM multiplier matrix. More precisely, it is a matrix of „accounting" multipliers. If A represents the pattern of outlays (i.e. expenditure and distribution coefficients) and is assumed to be fixed, then M_A is fixed. Equation (6.1) determines the equilibrium total outputs and incomes y consistent with any set of injections x. The output multiplier measures the sum of direct and indirect input requirements needed to satisfy a unit final demand for goods produced by industry *i*. When a shock is applied to the SAM, such as changes to export demand, government spending, or investment demand, the exogenous accounts will be affected by the initial shock. A shock results in the leakages from the endogenous to the exogenous accounts in order to balance the exogenous accounts as a group. These are the only changes that occur to the exogenous accounts.

6.3.3 Types of multipliers

Type I multipliers constitute direct and indirect output changes to the initial direct change in final demand (Learmonth *et al.,* 2003). Miller and Blair (1985) define Type II multipliers as the ratio of the direct, indirect and (income) induced changes associated with a direct change in a given sector. This means that Type II multipliers account for induced impacts based on the purchases made by employees in addition to the direct and indirect impacts (Bess & Ambargis, 2011). Lee (1986) stated that Type III multipliers involve the inclusion of another final demand component such as state and local government expenditure as an endogenous account. Type IV multipliers (income and employment multipliers) can be obtained by pre-multiplying the matrix of output multipliers by a row vector of wage to output ratios in the case of income, and employment to output ratio in case of employment (Ciaschini *et al.,* 2007; Polenske, & Jordan, 1988).

6.4 Graphical representation of multiplier analysis

The SAM provides a basis for measuring the strength of interaction among sectors (see section 3.4.1; Czamanski, 1974). This is achieved by analysing multipliers. Multipliers measure the forward and backward as well as the direct and the indirect linkages that exist between the cluster sectors themselves and between cluster and non-cluster sectors (Learmonth, Munrow & Swales, 2003; see section 6.5). Porter (2002) highlighted that downstream industries are drawn to the cluster location to enhance the transmission of information to suppliers about their needs. Following Learmonth *et al.* (2003), the linkages a cluster has with the rest of the economy are identified using an accounting procedure that quantifies the intermediate purchases made by that sector (both direct and indirect). This proposed method has been discussed in detail by Learmonth *et al.* (2003) and can be illustrated using an example. The production of the agriculture cluster sector output (commodities) as an example requires intermediate production inputs. The intermediate inputs, in turn, require intermediate inputs *ad infinitum*, thereby generating a multiplier process.

Type I multipliers will be calculated in each case to capture the downstream effects. Type I multipliers incorporate the indirect impacts associated with intermediate purchases (Ciaschini *et al.,* 2007; see sections 6.4.3 and 6.5). In order to capture the upstream effects, Type II multipliers are calculated. In addition to capturing the indirect impacts associated with intermediate purchases, Type II multipliers also include induced consumption effects on gross output, employment, wage income or value added (Ciaschini *et al.,* 2007; see section 6.3.4).

This section graphically presents the summary multiplier values for the ten identified potential clusters for the NWP. Data from the NWP SAM, in particular the intermediate demand, is used. The full direct and indirect linkages associated with the production of any of the cluster sectors and their associated sectors‟ outputs are calculated from information embedded in the SAM table (Miller & Blair, 1985). The main advantage of presenting the linkages between the cluster sectors and the non-clusters sectors in this way is that no information is lost. The graphical presentation presented in this section depicts all the linkages a particular cluster has with the rest of the NWP economy.

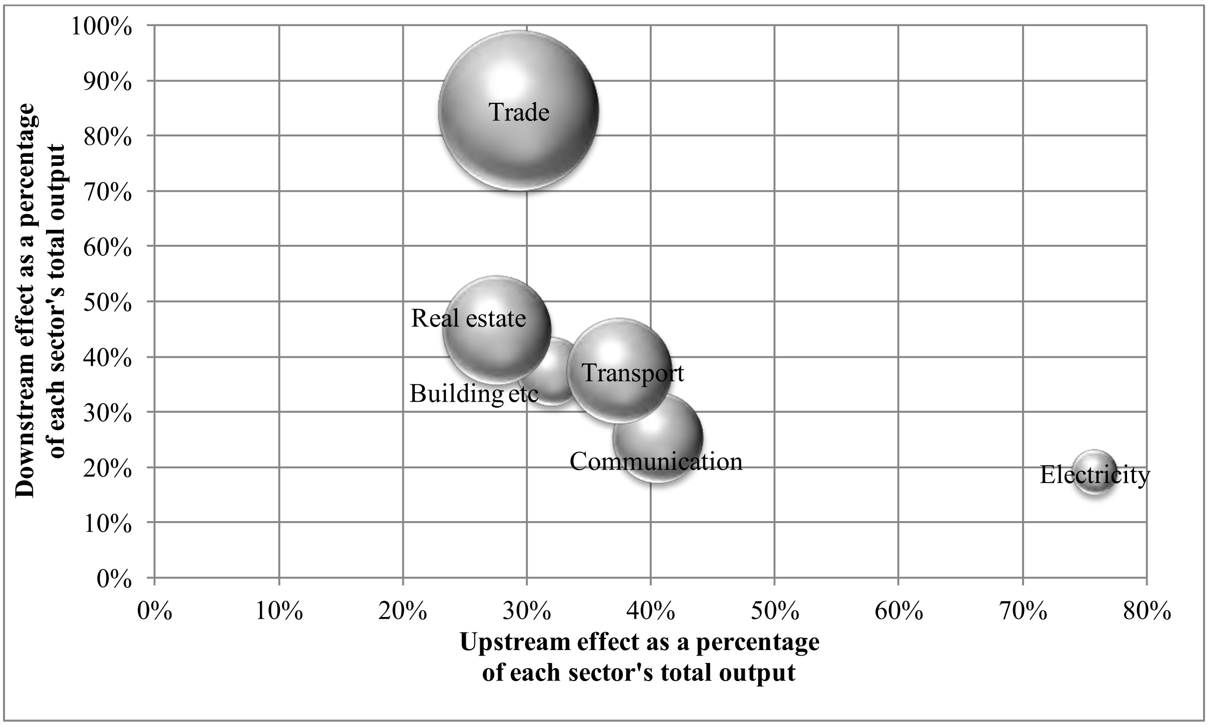
In the figures in this section, three variables for each of the sectors in each cluster are presented, namely the upstream effects, the downstream effects and scale. The sum of the upstream linkages of a particular cluster sector represents its utilisation of the value added of all other sectors‟ outputs as intermediate inputs. Additionally, in monetary terms, this represents "the proportionate reduction in costs in an individual cluster sector caused by the lowering of intermediate input prices if the value added of all cluster sectors could be produced at zero cost" (Learmonth *et al.*, 2003: 579). A high upstream effect score means that the sector utilises a large amount of intermediate inputs from other sectors in the NWP economy.

The downstream effects represent the proportion of a sector"s gross output that is utilised directly or indirectly as an intermediate input (final demand) by other sectors in the economy. In monetary terms, the downstream effect measures "the proportionate reduction in the output of a particular cluster caused as a result of reduced intermediate demand if the final demands for the output of all cluster sectors fell to zero" (Learmonth *et al.*, 2003: 579). A high downstream effects score means that a sector has high intermediate sales to other sectors. Downstream and upstream effects are measured on a scale of 0 and 100 percent, respectively. The upstream effects for individual sectors are shown on the x-axis, and the downstream effects on the y-axis. Scale is measured as the size of the sector"s value-added in the NWP SAM. The scale is shown by the size of the bubble (area of the bubble) in the figures. There is no direct association between the scale and the upstream and downstream effects, respectively. Sectors towards the top right corner of the diagram are ones that have the highest relative backward and forward linkages. A strong cluster may be represented by an image with many sectors in the top right corner of the bubble chart, indicating an integrated set of sectors that are reliant on each other"s value added and final demands.

6.4.1 Communication cluster

In the communication cluster (see Figure 6.1), the electricity sector has high upstream linkages, although the sector is relatively small (i.e. the relative size of the bubble). The trade sector is the largest sector in the cluster and has high downstream linkages. The real estate and building and other construction sectors also have high downstream effects, though much lower than the trade sector. Similarly, the communication and transport sectors have high upstream effects relative to the electricity sector. The linkages between the other sectors are relatively weak. Figure 6.1 illustrates that most sectors are located in the bottom left section of the charts, indicating that the cluster has relatively low upstream and downstream linkages.

Figure 6.1: Upstream and downstream linkage effects of the NWP communication cluster and related sectors

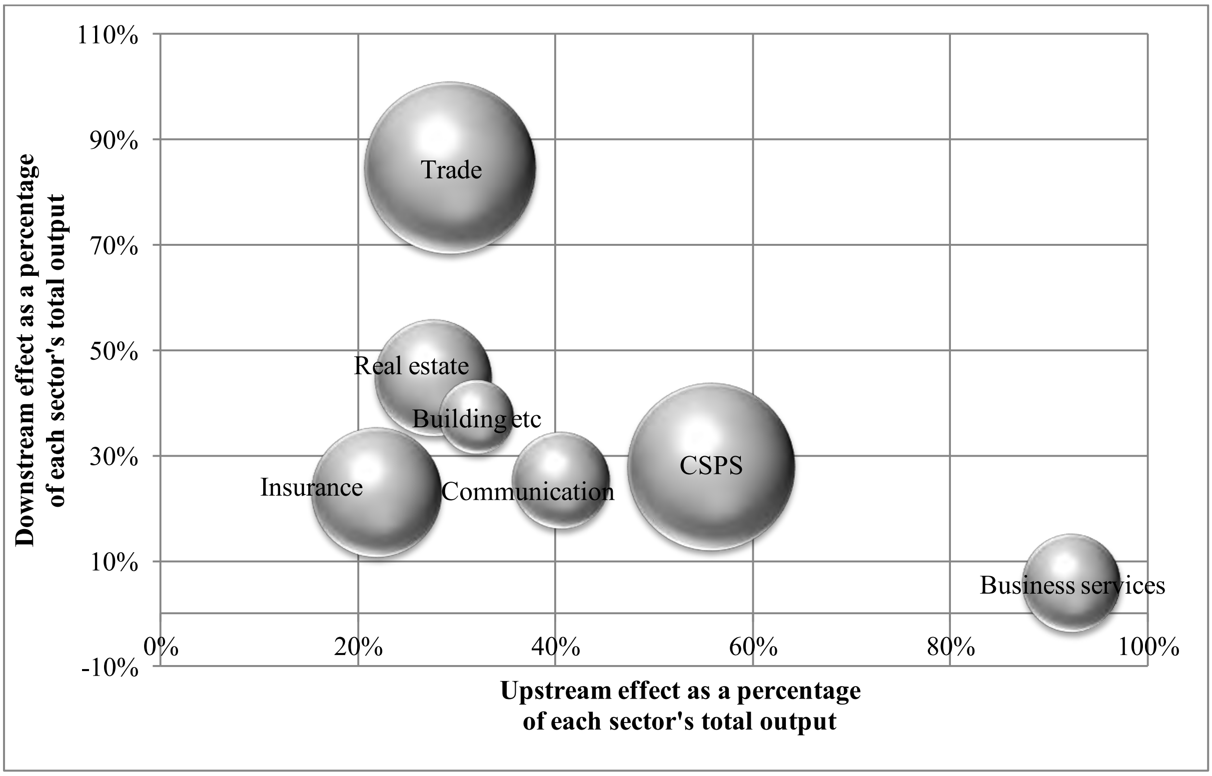


Source: Compiled by author from Conningarth Economists SAM, 2009

6.4.2 Real estate

Figure 6.2 shows the upstream and downstream linkage effects of the NWP real estate cluster and related sectors. The business services sector and the community, social and personal services sector have the highest upstream effects, respectively. The community, social and personal services and the trade sectors are the largest sectors in terms of value added in this cluster (see Table 6.1). Additionally, the trade sector has high downstream effects. Similar to the communication cluster, the real estate cluster is not highly integrated and the sectors in this cluster are not reliant on each other‟s value added and final demands. This is shown by the low levels of upstream and downstream effects of the sectors in this cluster (most sectors are located in the lower left corner of Figure 6.2).

Figure 6.2: Upstream and downstream linkage effects of the NWP real estate cluster and related sectors

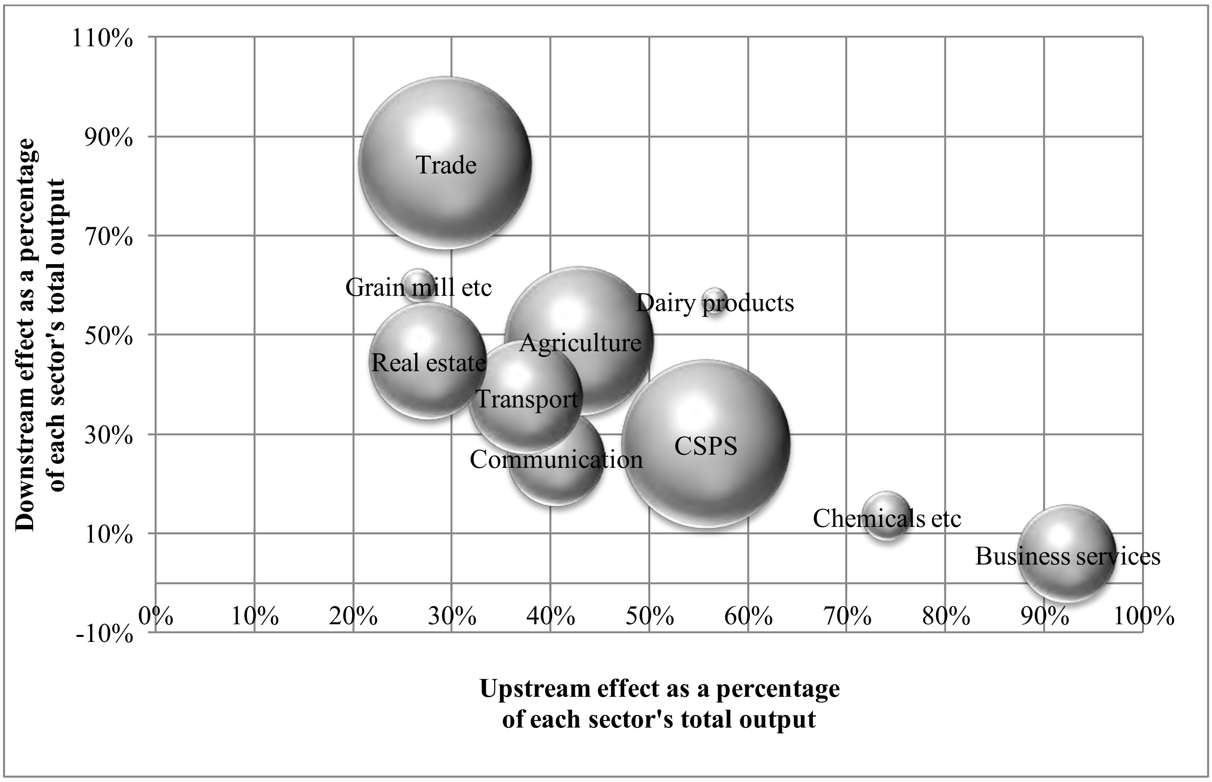


Source: Compiled by author from Conningarth Economists SAM, 2009

6.4.3 Grain mill, bakery and animal feed products

The grain mill, bakery and animal feed products (grain etc.) cluster comprises several sectors with high upstream and downstream effects. Trade, community, social and personal services and agriculture respectively are the three largest sectors in the grain etc. cluster (see Figure 6.3). The business services sector, chemicals and chemical products sector (chemicals etc.) have the highest upstream effects in this cluster. The trade and grain mill etc. sectors have the highest downstream effects. This cluster includes the dairy products sector. Although this sector is small, it has high upstream and downstream effects (above 50%; see Figure 6.3). Similarly, the community, social and personal services and agriculture sectors have relatively high upstream and downstream effects (close to 50%). This shows that this cluster is more integrated and has potential to integrate more with cluster formation.

Figure 6.3: Upstream and downstream linkage effects of the NWP grain mill, bakery and animal feed products cluster and related sectors

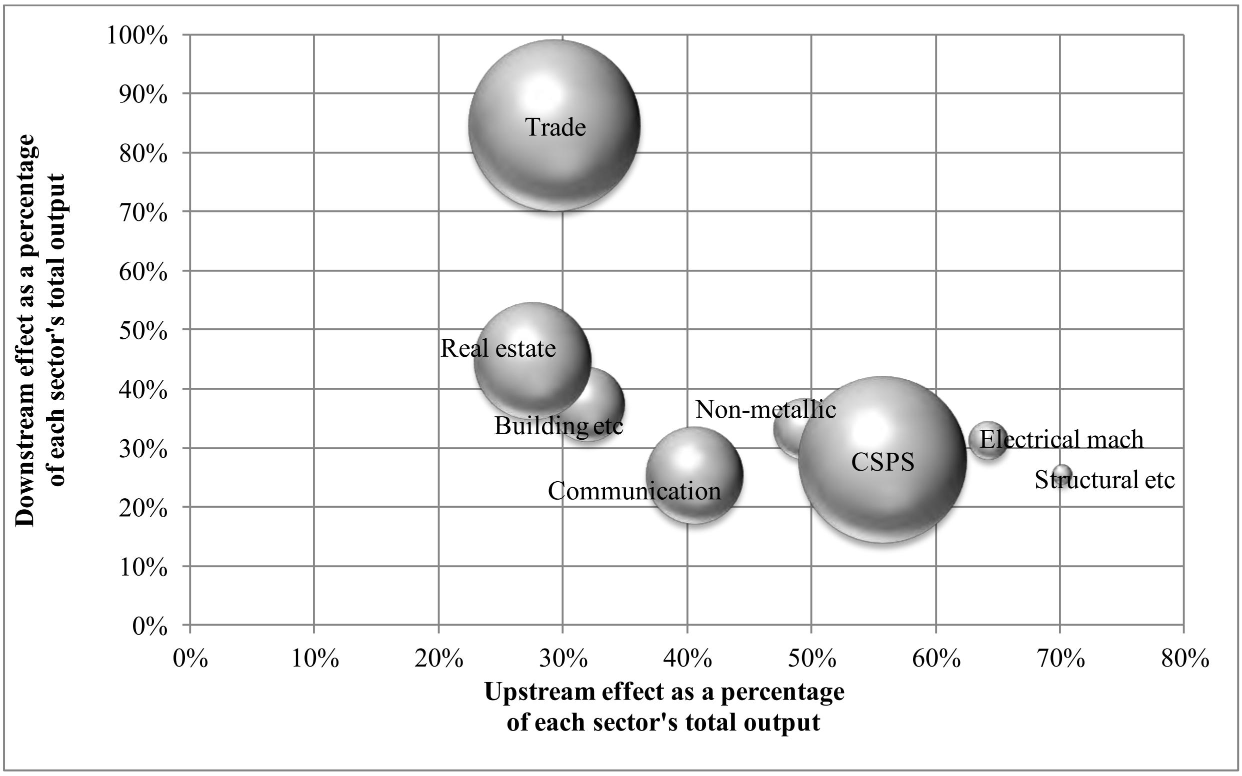


Source: Compiled by author from Conningarth Economists SAM, 2009

6.4.4 Building and other construction

As shown in Figure 6.4, the following sectors have high upstream effects in the building and other construction (building etc.) cluster; non-metallic mineral products (non-metallic etc.), community, social and personal services, electrical machinery (electrical mach) and structural metals products (structural etc.). Only the trade sector has high downstream effects. Efforts to promote industrial cluster formation can enhance the downstream effects in the non-metallic mineral products, community, social and personal services, and electrical machinery sectors as they already have high existing upstream effects. This would make the cluster more integrated and would enhance the effects (power-of-pull; see section 5.3.2) of the building and other construction cluster in the NWP economy.

Figure 6.4: Upstream and downstream linkage effects of the NWP building and other construction cluster and related sectors

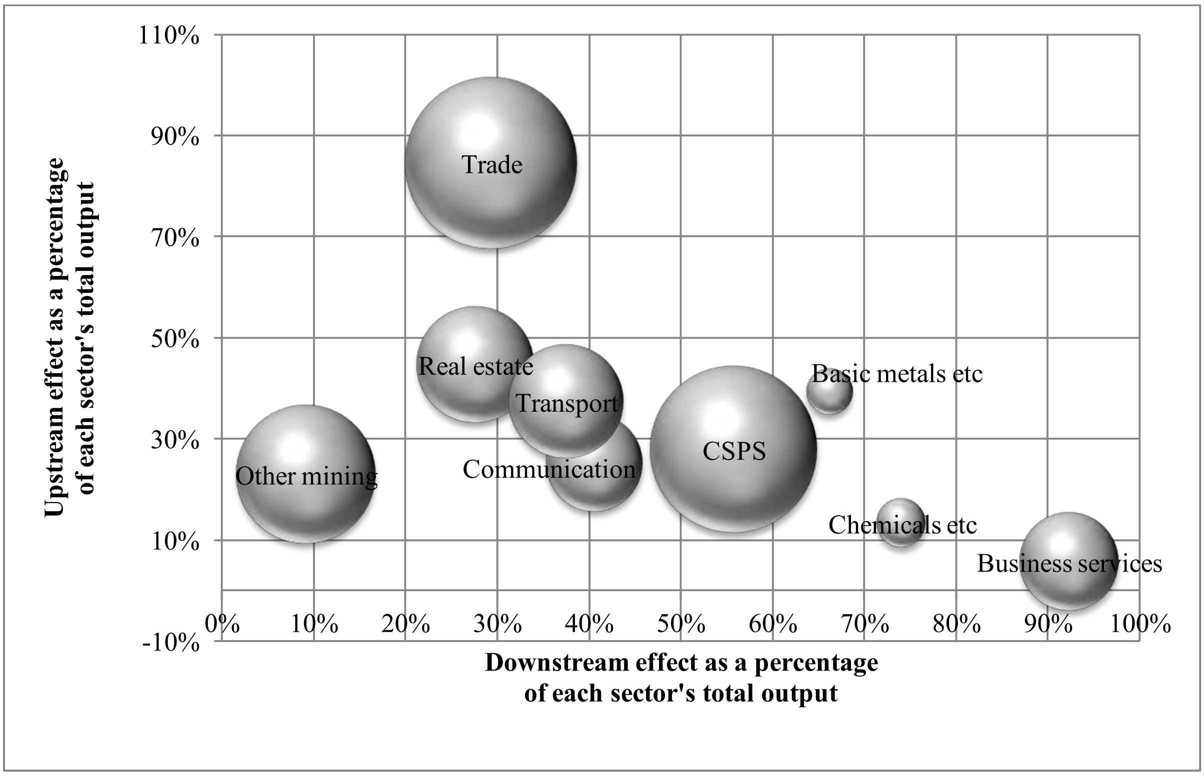


Source: Compiled by author from Conningarth Economists SAM, 2009

6.4.5 Basic metal products

Figure 6.5 illustrates the upstream and downstream linkage effects of the NWP basic metal products cluster and related sectors. The other mining sector has low downstream and upstream linkages relative to the other sectors in the cluster. The low downstream effects imply that this sector does not use up a lot of intermediate inputs from other sectors in its production (downstream linkages; 9%). Similarly, other mining output is not utilised by many sectors in the NWP as final demand (upstream linkages; 23%). The following sectors in the basic metal products cluster have high downstream linkages; business services, chemicals and chemical products, basic metals and community, social and personal services.

Figure 6.5: Upstream and downstream linkage effects of the NWP basic metal products cluster and related sectors

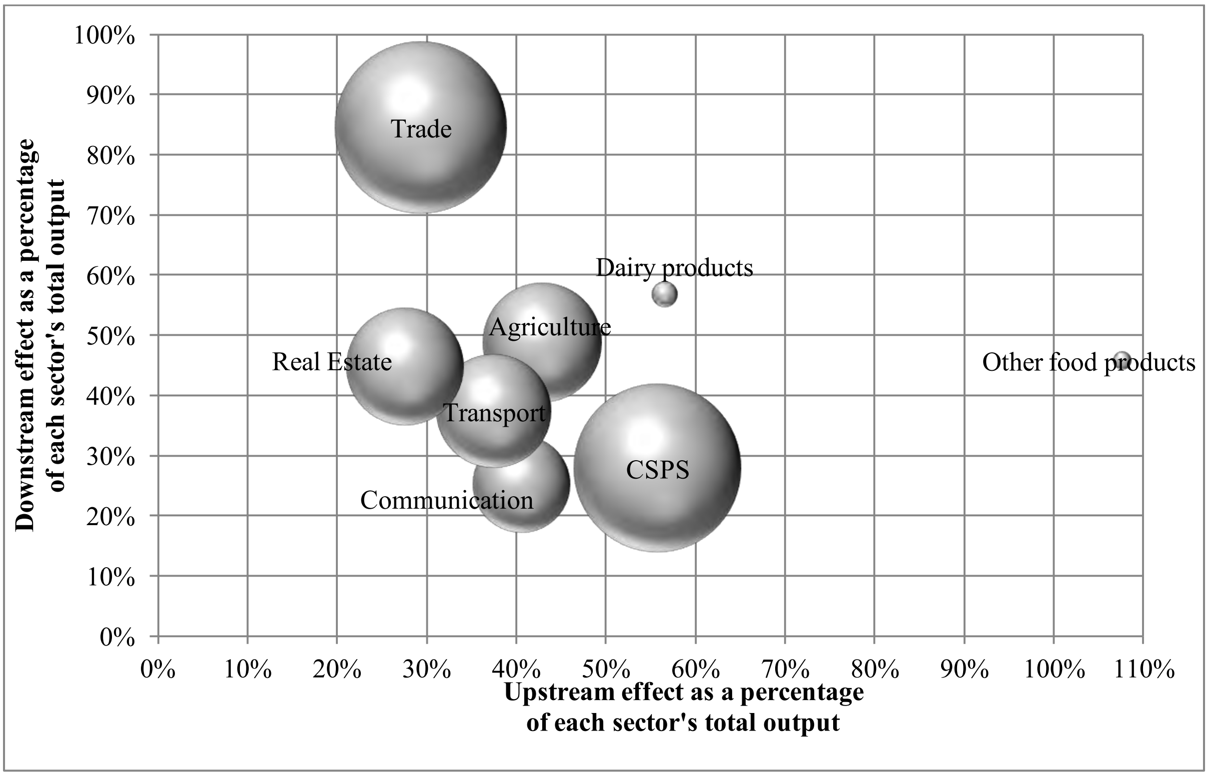


Source: Compiled by author from Conningarth Economists SAM, 2009

6.4.6 Other food products

The other food products and dairy products sectors are the smallest in this cluster (see Figure 6.6). However, these two sectors have the highest linkages (both upstream and downstream) with other sectors the NWP economy. Similar to the five clusters discussed thus far, the trade sector is large and had high downstream linkages. Figure 6.6, however, reveals that most sectors are located in the bottom left section of the charts and as such have relatively low upstream and downstream linkages.

Figure 6.6: Upstream and downstream linkage effects of the NWP other food products cluster and related sectors

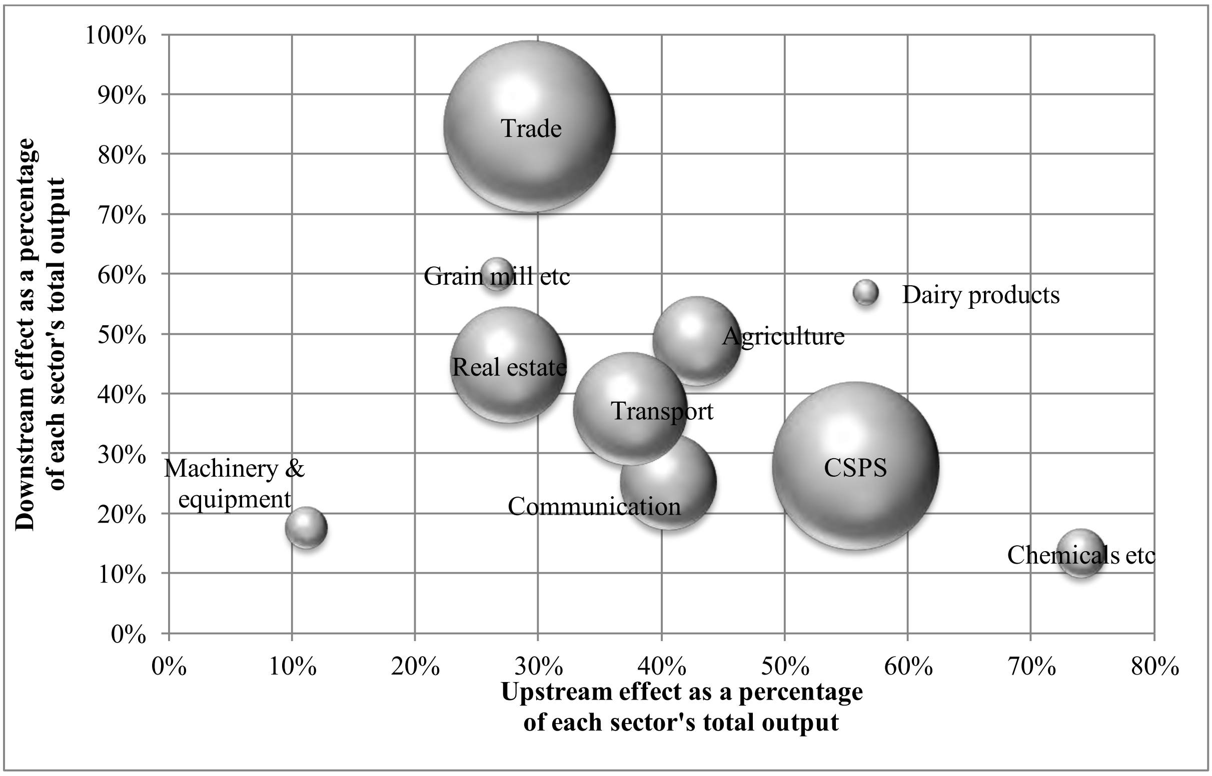


Source: Compiled by author from Conningarth Economists SAM, 2009

6.4.7 Agriculture

In the agriculture cluster, the chemical and chemical products sector has high downstream linkages although the sector is relatively small. The trade sector is the largest sector in the cluster (see Figure 6.6) and has high downstream linkages. The grain mill, bakery and animal feeds and real estate sectors also have high downstream effects although much lower than the trade sector. Similarly, the community, social and personal services and dairy products sectors have high upstream effects relative to the electricity sector. The dairy products sector has high upstream and downstream linkages. The machinery and equipment sector has low upstream and downstream linkages. The linkages between the other sectors are relatively weak as shown by the clustering of the sectors in the lower centre of Figure 6.7.

Figure 6.7: Upstream and downstream linkage effects of the NWP agriculture cluster and related sectors

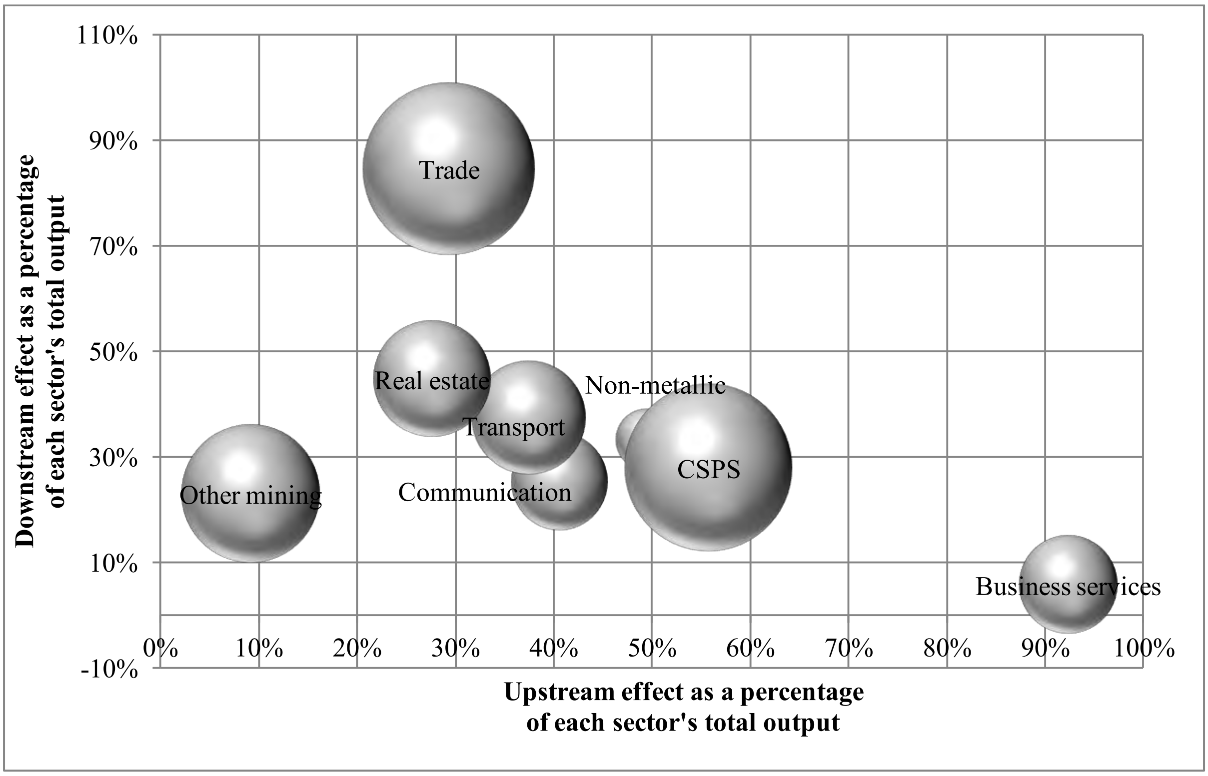


Source: Compiled by author from Conningarth Economists SAM, 2009

6.4.8 Non-metallic mineral products

Figure 6.8 illustrates that the non-metallic mineral products cluster in the NWP comprises several sectors that contribute a large portion to the province‟s value added (see Figure 6.8). This is shown by the diameter of the bubbles for the different sectors. In terms of upstream linkages, the business services; community, social and personal services and non-metallic mineral products sectors, respectively, have the highest upstream linkages (50% and above). The trade sector has the highest downstream effects in the cluster. However, most of the sectors in the clusters are located in the lower left hand corner of Figure 6.8. This indicates that the cluster is not highly integrated and that the upstream and downstream linkages between the sectors in the cluster are weak.

Figure 6.8: Upstream and downstream linkage effects of the NWP non-metallic mineral products cluster and related sectors

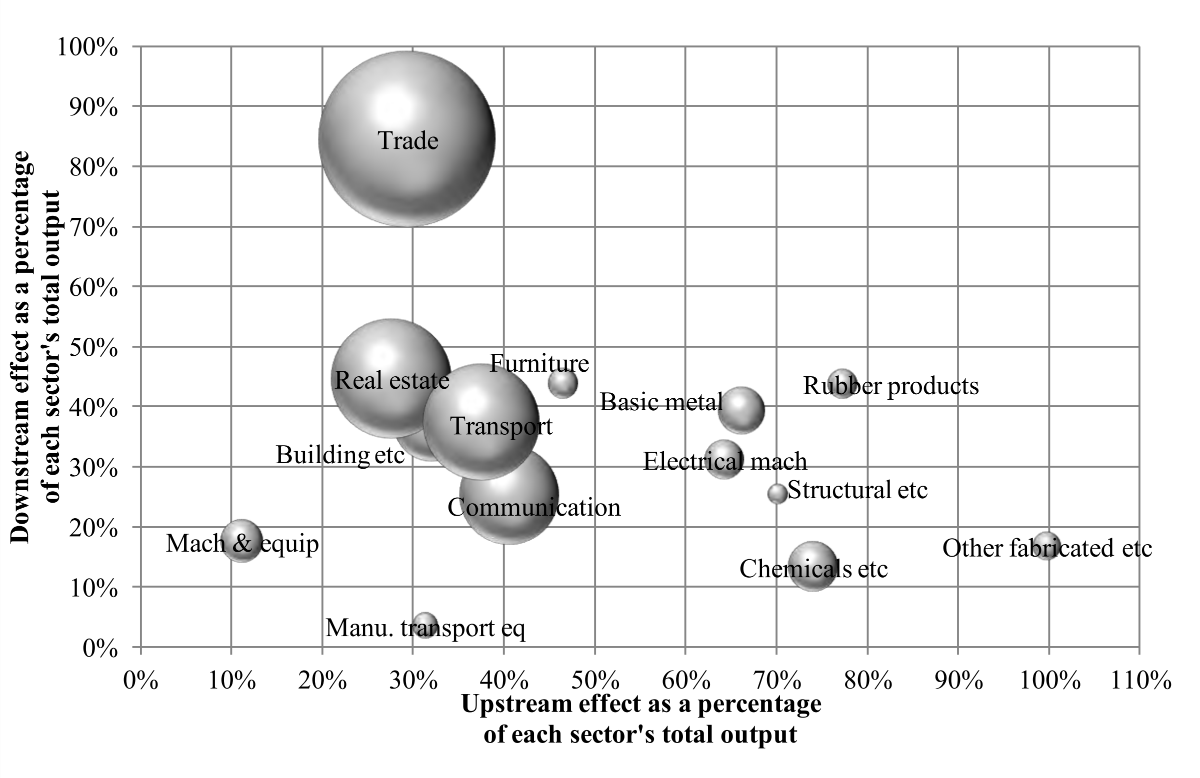


Source: Compiled by author from Conningarth Economists SAM, 2009

6.4.9 Trade

The trade cluster comprises the most number of sectors relative to the nine other clusters identified for the NWP. It comprises mostly small sectors. The trade sector itself is the largest in the cluster, while the real estate; transport and communication sectors are relatively large (see Figure 6.9 and Table 6.1). Six sectors in the trade cluster have high upstream effects (above 50%). These are other fabricated metals; rubber products; chemicals and chemical products (including plastics); structural metal products electrical machinery and basic metal products, respectively. Only the trade sector has high downstream effects. Efforts to enhance the effectiveness and competitiveness of the trade cluster should be directed towards enhancing the downstream effects.

Figure 6.9: Upstream and downstream linkage effects of the NWP trade cluster and related sectors

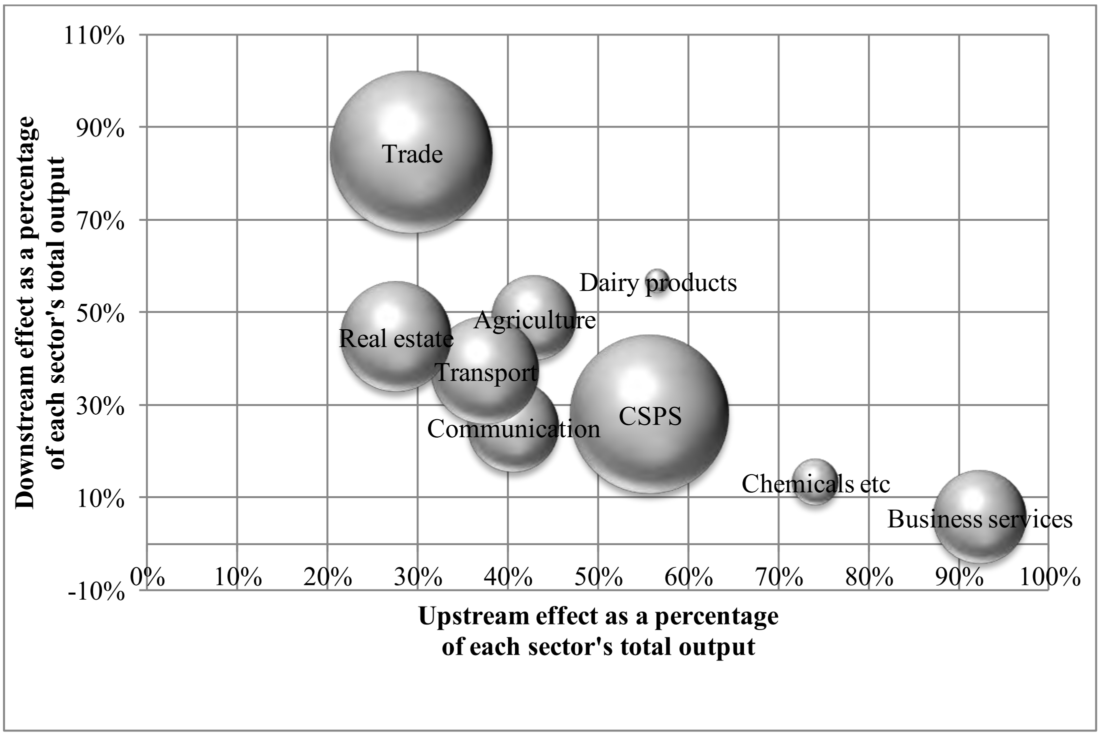


Source: Compiled by author from Conningarth Economists SAM, 2009

6.4.10 Dairy products

Figure 6.10 shows that although the dairy products cluster is small, it has high upstream (57%) and downstream (54%) linkages in the NWP economy. The business services, chemicals and chemical products (including plastics) and community, social and personal services sectors, respectively, have high upstream and low downstream effects. The trade sector has high downstream effects and moderate upstream effects. Most of the sectors in the dairy products cluster are located in the central lower part of Figure 6.10. This shows that the upstream effects of this cluster are relatively high. This also indicates that the downstream effects of this cluster are low and efforts should be directed towards enhancing these downstream effects in order to improve the cluster‟s effectiveness.

Figure 6.10: Upstream and downstream linkage effects of the NWP dairy products cluster and related sectors



Source: Compiled by author from Conningarth Economists SAM, 2009

6.5 Output, employment, employment income, GDP and exports supported by cluster formation for the NWP

In Learmonth *et al.* (2003), multiplier analysis was used together with I-O data to determine each cluster‟s supported output and to show the impact of each cluster on the economy. Supported output is the direct final demand for cluster output. This includes indirect expenditure on intermediate goods directly or indirectly needed to meet final demands. Additionally, supported output includes exports, sales to the government and investment. Type I and Type II multiplier analysis was conducted (see section 6.3.4). This means that under Type I analysis, consumption demand is treated as a final demand in its own right. Contrary to this, in Type II analysis, consumption demand is treated as induced expenditure on consumer goods and services purchased from the wages generated ultimately by the sales to other final demand (see section 6.3.4). Resultantly, the sum of supported activity for all sectors in the economy gives sum to the total activity in the economy as a whole. The level of activity directly associated with a sector differs from the level of activity it supports. According to Learmonth *et al.* (2003), the supported activity of clusters is expected to be higher than the direct activity owing to the enhanced competitiveness of clusters (see sections

2.5.10 to 2.5.14). Porter"s view on the genesis and evolution of industrial clusters supports this notion (see section 2.3.1). According to Porter (2002), the establishment of firms and subsequently clusters in response to the availability of factors of competitiveness in a region leads to the establishment of a competitive industry. The success of an industry makes it a sophisticated buyer of products and services (Porter, 2002; see section 2.3.1). Both domestic and foreign suppliers will be attracted to establish in close proximity to this competitive industry to provide goods and services thereby increasing the cluster"s supported output. This section demonstrates the effects of cluster formation on the NWP economy. In particular, the supported output, employment income, GDP and exports that can be generated by cluster formation in the NWP are reviewed.

The graphical presentation of the multiplier analysis presented in section 6.5 illustrated the strength of existing linkages in each of the ten clusters. This highlighted the level of integration (dependency of sectors) that exists between the sectors in each of the clusters. This section presents the results of applying multiplier analysis to the I-O data for the ten identified potential clusters for the NWP. The aim of this analysis is to show the impact of each cluster on the NWP economy, in particular on output, employment, employment income and GDP (see sections 2.5.6 and 2.5.10). The output, employment income and GDP data used are obtained from the 2006 NWP SAM (Conningarth Economists, 2009). The employment numbers used were obtained from the NWP SAM of Conningarth Economists (2009). Additionally, employment numbers are measured as full-time equivalents. The monetary values are measured in 2006 prices. The supported activity is derived using the relevant Type II SAM multipliers applied to the sector"s final demand.

This section also provides insight into the export potential of the clusters" products and services according to the DSM. The export opportunities identified for each cluster in Chapter 5 (see Tables 5.7 and 5.8) will be presented and discussed. This will be based on the classification of REOs according to the DSM for products and the DSM for services. The final categorisation of REOs in Filter 4 of the DSM for products is based on (i) the relative market share and (ii) the size and growth of imports of the different markets (Cuyvers *et al.,* 2012; see Table 5.6). The relative market share is South Africa"s current export performance in these markets compared to that of the top six competitors in each market. A potential export value is also assigned to each identified product-country combination to enable the prioritisation of the shortlisted export opportunities. Potential export values for each REO are calculated to provide a better indication of the size of the export opportunities relative to one another than merely looking at the number of opportunities (Cuyvers, Steenkamp & Viviers, 2012). In addition, South Africa‟s exports of each product are compared to the potential export values. The aim is to provide insights into the scale of the export potential in each market relative to South Africa‟s current exports. For each cluster, the top five potential export opportunities (product-country combination per cluster) according to the potential export value are provided. These product-market combinations were identified in section 5.5.3.1. The market access index, South Africa‟s actual exports of the REO‟s identified for the NWP and cell classification (see Table 5.6) are also provided. The market access index lies between 0 and 100. An index score closer to 100 indicates highly accessible markets, while an index score close to 0 indicates a highly inaccessible market. It includes the following criteria: international and domestic shipping time and cost, logistical efficiency, tariffs and non-tariff barriers (Steenkamp, 2011).

As mentioned in section 5.5.2, the results for the DSM for services differ from those of the DSM for products. The results for the DSM for services group service-country combinations into a cell structure that differentiates the opportunities according to the market size and characteristics in the import market, as well as market openness and accessibility (Grater, 2011; see section 5.5.2 and Table 5.7). The proceeding section presents service-country combinations as identified in section 5.5.3.2. Since there is no available data on the provincial services exports, current provincial exports per service were not included in the analysis. For each service-country combination, the total import value in 2007 is a proxy for the market size and is given by the total imports for that services sector in the market, which shows whether it is a large market (Grater *et al.,* 2012*)*. The size of the market helps in the decision-making process to determine whether it is worth seeking to penetrate such a market (Grater, 2011). The cell classifications provide a method by which the results of the DSM for services can be used in order to differentiate among the different export promotion strategies. Finally, the cell classification shows the overall classification for each opportunity by combining the Filter 2 and Filter 4 column classifications (see Table 5.8). The Filter 2 classification groups the service-country combinations according to market size or growth. Filter 4 column classification shows the levels of market openness to services (OSI) (according to filter 3.1) and market accessibility (MA) (according to filter 3.2; see section 5.5.2).

6.5.1 Communication cluster

Table 6.2 shows the NWP‟s output, employment, income and GDP supported by the communication services industry cluster. The supported activity by the communication cluster is much higher than the actual activity. The communication services cluster will stimulate additional output of 18% and increase employment by 44%. Employment income in the communication cluster will significantly increase by 172% as a result of cluster formation. GDP will increase by 26% from R3.4 billion to R 4.3 billion.

Table 6.2: NWP output, employment, income and GDP supported by the communication services industry cluster

	Output (R millions)	**Employment (Number)**	**Employment income (R millions)**	**GDP (R millions)**
Actual	8,455.70	13,161	1,304.78	3,409.59
Supported	9,953.53	23,455	3,549.47	4,295.14

Source: Conningarth Economists, 2009 and Quantec Easydata, 2013

Table 6.3: Communication services cluster top five export opportunities

Cluster	**Country**	**EBOPS code**	**Sub-sector**	**Cell classification**	**Total import value in 2007 (USD thousand)**
Communication	Canada	246	3.1 Communications services - postal and courier services	3	864.3
	Hong Kong	246	3.1 Communications services - postal and courier services	11	739
	Norway	246	3.1 Communications services - postal and courier services	12	927.2
	Latvia	246	3.1 Communications services - postal and courier services	17	384
	Estonia	246	3.1 Communications services - postal and courier services	17	0.960

Source: Grater, 2011

Table 6.3 presents the communication services cluster‟s top five REOSs i.e. the potential target markets for the identified realistic export opportunities according to the DSM for services. From Table 6.3, the top five opportunities for the communications services cluster ranked according to the total import value in 2007 are Canada, Hong Kong, Norway, Latvia and Estonia. Opportunities in the communication services cluster for South Africa in Canada are classified in cell 3, which is a large market with short-term growth, indicating low market openness and low market access (see Tables 6.3 and 5.6). Norway, Latvia and Estonia are large markets with long-term growth. Hong Kong is classified under cell 3, which is a large market with short-term growth, while Canada is a large market with both short-term and long-term growth.

The communication cluster‟s competitiveness can be enhanced through the adaptation and self-organisation of firms that foster research and development and innovation (Feldman *et al.*, 2005; see sections 2.3.2 and 2.5.3). Clusters are repositories of specialised and flexible labour markets, capital and research and development to firms (Doeringera & Terkla, 1995; Lee, 2006). The collaboration of firms in the five sectors that make up the communication cluster can provide access to the skills, knowledge and research and development findings of other firms in the cluster (see section 2.5.1). Firms in the communication cluster can adopt innovation from a lead foreign firm (see section 2.8.3). The lead foreign firm in the cluster first adopts the new technology and then local firms can imitate or reverse engineer the technology.

Furthermore, the communication cluster has the potential to develop and evolve into a Marshalian industrial district (see section 2.7.1). The main characteristic of this type of cluster is product specialisation at industry level. Although this type of cluster is usually made up of firms producing the same product to become a competitive force in that industry, the NWP‟s communication cluster can adapt the characteristics of this type of cluster. It is characterised by labour specialisation throughout the production chain in the cluster. Firms specialise in tasks in which they are competitive and efficient and leave tasks where they are less competitive and efficient to other firms in the cluster. As a result, the cluster has strong interdependence and cooperation. This can be the case for the communication cluster as it consists of related firms. The communication sector is a key sector for the transport, real estate and building and other construction sectors. The electricity sector‟s output is a major input for the communication sector. This type of cluster maintains competitive and cooperative relationships that drive firms to be efficient in order to survive (Markusen, 1996; see section 2.7.1).

6.5.2 Real estate cluster

The supported output, employment, income and GDP for the real estate cluster are shown in Table 6.4. The supported output and GDP for the real estate cluster are much lower than the actual figures. The number of people employed in the cluster will increase from 12 657 to 40 251. In addition, employment income is expected to more than treble (240%) with cluster formation.

Table 6.4: NWP output, employment, income and GDP supported by the real estate services industry cluster

	Output (R millions)	**Employment (Number)**	**Employment income (R millions)**	**GDP (R millions)**
Actual	16,359.74	12,657	1,673.33	10,021.77
Supported	12,315.04	40,251	5,735.48	5,523.81

Source: Conningarth Economists, 2009

The analysis to determine whether any of the real estate services have REOs according to the DSM for services revealed that none of the real estate services have REOs (see section 5.5.3.2). The real estate cluster can evolve to become a high technology cluster. This is because high technology clusters are highly innovative and span over several technologically unrelated industries (Enright, 2003; Amin, 1994; Madsen *et al.*, 2004), which is the case for the real estate cluster (see Figure 5.2). This empowers the cluster with innovative capabilities as the technologies of one industry can be adopted to develop new products and new processes (Madsen *et al.*, 2004; see section 2.5.2). This same principle is applicable to the communication cluster.

6.5.3 Grain mill, bakery and animal feed products

Industrial cluster formation in the grain mill, bakery and animal feed products sector will generate higher levels of economic activity in the NWP. As shown in Table 6.5, output, employment, employment income and GDP will all increase in response to cluster formation.

Table 6.5: NWP output, employment, income and GDP supported by the grain mill, bakery and animal feed products industry cluster

	Output (R millions)	**Employment (Number)**	**Employment income (R millions)**	**GDP (R millions)**
Actual	2,946.62	2,916	181.44	593.71
Supported	3,795.87	34,032	993.66	1,650.35

Source: Conningarth Economists, 2009 and Quantec Easydata, 2013

Table 6.6: Grain mill, bakery and animal feed products industry cluster top five export opportunities

Cluster	**Country**	**HS 6-digit product code and description**	**Filter 4 cell classification**	**Potential export value (US$ thousands)**	**South Africa's actual exports of the REO's identified for the NWP (US$ thousands)**	**Market accessibility (%)**
Grain mill, bakery and animal feed products	Israel	110313 - Maize (corn) grouts or meal	3	8,263	0	53.63
	Germany	110313 - Maize (corn) grouts or meal	3	2,927	0	54.95
	Malaysia	110313 - Maize (corn) grouts or meal	4	2,814	0	56.15
	France	110313 - Maize (corn) grouts or meal	2	1,295	0	63.07
	Jordan	110313 - Maize (corn) grouts or meal	2	989	0	58.40

Source: Steenkamp, 2011

The grain mill cluster was identified as having one REO; HS 110313 - Maize (corn) grouts or meal. Table 6.6 shows the top five opportunities for the grain milling cluster‟s REO. The top five potential markets in terms of potential export value are Israel, Germany, Malaysia, France and Jordan. Israel and Germany are classified under cell 3, which are large product markets with short-term growth. However, South Africa does not currently export to these markets. The market accessibility index cross all service – country combinations in the grain milling cluster are relatively high (greater than 50%) indicating that accessing these markets will be relatively easy.

Empirical evidence that the grain milling cluster can learn from includes the grain milling cluster in Burkina Faso. It is an informal enterprise cluster. Informal enterprise clusters are a self-employment survival strategy in metropolitan areas (McCormick, 1999; Dawson & Oyeyinka, 1993; van Dijk & Rabelloti, 1997). Although this empirical example is dated, the experience is still relevant. Informal enterprise clusters mainly consist of small and medium-sized enterprises. Alternatively, the grain milling cluster can evolve into a diversified cluster. A diversified cluster is characterised by individual firm vertical specialisation, vertical diversity, broad sectoral specialisation and efficiency gains from collaboration (see section 2.7.1). The grain mill cluster can easily evolve into a diversified cluster because it is relatively highly integrated and comprises several sectors with high upstream and downstream effects (see section 6.4.3).

6.5.4 Building and other construction

All the variables are expected to increase more than the actual values with cluster formation in the building and other construction cluster (see Table 6.7). This highlights that cluster formation will enhance the competitiveness of the building and other construction cluster resulting in supported activity being greater than the actual activity.

Table 6.7: NWP output, employment, income and GDP supported by the building and other construction industry cluster

	Output (R millions)	**Employment (Number)**	**Employment income (R millions)**	**GDP (R millions)**
Actual	9,270.78	35,333	1,132.81	2,206.40
Supported	14,259.51	56,577	4,248.22	5,495.09

Source: Conningarth Economists, 2009 and Quantec Easydata, 2013

Table 6.8 shows the top five export opportunities for the building and other construction services cluster. Germany had the highest total imports of construction services in 2007. However, although Germany is a large market for construction services, it has low market openness and market access. Similarly, Italy and the Netherlands are classified in cell 1. This implies that if the firms in the NWP communications cluster explore these markets then more strategic planning is required to succeed. Opportunities to Saudi Arabia are classified, however, in cell 8. This means that it is a large market with short-term growth, low market openness and high market access. Therefore, opportunities in Saudi Arabia in the building and other construction cluster would be easier to explore relative to the other top five opportunities.

Table 6.8: Building and other construction cluster top 5 opportunities

Cluster	Country	EBOPS code	Sub-sector	Cell classification	Total import value in 2007 (US$ thousands)
Building and other construction	Germany	250	4.1 Construction services - construction abroad	1	4, 123
	Saudi Arabia	251	4.2 Construction services - construction in the compiling economy	8	3, 715
	Saudi Arabia	250	4.1 Construction services - construction abroad	8	2, 607
	Italy	250	4.1 Construction services - construction abroad	1	1, 994
	Netherlands	250	4.1 Construction services - construction abroad	1	774

Source: Grater 2011

As mentioned in section 6.4.4, the building and other construction cluster is not highly integrated. The non-metallic mineral products, community, social and personal services, electrical machinery and structural metals products have high upstream effects. The trade sector has high downstream effects. Through government intervention, efforts to promote industrial cluster formation can enhance the downstream effects in the non-metallic mineral products, community, social and personal services, electrical machinery sectors as they already have high existing upstream effects. This would make the cluster more integrated and make the building and other construction cluster a policy-driven cluster (see section 2.7.2). Policy-driven clusters are characterised by government support, which can be in the form of industry restructuring or industry development (Chiesa & Chiaroni, 2006; see section 2.7.1). In policy driven clusters government support stimulates cluster formation where favourable conditions for spontaneous formation are lacking.

6.5.5 Basic metal products

Output, employment income and GDP in the cluster will increase to support enhanced demand generated by the cluster. The supported employment (number), employment income and GDP in the basic metals products cluster are greater than actual activity (more than 10% increases).

Table 6.9: NWP output, employment, income and GDP supported by the basic metal products industry cluster

	Output (R millions)	Employment (Number)	Employment income (R millions)	GDP (R millions)
Actual	4,173.59	7,198	342.61	894.04
Supported	7,108.30	20,602	1,836.23	2,993.31

Source: Conningarth Economists, 2009 and Quantec Easydata, 2013

Table 6.10: Basic metal products cluster top five opportunities

Cluster	Country	HS 6-digit product code and description	Filter 4 cell classification	Potential export value (US$ thousands)	South Africa's actual exports of the REO's identified for the NWP (US$ thousands)	Market accessibility (%)
Basic metal products	China	740311 - Copper cathodes and sections of cathodes unwrought	10	2,058,369	6,267	50.53
	United States	740311 - Copper cathodes and sections of cathodes unwrought	5	1,893,348	0	55.39
	Italy	740311 - Copper cathodes and sections of cathodes unwrought	20	1,209,738	40,421	45.40
	Belgium	720421 - Waste or scrap, of stainless steel	11	953,842	202	74.31
	South Korea	730799 - Fittings, pipe or tube, iron or steel, nes	2	526,705	0	64.06

Source: Steenkamp, 2011

Table 6.10 shows the top five export opportunities for the basic metal products cluster. The product HS 740311 - Copper cathodes and sections of cathodes unwrought appeared three times as an REO in the basic metal products cluster to China, the United States and Italy. Of the three opportunities, HS 740311 - Copper cathodes and sections of cathodes unwrought to Italy classified in cell 20, where the market is large and growing, and the market is very open and accessible, will be easier to act upon. Belgium is the most accessible market, followed by South Korea and the United States as shown by the market accessibility index scores.

The major manufacturing activities in the NWP in the basic metal products sector are steel manufacturing, cable and engineering works, electrical-wiring looms and automotive safety glass (for the automotive industry) (North West Business, 2013; see section 4.5.2.6). The presence of a Bosch plant in the local municipality of Madibeng, which specialises in the production of starters, alternators, braking systems and electronic control units, also contributes a large proportion of employment in the sector (North West Business, 2013). Therefore, the basic metal products cluster can evolve to become a hub and spoke cluster. These clusters comprise one or several large firms with several supporting service firms and small suppliers (see section 2.8.3). The large firms determine the terms of inter-firm linkages with the small suppliers as well as the growth prospects of the cluster.

6.5.6 Other food products

Table 6.11 shows the output, employment, income and GDP supported by the other food products industry cluster for the NWP. The other foods cluster will generate higher supported output, employment (number) employment income and GDP for the NWP as shown in Table 6.11.

Table 6.11.: NWP output, employment, income and GDP supported by the other food products industry cluster

	Output (R millions)	**Employment (Number)**	**Employment income (R millions)**	**GDP (R millions)**
Actual	351.52	2,931	48.52	106.00
Supported	518.58	3,292	161.98	214.56

Source: Conningarth Economists, 2009 and Quantec Easydata, 2013

The analysis to determine whether any of the other food products have REOs according to the DSM for products revealed no REOs for this cluster (see section 5.5.3.1). Section 5.4.6 revealed that an injection in the other food products cluster is effective in generating high inter-industry linkages and additional production in the other sectors in the cluster. Several production activities benefit both directly and indirectly from an injection in the other food products sector. This is owing to the fact that the other food products sector utilises inputs from the agriculture and dairy products sectors and sells its output to other sectors and institutions in the economy through the trade sector. The communication sector is utilised to advertise the products of the other food products sector. The other foods cluster can benefit from adapting the characteristics of and evolving into a diversified cluster. A diversified cluster is characterised by individual firm vertical specialisation, vertical diversity and broad sectoral specialisation (McCormick, 1998). These characteristics result in efficiency gains from collaboration with the members of the cluster.

6.5.7 Agriculture

With cluster formation, output, employment and GDP in the agriculture cluster will decline by 27%, 66% and 40%, respectively (see Table 6.12). This may be attributed to outsourcing. With cluster formation, firms specialise in activities that they are more efficient in and outsource the rest in order to maintain and enhance cluster competitiveness (see section 2.5.5). Employment income, however, will increase by 70%.

Table 6.12: NWP output, employment, income and GDP supported by the agriculture industry cluster

	Output (R millions)	**Employment (Number)**	**Employment income (R millions)**	**GDP (R millions)**
Actual	8,285.52	81,088	881.95	4,188.40
Supported	6,049.62	27,633	2,913.43	2,529.29

Source: Conningarth Economists, 2009 and Quantec Easydata, 2013

Table 6.13: Agriculture cluster top five opportunities

Cluster	**Country**	**HS 6-digit product code and description**	**Filter 4 cell classification**	**Potential export value (US$ thousands)**	**South Africa's actual exports of the REO's identified for the NWP (US$ thousand**	**Market accessibility (%)**
Agriculture	Netherlands	060210 - Cuttings and slips, not rooted	20	13,189	7,432	56.43
	United States	060210 - Cuttings and slips, not rooted	9	12,185	342	72.61
	Germany	060210 - Cuttings and slips, not rooted	6	6,562	23	62.95

	Austria	060390 - Cut flowers and flower buds for bouquets, dried, etc.	4	5,957	53	73.19
	United Kingdom	060240 - Roses	5	5,624	0	70.65

Source: Steenkamp, 2013

The largest export opportunity for the agriculture cluster in terms export potential value was HS 060210 – Cuttings and slips, not rooted to the Netherlands. This export opportunity is classified in cell 20 implying that it will be easy to access. South Arica‟s current exports for the remaining four identified REOs in the agriculture cluster were low or equal to zero (see Table 6.13). This highlights that great export potential exists for the agriculture cluster in the NWP. All the opportunities in the agriculture cluster are easily accessible as shown by the high market accessibility index scores.

As highlighted in Table 6.12, the supported output, employment and GDP in the agriculture cluster will be lower than the actual activity. For the cluster to successfully enhance the competitiveness of firms in the NWP, it must evolve and develop into a sub-contractor cluster. This can be achieved through narrow vertical and horizontal specialisation, sub-contraction of economic activities and the interaction of large and small firms to achieve collective efficiency from reduced transaction costs (Pedersen, 1998; see section 2.7.1).

6.5.8 Non-metallic mineral products

The non-metallic mineral products cluster will generate more output, employment income and GDP as shown by the supported activity being larger than the actual activity (see Table 6.14). The number of people employed in the cluster will decline from 16 328 to 15 971.

Table 6.14: NWP output, employment, income and GDP supported by the non-metallic mineral products industry cluster

	Output (R millions)	**Employment (Number)**	**Employment income (R millions)**	**GDP (R millions)**
Actual	3,274.68	16,328	639.29	1,046.34
Supported	4,821.92	15,971	1,442.34	2,074.95

Source: Conningarth Economists, 2009 and Quantec easydata, 2013

Table 6.15: Non-metallic mineral products cluster top 5 export opportunities

Cluster	**Country**	**HS 6-digit product code and description**	**Filter 4 cell classification**	**Potential export value (US$ thousands)**	**South Africa's actual exports of the REO's identified for the NWP (US$ thousand**	**Market accessibility (%)**
Non-metallic mineral products	South Korea	401120 - Pneumatic tyres new of rubber for buses or lorries	2	2,444,054	0	46.46
	India	710231 - Diamonds (jewellery) unworked or simply sawn, cleaved	13	2,176,369	13,010	56.17
	United Kingdom	710231 - Diamonds (jewellery) unworked or simply sawn, cleaved	16	2,002,054	973,982	72.35
	Belgium	710231 - Diamonds (jewellery) unworked or simply sawn, cleaved	15	1,646,037	349,782	76.26
	United States	711031 - Rhodium unwrought or in powder form	16	1,201,187	1,201,187	71.66

Source: Steenkamp, 2011

The non-metallic mineral products cluster contains the highest REOs in terms of export potential value relative to all other clusters. Opportunities to the United Kingdom and United States are classified in cell 16, which is a large market with high openness and high market access. The export opportunity to Belgium is classified under cell 15, while that to India is classified under cell 13. In terms of the market accessibility index, South Korea and India are the most accessible relative to the other top five opportunities. The United Kingdom, United States and Belgium have high market accessibility index scores. However, South Africa"s current exports of HS 711031 – Rhodium unwrought or in powder form to the United States were equal to the export potential value. This implies that South Africa has realised the potential in this export opportunity.The non-metallic mineral products cluster can evolve into a satellite platform. They are composed of medium and large branch plants of large companies. Inter-firm linkages are minimal in this type of cluster as branch plants are self-sufficient (Shields *et al*., 2010; Markusen, 1996).

6.5.9 Trade

The trade cluster"s supported output, employment (number), employment income and GDP are lower than actual figures. This may be as a result of sectors in the cluster using up more domestic inputs. This will result in the cluster requiring fewer imports of intermediate goods as the cluster evolves to become more competitive and self-reliant.

Table 6.16: NWP output, employment, income and GDP supported by the trade industry cluster

	Output (R millions)	**Employment (Number)**	**Employment income (R millions)**	**GDP (R millions)**
Actual	21,685.45	89,816	5,332.07	10,786.27
Supported	10,531.64	30,595	5,212.30	4,868.03

Source: Conningarth Economists, 2009 and Quantec easydata, 2013

The analysis to determine whether any of the trade services have REOs according to the DSM for services revealed no REOs for this cluster (see section 5.5.3.2). The trade cluster comprises the most number of sectors relative to the 10 clusters identified for the NWP. It consists mostly of small sectors. Efforts to enhance the effectiveness and competitiveness of the trade cluster should be directed towards enhancing the downstream effects. As the trade cluster exhibits high levels of interaction among the sectors, it can be assumed to be a latent cluster. Latent clusters are characterised by high critical mass for cluster formation although no interactions and information flows are taking place (Enright, 2004; see section 2.7.2). Cluster formation can be stimulated by the NWP government through engaging the stakeholders on the possible benefits of cluster formation thereby making the cluster a policy driven cluster (see section 2.10).

6.5.10 Dairy products

With cluster formation, the dairy products sector will contribute more to the NWP economy. Table 6.17 shows that supported output, employment, employment income and GDP are greater than the actual figures.

Table 6.17: NWP output, employment, income and GDP supported by the dairy products industry cluster

	Output (R millions)	**Employment (Number)**	**Employment income (R millions)**	**GDP (R millions)**
Actual	1,868.32	2,430	107.54	426.88
Supported	4,485.99	16,790	699.17	981.69

Source: Conningarth Economists, 2009 and Quantec easydata, 2013

The analysis to determine whether any of the dairy products have REOs according to the DSM for products revealed no REOs for this cluster (see section 5.5.3.2). Similar to the other foods cluster, the dairy products cluster comprises various sectors as it uses their output as inputs. It also utilises various sectors to sell its products. Therefore, the dairy products cluster can achieve greater competitiveness by evolving into a diversified cluster (see sections 2.7.1 and 6.5.6).

6.6 Conclusion

In this chapter, the impact of industrial cluster formation on the NWP economy was explored using SAM multiplier analysis. Solid evidence has been provided to show that industrial cluster formation will enhance economic activity in the NWP based on the existing economic structure as captured in the SAM. An aggregated SAM table highlighted the major transactions between the identified ten potential clusters and related sectors. In particular, the table showed the purchases, sales, imports and exports for the clusters and related sectors. The aggregated SAM table showed that the estimate of the total gross cluster output represents 38% of the NWP total gross output.

This chapter further illustrated the strength of the existing inter-industry linkages by quantifying and graphically presenting the backward and forward linkages between the clusters and their related sectors. This highlighted the level of integration of the industries‟ inter-industry transactions. The literature suggests that a cluster that is highly integrated, where the sectors in that cluster are highly dependent on each other‟s output, is shown by high upstream and downstream linkages. Of the ten identified clusters for the NWP, the following were found to be moderately integrated; (i) trade (ii) basic metal products (iii) grain mill, bakery and animal feed products and (iv) building and other construction. These clusters have high upstream effects. Efforts to promote industrial cluster formation should aim at enhancing the inter-industry linkages, particularly the downstream effects in these clusters, as they already have moderately high existing upstream effects. This would make the clusters more integrated and would enhance the effects (power-of-pull) of the clusters. For the rest of the clusters, namely communication, real estate, other food products, agriculture and non-metallic mineral products, the levels of cluster integration were weak therefore, efforts to promote industrial cluster formation should aim at enhancing both the upstream and downstream effects.

SAM-based multiplier analysis was used to demonstrate the output, employment, employment income and GDP supported by cluster formation for the NWP. This is demonstrated by comparing the actual activity (output, employment, employment income and GDP; given in the SAM) with the supported activity (computed using SAM data and the multipliers) for each cluster. The literature suggests that the supported activity of clusters is expected to be higher than the direct activity owing to the enhanced competitiveness of clusters. Contrary to the literature, the supported activity for the agriculture and trade clusters was less than the actual activity. As supported by the literature, the following clusters‟ supported activity was greater than the actual activity; communication; real estate; grain mill, bakery and animal feed products; building and other construction; basic metal products; other food products; non-metallic mineral products; and dairy products.

Lastly, the results of the DSM for products and the DSM for services were analysed further to show the export opportunities of the 10 potential clusters identified for the NWP. For the product clusters, the basic metal products and non-metallic mineral products clusters were shown to have the REOs with the highest export potential values. No REOs were identified for the other food products and dairy products clusters. For the services clusters the communications services cluster was found to have export opportunities that can be explored easily relative to the building and other construction cluster. This is owing to relatively lower market openness and market access. No REOs were identified for the real estate and trade clusters. Chapter 7 proceeds to conclude this study by providing a summary, conclusions and recommendations.

CHAPTER 7: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter provides an overview of the research questions and objectives, key findings, implications of the findings of the study and recommendations for cluster formation as well as for future research. The concept of industrial clusters has many variations. In particular, the definition and scope of industrial clusters vary according to different authors. Chapter 2 set out to clarify and elucidate the industrial cluster concept by discussing and explaining various concepts associated with industrial clusters such as their benefits, limitations, conditions necessary for formation and the role of government in industrial cluster formation. Chapter 3 proceeded to provide a discussion of the methods to identify industrial clusters that exist in the literature thereby motivating why the SPA and PoP methods are used in this study.

A sector-based spatial overview of the NWP economy was provided in Chapter 4 to provide an overview of the NWP‟s comparative advantage based on production. The results of applying the SPA and PoP methods to identify and prioritise industrial clusters in the NWP were presented in Chapter 5. In addition, Chapter 5 presented the results of investigating whether any of the identified industrial clusters‟ products and services have REOs according to the DSM. In Chapter 6, the impacts of industrial cluster formation on the NWP economy using SAM multiplier analysis were discussed. In addition, the export potential of the clusters identified to have REOs was explored and discussed in Chapter 6. Policy recommendations to government to enhance industrial cluster formation in the NWP as well as recommendations for future research are discussed in this present chapter (see section 7.3). Table 7.1 shows the research questions of this study and how they were answered.

Table 7.1: Research questions of this study

	Research question	How it was answered
v.	Are there industrial clusters in the NWP?	Ten industrial clusters were identified for the NWP using the SPA and PoP methods.
vi.	Do any of the identified industrial clusters" products and services have REOs according to the DSM?	Six of the ten identified industrial clusters" products have REOs according to the DSM
vii.	What are the impacts of industrial cluster formation on the NWP economy and what is the export potential of the identified clusters" products and services?	a) Cluster formation will result in the supported activity for the agriculture and trade clusters being less than the actual activity. b) The communication; real estate; grain mill, bakery and animal feed products; building and other construction; basic metal products; other food products; non-metallic mineral products; and dairy products clusters" supporting activity will be greater than the actual activity. c) Two of the product clusters, namely other food products and dairy products and two of the service clusters, namely real estate and trade had no REOs; therefore, their export potential could not be demonstrated. d) The communication cluster had one product with REOs to five different countries. e) The grain mill, bakery and animal feed products; building and other construction; basic metal products; non-metallic mineral products; and agriculture clusters had REOs in five products and services and to five countries each.
viii.	What policies should the government implement to enhance industrial cluster formation and the promotion of these clusters" exports?	Addressed in this chapter (see section 7.3)

Table 7.2 provides a summary of the chapters in which the different objectives of this study were addressed and how they relate to the rest of the study.

Table 7.2: Research objectives addressed in this study

Objective	Chapter in which objective is reached	How does the objective relate to the rest of the study
i. Provide a theoretical background and understanding of industrial clusters by discussing the definitions, genesis and evolutionary processes, measurable characteristics, advantages as well as the shortcomings of industrial cluster formation; ii. Provide a discussion on the different types of clusters and conditions necessary for industrial cluster formation; iii. Provide a discussion on the role of government in industrial cluster formation; iv. Provide a discussion on the strategies, instruments and policies to promote industrial cluster formation;	Chapter 2	a) The measurable characteristics of industrial clusters determine the variables (data and methods) used to identify industrial clusters (see sections 3.2 and 3.4) b) The different cluster taxonomies provide insights into the different types of clusters that can be formed in the NWP (see section 6.5) c) The different viewpoints on the evolutionary process of cluster formation, conditions necessary for industrial clusters formation; the role of government and the strategies, instruments and policies to promote industrial cluster formation provide insights into policy recommendations for the promotion of cluster formation (see section 7.3)
v. Provide an assessment of the quantitative and qualitative tools available to investigate the existence of industrial clusters	Chapter 3	a) Demonstrated why the SPA method was selected to identify industrial clusters in the NWP in this study (see sections 3.3.1 and 5.3). b) Demonstrated why the PoP method was used to prioritise the number of industrial clusters for this study (see sections 3.3.2 and 5.4).
vi. Provide a sector-based spatial overview of the economy of the NWP of South Africa;	Chapter 4	a) Demonstrated in which sectors and the locality of the NWP‟s comparative advantage based on production (see sections 4.4 and 4.5). b) Demonstrated the strength of the clusters according to the NWP‟s contribution to production in the various sectors (see sections 4.4, 4.5 and 5.4). c) Highlighted the locality of the clusters based on the locality of

			production in the various sectors that make up the cluster (see section 4.4, 4.5 and 5.4).
vii. viii. ix. x.	Apply the structural path analysis method to a social accounting matrix for the NWP; Identify industrial clusters in the NWP; Prioritise the identified industrial clusters using the power of pull method; Investigate whether any of the identified industrial clusters" products have REOs according to the DSM;	Chapter 5	a) Answered the first two research questions of the study (see section 1.5 and Table 7.1). b) Applied the SPA method thereby identifying industrial clusters demonstrating the advantages of this method over other methods to identify industrial clusters (see sections 3.3.1 and 5.3.1). c) Applied and demonstrated the PoP method to prioritise the number of clusters (see sections 3.3.4 and 5.3.2) d) Identified the clusters with REOs according to the DSM thereby demonstrating that the clusters can explore scientifically determined export potential in foreign markets thereby also enhancing competitiveness in foreign markets (see section 5.5 and 6.5).
xi. xii. xiii. xiv.	Quantify the intermediate and final demand linkages identified in the NWP cluster map in a SAM; Measure the strength of interaction among the clusters and the related sectors and determine the level of integration (that is how much the sectors in a cluster are reliant on each other"s value added and final demands); Demonstrate the effects of industrial cluster formation on the regional economy using SAM multiplier analysis; Demonstrate the export potential of the industrial clusters" products and services for the NWP; and	Chapter 6	a) Showed the level of integration and dependence among sectors in the various clusters thereby highlighting areas that need to be addressed for the clusters to be successful (see sections 6.2, 6.4 and 7.3). b) Answered the third research question of the study (see section 1.5 and Table 7.1). c) Demonstrated in part the associated benefits of industrial cluster formation on the NWP economy that is the increased economic activity associated with cluster formation (see sections 2.5 and 6.5). d) Demonstrated the export potential of the industrial clusters thereby highlighting the factors that should be taken into account before export potential can be realised (see sections 6.5 and 7.3)
xv.	Recommend policies and/or instruments to promote the formation of industrial clusters and exports in the NWP.	Chapter 7	a) See section 7.3

7.2 Summary of empirical results

7.2.1 The comparative advantage of the NWP

Chapter 4 provided a sector-based spatial economic overview of the NWP of South Africa thereby providing insights into the province‟s comparative advantage based on contributions to national production in the various sectors. An analysis of the province‟s economic activities revealed some interesting points. The mining sector is the most important sector in the province. In the NWP, in 2011, the mining and quarrying sector contributed the most to output (%), it is the province‟s largest contributor to GVA (%), and accounted for the highest share of profits (%). This is attributed to the fact that the largest platinum deposits in the world are found in the province. The NWP‟s mining sector produces 70% of South Africa and the world‟s platinum, mostly from mines in the Rustenburg region and a third of the NWP‟s gold output. In addition, the mining and quarrying sector was also the largest employer in the NWP economy across all industries. This is because major ferrochrome operations in the country are located in Kroondal (Xstrata Alloys), Rustenburg (Samancor Chrome Mines) and Brits (Hernic Ferrochrome), thereby considerably contributing to employment in the province. In the gold mining sector, four major companies operate in Carletonville, i.e. AngloGold Ashanti, Gold Fields, Harmony and DRD Gold Fields.

The manufacturing sector in the NWP is not a major contributor to GVA. Manufacturing output ranked 20th, relative to all other sectors and sub-sectors in 2011 (See Table 4.1). The manufacturing sector ranked second in terms of profit, after mining and quarrying in the province in 2011. The NWP contributed 4.5% to national employment in the manufacturing sector. The Bojanala District Municipality was the main centre of manufacturing output. The Madibeng local municipality, situated in the Bojanala District Municipality, was the main centre of manufacturing. Major companies such as Bosch and Bridgestone are located in Madibeng where they serve as an anchor to the automotive-supply sector. Madibeng was the leading producer (GVA) in the following manufacturing sub-sectors:

- Textiles, clothing and leather goods (R63.4 million),
- Wood, paper, publishing and printing (R85.67 million),
- Petroleum products, chemicals, rubber and plastic (R394.53 million),
- Metals, metal products, machinery and equipment (R356.76)
- Electrical machinery (R192.87 million),

- Radio, TV, instruments, watches and clocks (R27.65 million);
- Transport equipment (R611.27 million) and
- Furniture and other manufacturing (R139.13 million) (Quantec, 2012).

The processing of mineral ores is a major activity in the NWP. The NWP"s other non-metal mineral products sub-sector was the second leading contributor (9.1%) to national employment in 2011. The NWP"s heavy industrial capacity is heavily dominated by ferrochrome production, ferrochrome smelting and processing plants. The construction sector contributed the most to output and employment to the secondary sector in the NWP in 2011. An increase in demand in the construction sector in the NWP after the 2010 World Cup infrastructure upgrade is attributed to the expansion of existing mines as well as the establishment of large numbers of new mines, the large number of cement manufacturers located in the province, and numerous housing projects.

The radio, TV, instruments, watches and clocks sector"s output and employment (number of people employed) was the least in the manufacturing sector in the NWP in 2011 (R90.78 million and 545 people, respectively). In the tertiary sector, the general government sector was the most important sector to the NWP in terms of output. The wholesale and retail trade, catering and accommodation sector was the most significant employer in the tertiary sector and in the whole province. In terms of contributing to employment, the NWP"s share is relatively low, with the highest contribution of 5.9% in the transport equipment sector. Catering and accommodation contributed to 5.8%.

7.2.2 Industrial clusters identified

The SPA and PoP methods were applied to a SAM for the NWP of South Africa to identify and prioritise industrial clusters. The effective promotion of industrial clusters requires prioritisation of the number of industrial clusters. The ten identified industrial clusters are:

(i) Communication;
(ii) Real estate;
(iii) Grain mill, bakery and animal feed products;
(iv) Building and other construction;
(v) Basic metal products;
(vi) Other food products;

(vii) Agriculture;

(viii) Non-metallic mineral products;

(ix) Trade; and

(x) Dairy products.

The communication cluster was identified as having the highest PoP for the NWP. This is shown by the frequency of the communication sector as a destination sector for the other clusters. The communication sector was the destination sector in eight of the 10 clusters. The communication cluster comprises six sectors. The efficacy of an injection into the communication sector is relatively weak as only five sectors will benefit from induced demand increases in the communication sector. Output, employment and profit centres of the communication sub-sector were Madibeng, Mafikeng, Rustenburg and City of Matlosana.

The agriculture cluster was identified as the seventh industrial cluster with the highest PoP for the NWP. The core structure of the agriculture cluster comprises ten industries. The cluster is strongly connected to the trade sector. The domination of the trade sector in this cluster suggests that developments in this cluster are transmitted through activities within the trade sector. The most significant contributors to agriculture, forestry and fishing output, employment and profit in 2011 were the local municipalities of Madibeng, Ditsobotla and Potchefstroom, respectively. These trends can be attributed to the climatic characteristics of the NWP. The trade sector was a significant contributor to output and employment in the NWP in 2011. The significance of the trade sector output in the NWP and in the cluster indicates that a significant proportion of the agricultural output is sold unprocessed through the trade sector. This could also be an indication of ownership ties, where large wholesale trade firms control the downstream food production chain.

The non-metallic mineral products cluster comprises eight sectors. The trade sector was the most important sector in transmitting influence in the cluster. The efficacy of an injection into the communication sector is relatively weak when the number of sectors that benefit are considered. Other non-metal mineral product output, profit and employment were concentrated in the Ditsobotla, Mafikeng and Madibeng local municipalities in the NWP.
The trade cluster was identified as the ninth industrial cluster for the NWP. The indirect paths were more significant in transmitting influence than the direct paths in the trade cluster. The trade cluster generated the most efficacies as it comprised fourteen sectors; the number of

sectors that benefit from stimuli in the trade sector. This is the highest number of sectors in a cluster compared to all other identified potential clusters. The highest contributions to wholesale and retail trade output, employment and profit in 2011 in the NWP originated from City of Matlosana, Rustenburg and Madibeng. The NWP"s wholesale and retail trade sub-sector was the largest employer in the tertiary sector in 2011. The NWP"s close proximity to Gauteng provides access to the domestic market as well as international markets for the firms in the NWP, thereby making trade a significant economic activity in the NWP.

7.2.3 Identified industrial clusters vs. REOs

7.2.3.1 Identified industrial cluster products with REOs

Chapter 5 explored the export potential of the identified industrial clusters according to the results of the DSM. This was achieved by taking the following steps. Firstly, since the DSM for products" results are at a country level, the exports of the NWP in the period 2003 to 2007 had to be analysed. This was done to assess the province"s current capacity to export the different products so as to avoid identifying REOs of products that are not currently exported. Therefore, only products with exports for at least three of the five years were selected for further analysis. All other products with export values for less than three years were excluded from further analysis. Secondly, the selected products (NWP"s export products with a positive export value for at least three years) were matched to the DSM study for products" results for South Africa, with a revealed comparative advantage (RCA) greater than 1. The RCA value that is greater than 1 indicates that South Africa has a sufficient share in trade in these products to gain a comparative advantage and is therefore relatively specialised in that product (Balassa, 1965).

Four of the six product clusters were found to have REOs according to the DSM study for products. The non-metallic mineral products cluster contained the most number of REOs relative to all the other clusters. The REOs for the non-metallic mineral products cluster include the second largest REO for South Africa in terms of potential export value. The product HS271011 - Aviation spirit had a potential export value of US$12.1 million and ranked as the second largest REO for South Africa. In the basic metal products and the non-metallic mineral products clusters, the products HS 710239 - Diamonds (jewellery) worked but not mounted or set and HS 740311 - Copper cathodes and sections of cathodes unwrought ranked third and fourth according to the highest export potential value for South Africa to all countries. This implies that South African and in particular NWP firms have the potential to take advantage of export opportunities worth US$11.7 million and US$9.9 million, respectively, for these two products. The grain mill, bakery and animal feed products cluster has one product with REO; HS 110313 - Maize (corn) grouts or meal. This product has an export potential value of US$ 12.6 million and export opportunities to nine countries. The dairy products and other foods clusters did not have any products with REOs with an RCA greater than 1. The products among the top 10 with the highest export potential include automobiles, aviation spirit, diamonds, bituminous coal, copper ores, nickel, aluminium, parts of seats and coal.

In addition, the DSM for products‟ results also revealed the countries where South Africa has high export potential for the products identified as having REOs. The countries that hold high export potential for the products of North West Province include the United States, Japan, China, Germany, the United Kingdom, India, Canada, Belgium, Italy and the Netherlands.

7.2.3.2 Identified industrial cluster services with REOs

The analysis of the service clusters differed from that of the product clusters. Firstly, it did not include the NWP provincial service exports as no data is available on the provincial exports of services. Secondly, the DSM for services‟ results differ from the DSM for products. The DSM for services‟ results do not include export potential values, but instead provide service-country combinations, cell classifications and the total import demand in 2007. The total import demand is the total imports for that services sector in each market, which shows whether or not it is a large market (Grater, 2011). Therefore, this study matched the cluster services to the identified REOs of the DSM for services. Only the communication and building and other construction clusters had services with REOs according to the DSM for services study.

For the communication cluster, the sub-sector: communications services - postal and courier services has export potential to Canada. Canada‟s total import demand was US$ 864.3 million in 2007 indicating that it is a large market. This REO is classified in cell 3, which means that it is a large market with short-term growth; however, with low market openness and low market access. Other countries to which the communications services cluster has REOs according to the DSM for services study are Estonia, Hong Kong, Latvia and Norway. For the building and other construction cluster, REOs were identified in the sub-sector: construction services - construction abroad. The countries with export potential for this sub-sector include Austria, Germany, Italy, Netherlands and Saudi Arabia. All other service clusters did not have REOs according to the DSM for services study.

7.2.4 SAM multiplier analysis to assess the impact of cluster formation in the NWP

The impact of industrial cluster formation on the NWP economy has been explored using SAM-based multiplier analysis in Chapter 6. Solid evidence has been provided to show that industrial cluster formation will, in most cases, enhance economic activity. An aggregated SAM table highlighted the major transactions between the identified ten potential clusters and the related sectors. In particular, the table showed the purchases, sales, imports and exports for the clusters and related sectors. The aggregated SAM table showed that the estimate of the total gross cluster output represents 38% of the NWP total gross output.

In addition, the strength of the existing inter-industry linkages in the identified clusters was quantified and graphically presented to illustrate the backward and forward linkages between the clusters and the related sectors. This highlighted the level of integration of the industries" inter-industry transactions. The literature suggests that a cluster that is highly integrated, where the sectors in that cluster are highly dependent on each other"s output, is shown by high upstream and downstream linkages. Of the ten identified clusters for the NWP, the following were found to be moderately integrated: (i) trade, (ii) basic metal products, (iii) grain mill, bakery and animal feed products, (iv) building and other construction, and (v) dairy products. These clusters have high downstream effects. Efforts to promote industrial cluster formation should aim at enhancing the inter-industry linkages, particularly the downstream effects in these clusters, as they already have moderately high existing upstream effects. This would make the clusters more integrated and would enhance the effects (power of pull) of the clusters. For the rest of the clusters, namely communication; real estate; other food products; agriculture and non-metallic mineral products, the level of cluster integration is weak. These clusters have low upstream and downstream linkages. Efforts to promote industrial cluster formation should aim at enhancing the inter-industry linkages, both upstream and downstream, in order to maximise the benefits of cluster formation.

SAM-based multiplier analysis was used to demonstrate the output, employment, employment income and GDP supported by cluster formation for the NWP. This is demonstrated by comparing the actual activity (output, employment, employment income and GDP) to the supported activity (computed using multiplier analysis) for each cluster. The literature suggests that the supported activity of clusters is expected to be higher than the direct activity owing to the enhanced competitiveness of clusters. Contrary to the literature, the supported activity for the agriculture, real estate and trade clusters was less than the actual activity. As supported by the literature, the following clusters‟ supported activity was greater than the actual activity: communication; grain mill, bakery and animal feed products; building and other construction; basic metal products; other food products; non-metallic mineral products; and dairy products.

7.2.5 The export potential of the NWP's identified potential clusters

The identified industrial cluster‟s REOs were explored further to provide more details on the products or services identified as having REOs. In addition, the countries to which REOs (products and services) were identified were discussed. In terms of product clusters identified to have REOs, the export potential values, cell classifications and market accessibility index scores were discussed. In terms of the service clusters identified as having REOs, the countries, market access, market openness, import demand and cell classifications were discussed. For the product clusters, the basic metal products and non-metallic mineral products clusters were shown to have REOs with the highest export potential values. No REOs were identified for the other food products and dairy products clusters. For the services clusters, the communications services cluster was found to have export opportunities that can be explored easily relative to the building and other construction cluster. This is owing to relatively lower market openness and market access of the building and other construction relative to the communications services REOS. No REOs were identified for the real estate and trade clusters. Table 7.3 summarises the empirical results of this study and provides a basis for recommendations.

Table 7.3: Summary of empirical findings

Potential cluster	**PoP ranking**	**Number of sectors in cluster**	**Does the cluster have REOs?**	**Cell classification of the largest REO according to potential export value**	**Level of upstream effects**	**Level of downstream effects**	**Level of cluster integration**	**Is the supported activity greater than the actual activity?**	**Recommendation for cluster type**
Communication	1	6	Yes	3	Low	Low	Low	4/4	Marshalian industrial district
Real estate	2	7	No	N/A	Low	Low	Low	1/4	High technology
Grain mill, bakery and animal feed products	3	10	Yes	3	Medium	Medium	Medium	4/4	Informal enterprise
Building and other construction	4	8	Yes	1	High	Low	Medium	4/4	Policy driven
Basic metal products	5	9	Yes	10	High	Low	Medium	4/4	Hub and spoke
Other food products	6	8	No	N/A	Low	Low	Low	4/4	Diversified
Agriculture	7	10	Yes	20	Medium	Low	Low	1/4	Sub-contractor
Non-metallic mineral products	8	8	Yes	2	Low	Low	Low	3/4	Satellite platform
Trade	9	14	No	N/A	High	Low	Medium	0/4	Policy induced
Dairy products	10	9	No	N/A	Medium	Low	Low	4/4	Diversified

7.3 Policy recommendations to the North West provincial government

7.3.1 The role of the North West provincial government in promoting industrial cluster formation

To our knowledge, no study exists to identify industrial clusters in the NWP. This study has demonstrated a methodological framework to identify and prioritise industrial clusters. Often, from a central planning point of view, it is difficult to select sectors and regions to focus economic development efforts on, as development strategies are often designed to be holistic (see section 2.6.1). However, this study identified industrial cluster in the NWP and demonstrated that these potential clusters have strong existing linkages (see sections 5.4, 6.2 and 6.4) and have the power to pull all other sectors in the NWP economy (see section 5.3.2). The provincial government should firstly play a catalytic and supportive role in cluster development in the NWP. The catalytic role involves bringing vested interests together to initiate collaboration and enhance cluster development (see section 2.9). This is necessary to establish the levels of existing cooperation between firms in the clusters and to raise interest into the potential benefits of cluster formation. This is because quantitative analysis conducted in the study does not provide insight into the cluster characteristics such as active networks, learning and innovation and sharing of information or equipment (see sections 2.4 and 2.5). Bringing the vested interests together will establish whether any forms of cooperation can be established.

Secondly, it is recommended that the provincial government‟s capabilities to foster the role of facilitating industrial cluster formation be assessed. This is necessary to establish the provincial government‟s capabilities and to identify what the provincial government is lacking as the facilitator of industrial cluster formation. Once this is achieved the provincial government should ensure that a business environment conducive to cluster formation is established in the NWP. This includes creating a favourable business environment for cluster formation. Chiarino and Chiesa (2006) identified a favourable environment as the key driver to industrial cluster formation. A favourable environment is characterised by a scientific base, finance, general context and an industrial base (see section 2.8.1). The provision of these factors by the government reduces the associated start-up costs of the cluster, and thereby ensures that the clusters are equipped to be successful. In addition, a favourable environment not only benefits the firms that form the clusters, but other firms outside the cluster as well. If a favourable environment is established, firms will establish branches in the NWP to take advantage of the various advantages the NWP will offer (see section 2.8.1).

7.3.2 Formulation of a cluster development strategy

Once the cluster formation process is initiated, the North West provincial government must formulate a cluster development strategy outlining the various stakeholders involved, the objectives, and determine the tools through which the objectives can be reached. In addition, the cluster development strategy should outline the steps for the implementation, monitoring and evaluation of the strategy (see section 2.10). At this stage, the provincial government should play a supportive role by taking the catalytic role a step further through the provision of infrastructure, education or training. Alternatively, the government‟s role can be directive; where the aim is to implement policies to improve the local business environment (see section 2.9). This is important as the ten clusters identified in this study include several related sectors and together account for a large proportion of the economic sectors. Policies to improve the local business environment can include tax policy review, reduction in costs of services or the provision of market, customer, technology and competitor information (see section 2.10). Additionally, cluster development strategies should include export promotion incentives to promote the exports of the cluster products (see section 7.3.4). This study has demonstrated that the results of the DSM for products and DSM for services can be utilised to explore the export opportunities of the clusters‟ products.

Furthermore, among the ten identified clusters for the NWP, the following were found to be moderately integrated: (i) trade, (ii) basic metal products, (iii) grain mill, bakery and animal feed products, (iv) building and other construction, and (v) dairy products. These clusters have high downstream effects. Efforts to promote industrial cluster formation should aim to enhance the inter-industry linkages, particularly the downstream effects in these clusters as they already have moderately high existing upstream effects. This would make the clusters more integrated and would enhance the effects (power of pull) of the clusters. For the rest of the clusters, namely communication, real estate, other food products, agriculture and non-metallic mineral products, the levels of cluster integration were weak. Efforts to enhance cluster formation discussed above will enhance the activities of the clusters (by enhancing cooperation and interdependency) and related sectors; thereby simultaneously increasing the backward and forward linkages of the clusters. Lastly, the findings on the locality of production in the NWP revealed that the most important centres at the local municipal level across all clusters were Madibeng, Rustenburg, City of Matlosana, Mafikeng and Ditsobotla. This indicates that efforts to stimulate cluster formation in this sector should be focused in these regions.

7.3.4 Cluster-specific strategies

Table 7.3 provides a summary of the empirical findings of this study. It highlights that the communication cluster has the highest PoP score relative to the other clusters. Although it comprises six sectors, this cluster generates the highest economy-wide effects as shown by the PoP ranking. Efforts to promote cluster formation should focus on enhancing the level of integration among the sectors that make up the communication cluster. The upstream as well as downstream effects in this cluster are low. Similarly, the real estate, other food products, agriculture, dairy products and non-metallic mineral products clusters have low levels of cluster integration (low or medium upstream and low or medium downstream effects). This means that the current level of integration (interdependence of the cluster members on each other‟s inputs and outputs) prior to cluster formation is low. Therefore, efforts should be directed at increasing the downstream and upstream effects. The grain mill, bakery, and animal feeds, building and other construction, basic metal products and trade clusters are moderately integrated. Therefore, it is recommended that efforts to enhance the level of cluster integration should firstly be directed to the clusters with low levels of integration.

The level of cluster integration can be enhanced through the implementation of political, economic and institutional changes by the government to build trust and ensure that antagonistic competition is discouraged (Hirst & Zeitlin, 1992; see section 2.6.4). These changes are necessary to discourage opportunistic behaviour and ensure the development of trust, cooperation, coordination, flexibility and collective action (see sections 2.5.5 and 2.5.9). The government‟s role in this case would be to ensure that factors that result in the failure to establish cooperative behaviour among firms and to conduct beneficial market exchange are eliminated. This is likely to be as a result of incomplete information, bounded rationality, opportunistic behaviour and asset fixity and specificity (Libecap, 1996). The North West provincial government can address this through the provision of leadership training programmes, strategic planning and the use of brokers to facilitate the stimulation of collective services and buyer-seller networks (see section 2.6.4). These steps are necessary to build trust among cluster members and to demonstrate the potential benefits of collective action to the firms.

Table 7.3 also shows the identified potential clusters‟ supported activity relative to the actual activity. Firstly, Table 7.3 shows, for each cluster, the number of variables out of the four analysed (output, number of people employed, employment income and GDP) for which the supported activity is greater than the actual activity. With cluster formation, the supported activity for the following clusters will be greater than the actual activity for all for variables (4 out of 4): communication; grain mill, bakery and animal feed products; building and other construction; basic metal products; other food products; and dairy products (see Table 7.3). For the agriculture and real estate clusters, only the supported employment (number) is greater than the actual employment (therefore 1 out of 4 in Table 7.3). For all the other variables, the actual activity is greater than the supported activity. The trade cluster‟s supported activity, however, is less than the actual activity for all four variables. Efforts to enhance cluster integration will also enhance the supported activity for the clusters whose supported activity is less than the actual activity. This is because once the clusters are formed and the various related sectors‟ upstream and downstream effects are enhanced, this will result in the clusters‟ supported activity increasing.

Furthermore, in Table 7.3, recommendations for the cluster type that each cluster should develop into are provided. As mentioned in section 2.7, an understanding of the different types of clusters is necessary for effective policy formulation. By adopting a cluster type to develop into, each of the NWP‟s identified industrial clusters has a basis to understand the characteristics of the cluster. The different cluster types also provide the provincial government with a better understanding of the requirements of each cluster. To achieve this, the provincial government can provide specialised services for the clusters. Specialised services are public sector services provided to firms by related experts who have specialised knowledge on the cluster (Lee, 2006; see section 2.5.16). Specialised services include bureaus for tariff duties to handle import as well as export affairs, logistic centres for customs-related issues, or one-stop services that offer employment information. In addition, the authorities should also provide preferential loans, tax relief, and long-term financing, among others. In addition, specialists such as designers, engineering consultants, accountants and lawyers, among others, can be employed to provide expertise in the cluster formation process.

7.3.5 The promotion of the identified potential clusters' export products

The national trade promotion agency in South Africa, the Department of Trade and Industry (the dti) provides several export promotion incentives. These include

- the prevision of market intelligence and advice, trade-lead facilitation;
- facilitation of exports by matching potential exporters with foreign buyers;
- the provision of in-market support;
- financial assistance; and
- the provision of access to markets through investment and trade initiatives, outward selling mission and national pavilions.

The identified cluster sectors with products found to have export potential according to the DSM should explore the incentives currently provided by the dti as a means to enhance their export performance. Existing export promotion incentives provided by the dti should be considered and explored before the provincial government provides additional support for the export of cluster products. This is important to utilise and maximise the efficient use of resources.

Section 5.5.1 described the methodology and classification of the results of the DSM for products. In particular, Table 5.5 showed the cell classifications of the REOs that are based on the size and growth of imports of the different markets and the relative market share of the exporting country. Cuyvers *et al.* (1995:183) and Cuyvers (1997:14-15; 2004:270) recommend that an offensive market exploration export promotion strategy should be implemented for export opportunities in cells 1 to 10. This strategy entails government support that involves providing market information on these opportunities and distributing this information to the relevant exporters (Cuyvers *et al.,* 2012). This is because the market share in these markets is relatively small and therefore limited export promotion resources cannot be allocated to an opportunity that is relatively small (Steenkamp, 2011). Export promotion requires active exploration in collaboration with South Africa"s foreign offices abroad. Active exploration involves organising trade missions and financial support of media campaigns in the target country (Cuyvers *et al*., 2012). In the NWP, this is the case for the grain mill; bakery and animal feed products; non-metallic mineral products; and basic metal products clusters. An offensive market expansion export promotion strategy can be implemented for export opportunities classified in cells 11 to 15. The aim of export promotion at this stage is to expand the market share as products already have intermediate high market share (see section 5.5.1 and Table 5.5). Finally, cells 16 to 20 require a defensive market maintenance export promotion strategy. The aim is to maintain the markets as the NWP has a relatively high market share. This is the case for the agricultural cluster‟s top REOs. These strategies can be adopted for all other REOs for the NWP product clusters.

The REOs for services were classified according to market characteristics; that is, according to the size of the import markets, market accessibility and market openness (see section 5.5.2 and Table 5.6). The rows represent the size and growth potential of the export opportunities. Export opportunities in cells 1, 6, 11 and 16 represent large markets (constant demand) with no growth potential (Grater, 2011). Export opportunities in cells 2, 7, 12 and 17 represent markets with both short-term and long-term growth. These opportunities are growing and the NWP‟s clusters‟ services exports in these cells should be promoted. The columns represent the extent of market access in the different markets. Cells 1 to 5 represent markets with a low market access and that require intervention by government to reduce barriers to entry (Grater 2011). The South African export promotion agency can assist by negotiating easier access in these markets. This is the case for the services export opportunities for the identified potential services clusters, communication and building and other construction, which are classified in cells 3 and 1, respectively. The remainder of the export opportunities can be explored taking into consideration the implications of the classifications. Cells 6 to 10 represent low market openness for services and limited demand for imports. Cluster formation and export promotion will enhance the competitiveness of the NWP‟s export to ensure they compete with domestically produced services in these markets. Cells 11 to 15 represent markets with high openness for services exports, but have low market access owing to stringent policies. Export promotion in the form of negotiations for lower barriers and easier access into these markets is required for these opportunities. Lastly, cells 16 to 20 represent markets with high openness for services and high market access and as such require little export promotion as these companies should have no trouble entering these markets themselves and may only need some assistance if they are new exporters and have very little export experience (Grater, 2011).

Based on the results of this study, a comprehensive export strategy will need to be developed, which will include export marketing studies for individual products to specific countries.

7.4 Recommendations for future research

The most recent available SAM for the NWP is from 2006. This is because I-O tables (data typically used to build SAMs includes I-O tables of the economy, national accounts, fiscal accounts, trade data, other balance-of-payments information and surveys providing information on the composition of household income and expenditures) are not compiled annually, but in five-year time intervals in comparison to national income and product data that is produced annually (lagged). The patterns depicted in the SAM are similar to the more recent data used in Chapter 4 to provide an overview of the structure of the NWP. This highlights that although the SAM data may be dated (2006 in this case), the structure of the economy and the underlying linkages do not change much over time. It is recommended that the analysis done in this study be replicated when more recent data (NWP SAM) is available in order to verify the results.

In addition surveys should be conducted to compliment the results of the quantitative analysis. As mentioned in section 7.3, this is important to establish the levels of existing cooperation between firms in the cluster and to raise interest into the potential benefits of cluster formation This is because the quantitative analysis conducted in the study does not provide insight into the qualitative characteristics of clusters such as networks, learning and innovation, and sharing of information or equipment. It is recommended that surveys of firms in the clusters and related sectors be conducted to compliment the results of the quantitative analysis and provide better insights into the existing linkages.

Additionally, from the findings and conclusions of this study, it is suggested that this study be replicated for the other eight provinces of South Africa. As stated in section 2.2.2, the geographic coverage or dispersion of firms in a cluster ranges from a single city or region to a country or even a network of regions in neighbouring countries. Furthermore, the close proximity of Gauteng to the NWP, for example, provides access to the domestic market as well as international markets for the firms in the NWP. Resultantly, significant economic activity (trade) between the NWP and Gauteng exists. Therefore, the likelihood of clusters spanning across provinces is high and should be investigated further.

Chapter 3 explored other methods used in literature to identify industrial clusters. The characteristics, advantages and disadvantages of each method were provided. However, other methods present interesting characteristics and advantages which present a need to further explore their application in the identification of industrial clusters in the NWP. It is therefore recommended that future studies apply other methods mentioned in chapter 3 such as graph theory.

7.5 Conclusions

This study set out with the main aim of identifying industrial clusters as a strategy to enhance firm competitiveness in the NWP of South Africa. Additionally, the main aim of this study was to provide insights into the policy implications for cluster formation in the NWP. Ten industrial clusters were identified and prioritised using the structural path analysis (SPA) and power of pull (pull) methods. The results of this study can be used by the North West provincial government to promote cluster formation to enhance the competitiveness and exports of firms in the province. These results can be used in the formulation of a cluster development and export strategy for the NWP.

APPENDICES

APPENDIX A: DETAILED SECTORS" OUTPUT, PROFIT AND EMPLOYMENT PER LOCAL MUNICIPALITY FOR THE NWP IN 2011

Table 1: Primary sector output, profit and employment per local municipality in the NWP in 2011

	GVA in 2011 (Rand; million; current prices)		**% contribution to GOS in 2011 (Rand; million; current prices)**		**Employment in 2011 (number)**	
Local municipality	**Agriculture, forestry and fishing**	**Mining and quarrying**	**Agriculture, forestry and fishing**	**Mining and quarrying**	**Agriculture, forestry and fishing**	**Mining and quarrying**
Moretele	132.62	89.11	2.94	0.14	1103	348
Madibeng	530.52	9337.26	11.67	15.36	4341	30519
Rustenburg	362.32	35131.32	7.85	57.94	2507	114557
Kgetlengrivier	147.80	633.46	3.19	0.90	1021	3042
Moses Kotane	38.99	7012.57	0.85	11.56	333	22749
Ratlou	109.85	68.75	2.37	0.10	915	281
Tswaing	332.56	35.60	7.18	0.05	2291	177
Mafikeng	261.91	375.40	5.65	0.57	2130	1582
Ditsobotla	525.14	101.93	11.33	0.14	3965	460
Ramotshere Moiloa	67.75	153.94	1.49	0.24	630	542
Kagisano	105.83	157.25	2.28	0.26	811	432
Naledi	98.45	11.16	2.12	0.01	833	57
Mamusa	213.68	117.49	4.61	0.16	1417	612
Greater Taung	36.36	104.98	0.80	0.16	339	389
Molopo	90.81	2.41	1.96	0.00	685	11
Lekwa-Teemane	139.32	112.15	3.01	0.15	1116	582
Ventersdorp	203.77	44.63	4.40	0.06	1504	230
Potchefstroom	427.90	261.67	9.23	0.33	3393	1160
City of Matlosana	419.77	5144.26	9.06	4.67	2544	28948
Maquassi Hills	217.13	635.15	4.69	0.86	1583	3305

Merafong City	149.55	7157.35	3.32	6.31	1126	41401

Table 2: Secondary sector output per local municipality in the NWP in 2011

	GVA in 2011 (Rand; million; current prices)											
Local municipality	**Food, beverages and tobacco**	**Textiles, clothing and leather goods**	**Wood, paper, publishing and printing**	**Petroleum products, chemicals, rubber and plastic**	**Other non-metal mineral products**	**Metals, metal products, machinery and equipment**	**Electrical machinery and apparatus**	**Radio, TV, instruments, watches and clocks**	**Transport equipment**	**Furniture and other manufacturing**	**Electricity**	**Water**	**Construction**
Moretele	117.63	27.49	42.56	83.38	57.56	124.24	28.17	4.32	90.98	72.46	83.57	33.00	323.91
Madibeng	285.56	63.40	85.67	394.53	130.86	367.50	192.87	27.65	611.25	139.16	49.11	17.08	657.94
Rustenburg	351.62	16.55	25.29	192.14	83.28	356.74	41.74	8.84	40.21	73.01	167.26	78.70	985.08
Kgetlengrivier	25.13	0.31	2.67	19.44	26.28	9.99	1.63	-	2.21	6.57	22.38	1.24	82.89
Moses Kotane	100.03	18.32	73.79	132.25	26.95	73.22	3.35	19.33	12.90	41.24	13.37	16.14	232.66
Ratlou	60.38	0.50	0.16	0.79	1.12	2.65	1.22	0.36	0.88	5.19	1.96	1.62	66.58
Tswaing	60.23	2.07	1.38	16.83	7.20	18.38	0.93	0.85	13.43	6.57	37.58	1.81	34.42
Mafikeng	250.54	13.30	51.20	66.96	244.94	67.87	9.29	6.63	11.16	40.20	151.52	100.67	569.62
Ditsobotla	289.91	5.73	15.31	82.50	276.30	75.34	3.54	0.87	16.72	20.46	119.15	21.80	299.16
Ramotshere Moiloa	36.94	2.54	5.70	14.41	39.68	24.37	1.91	2.22	12.50	15.83	96.21	65.09	83.26
Kagisano	36.75	1.10	0.39	2.12	2.52	4.69	-	1.84	0.00	-	-	27.96	31.48
Naledi	57.09	2.02	2.46	14.10	10.47	8.45	0.49	-	4.65	6.95	67.60	6.58	106.98
Mamusa	19.28	0.16	0.20	0.94	0.14	5.27	0.59	-	1.18	1.22	16.27	3.72	35.08
Greater Taung	33.83	2.26	1.27	9.66	25.37	18.97	2.08	0.80	1.71	16.24	18.42	32.05	114.08
Molopo	-	-	-	-	-	-	-	-	0.00	-	7.90	-	9.14
Lekwa-Teemane	100.85	0.29	0.96	17.91	5.55	4.68	1.06	0.44	2.00	1.32	25.16	4.94	52.77
Ventersdorp	68.16	0.38	1.28	18.83	6.54	17.17	-	-	1.06	4.26	23.75	40.67	37.50

Potchefstroom	208.02	4.03	19.38	296.74	37.22	134.61	7.32	4.45	18.52	32.45	158.40	60.35	335.50
City of Matlosana	372.29	13.70	52.95	222.23	71.53	224.83	27.66	9.82	78.41	74.78	468.04	59.42	809.24
Maquassi Hills	55.58	1.37	4.22	17.88	1.90	17.88	3.13	-	6.92	11.15	38.23	-	100.86
Merafong City	60.60	6.68	22.73	66.45	49.43	113.47	12.32	2.36	25.11	36.43	129.82	46.26	346.33

Table 3: Secondary sector profit per local municipality in the NWP in 2011

	% contribution to GOS in 2011 (Rand; million; current prices)											
Local municipality	**Food, beverages and tobacco**	**Textiles, clothing and leather goods**	**Wood, paper, publishing and printing**	**Petroleum products, chemicals, rubber and plastic**	**Other non-metal mineral products**	**Metals, metal products, machinery and equipment**	**Electrical machinery and apparatus**	**Radio, TV, instruments, watches and clocks**	**Transport equipment**	**Furniture and other manufacturing**	**Electricity**	**Water**	**Construction**
Moretele	4.54	15.47	11.68	3.99	4.76	6.52	8.30	5.24	9.51	10.42	4.93	5.33	6.09
Madibeng	11.17	32.73	23.60	19.25	10.72	22.96	56.84	31.27	65.65	18.18	2.90	2.76	12.38
Rustenburg	15.57	9.75	6.38	12.27	7.44	25.37	12.30	9.91	4.19	13.10	9.86	12.71	18.54
Kgetlengrivier	0.94	0.16	0.56	1.13	2.48	0.52	0.48	0.00	0.24	0.86	1.32	0.20	1.56
Moses Kotane	4.44	10.00	17.91	7.93	2.37	4.25	0.99	18.57	0.98	7.49	0.79	2.61	4.38
Ratlou	2.08	0.25	0.05	0.07	0.11	0.14	0.36	0.33	0.10	1.02	0.12	0.26	1.25
Tswaing	2.10	1.20	0.25	1.12	0.54	0.94	0.27	0.78	1.39	1.22	2.22	0.29	0.65
Mafikeng	9.29	7.45	8.95	4.20	23.02	3.66	2.74	7.25	1.22	7.21	8.94	16.26	10.72

Ditsobotla	9.99	3.44	3.88	5.49	25.89	4.16	1.04	0.81	1.45	3.75	7.03	3.52	5.63
Ramotshere Moiloa	1.29	1.54	1.75	0.85	3.65	1.17	0.56	2.62	1.37	2.95	5.67	10.51	1.57
Kagisano	1.26	0.55	0.12	0.08	0.24	0.31	0.00	2.18	0.00	0.00	0.00	4.52	0.59
Naledi	2.10	1.25	0.65	0.71	0.94	0.44	0.14	0.00	0.45	1.24	3.99	1.06	2.01
Mamusa	0.66	0.13	0.05	0.05	0.01	0.26	0.17	0.00	0.13	0.24	0.96	0.60	0.66
Greater Taung	1.20	1.29	0.39	0.75	2.35	1.40	0.61	0.74	0.19	3.05	1.09	5.18	2.15
Molopo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.17
Lekwa-Teemane	3.45	0.17	0.24	1.34	0.52	0.24	0.31	0.41	0.16	0.26	1.48	0.80	0.99
Ventersdorp	2.48	0.19	0.18	1.09	0.62	0.85	0.00	0.00	0.12	0.81	1.40	6.57	0.71
Potchefstroom	8.99	2.06	4.21	21.30	3.43	8.00	2.16	5.11	1.84	5.40	9.34	9.75	6.31
City of Matlosana	14.02	7.93	12.14	13.38	6.25	11.58	8.15	12.29	8.08	13.86	27.60	9.60	15.23
Maquassi Hills	1.94	0.78	0.74	1.27	0.18	1.01	0.92	0.00	0.76	2.09	2.25	0.00	1.90
Merafong City	2.51	3.66	6.25	3.74	4.50	6.23	3.63	2.50	2.18	6.88	7.66	7.47	6.52

Table 4: Secondary sector employment per local municipality in the NWP in 2011

	Employment in 2011 (number)												
Local municipality	**Food, beverages and tobacco**	**Textiles, clothing and leather goods**	**Wood, paper, publishing and printing**	**Petroleum products, chemicals, rubber and plastic**	**Other non-metal mineral products**	**Metals, metal products, machinery and equipment**	**Electrical machinery and apparatus**	**Radio, TV, instruments, watches and clocks**	**Transport equipment**	**Furniture and other manufacturing**	**Electricity**	**Water**	**Construction**
Molopo	-	0	-	-	-	-	-	-	0	-	10	-	121
Kagisano	188	26	4	6	15	38	-	13	0	-	-	35	280
Madibeng	1506	1608	650	1366	1129	2691	1556	164	611	1482	52	22	5830
Moretele	636	783	380	337	520	1176	217	34	91	919	108	41	2809
Rustenburg	1422	379	193	493	707	2328	317	45	40	478	217	85	7086
City of Matlosana	1944	342	404	709	461	2140	182	80	78	472	593	76	5332
Moses Kotane	469	495	499	383	247	615	27	93	13	301	11	21	2007
Potchefstroom	950	93	159	529	217	996	40	32	19	291	134	76	2586
Mafikeng	1365	340	270	167	1134	699	52	42	11	282	140	102	3826
Merafong City	308	181	175	152	355	848	70	12	25	175	164	42	2672
Ditsobotla	1460	125	118	183	1148	658	22	4	17	144	104	27	2002
Greater Taung	186	60	9	19	189	124	10	4	2	104	24	39	1153
Kgetlengrivier	151	7	24	61	245	93	9	-	2	97	28	2	544
Ramotshere Moiloa	217	58	49	43	244	233	15	16	12	80	81	83	804
Maquassi Hills	338	33	40	39	13	168	20	-	7	58	48	-	766
Naledi	326	37	21	58	91	83	4	-	5	49	55	8	699
Tswaing	371	53	13	40	44	199	8	4	13	43	48	2	469
Ratlou	316	12	2	1	9	32	7	2	1	27	3	2	426
Ventersdorp	407	9	12	44	38	193	-	-	1	26	29	52	392
Lekwa-Teemane	661	6	10	28	48	52	6	2	2	7	32	6	530
Mamusa	112	3	2	4	1	51	3	-	1	6	21	5	388

Table 5: Tertiary sector output per local municipality in the NWP in 2011

	GVA in 2011 (Rand; million; current prices)							
Local municipality	**Trade**	**Catering and accommodation**	**Transport and storage**	**Communication**	**Finance and insurance**	**Business services**	**CSPS**	**General government**
Moretele	774.50	52.01	368.07	76.34	305.56	809.37	851.10	1132.89
Madibeng	2218.44	186.82	1717.35	504.49	961.50	2382.29	1687.10	2086.25
Rustenburg	2324.78	258.39	2563.58	449.18	1501.81	2709.32	2380.93	3491.02
Kgetlengrivier	312.89	18.70	76.71	27.25	82.17	188.83	91.18	68.46
Moses Kotane	711.00	463.75	939.53	171.06	806.80	1290.64	1045.15	1183.58
Ratlou	267.46	9.75	13.44	4.21	37.90	41.86	171.69	159.82
Tswaing	317.36	14.70	238.46	48.70	80.37	131.39	400.42	376.26
Mafikeng	1623.46	184.89	524.63	440.89	975.90	1970.25	1374.08	3994.92
Ditsobotla	1322.74	82.52	433.92	103.13	668.50	796.89	857.46	857.43
Ramotshere Moiloa	817.72	49.00	109.99	36.09	192.37	257.61	405.34	680.71
Kagisano	138.69	8.56	100.72	46.21	40.23	81.95	219.23	281.91
Naledi	279.71	20.92	182.71	107.84	122.31	343.16	343.03	684.73
Mamusa	179.29	7.29	34.62	8.03	126.46	138.10	226.68	139.54
Greater Taung	232.72	17.18	61.35	11.87	108.88	258.79	736.73	933.38
Molopo	19.04	1.50	4.04	0.28	-	9.06	29.38	12.89
Lekwa-Teemane	137.87	10.02	139.99	32.22	33.81	78.41	126.30	132.24
Ventersdorp	128.03	8.20	52.87	8.68	135.58	61.16	174.47	182.29
Potchefstroom	760.09	92.28	416.78	157.06	589.56	1170.49	1506.68	2993.14
City of Matlosana	2970.85	192.98	1216.28	384.21	1112.78	1817.01	2370.56	2913.82

Maquassi Hills	531.69	35.84	104.26	26.82	152.41	188.61	358.11	280.90
Merafong City	1280.06	86.27	421.12	120.18	607.70	795.79	1299.66	1290.45

Table 6: Tertiary sector profit per local municipality in the NWP in 2011

	% contribution to GOS in 2011 (Rand; million; current prices)							
Local municipality	**Trade**	**Catering and accommodation**	**Transport and storage**	**Communication**	**Finance and insurance**	**Business services**	**CSPS**	**General government**
Moretele	4.59	38.59	3.72	2.57	3.50	5.03	5.00	114.95
Madibeng	12.89	138.64	17.66	18.79	11.27	15.43	9.55	211.68
Rustenburg	13.42	191.75	26.44	16.04	17.66	18.36	14.13	354.21
Kgetlengrivier	1.81	13.88	0.80	1.02	1.00	1.31	0.47	6.95
Moses Kotane	4.04	344.14	9.51	6.25	9.41	7.37	6.76	120.09
Ratlou	1.44	7.23	0.14	0.06	0.32	0.22	1.10	16.22
Tswaing	1.76	10.91	2.41	1.84	0.94	0.95	2.23	38.18
Mafikeng	9.45	137.21	5.29	16.58	10.35	12.61	8.98	405.34
Ditsobotla	7.49	61.24	4.53	3.74	7.54	4.54	4.64	87.00
Ramotshere Moiloa	4.70	36.36	1.13	1.24	2.28	1.72	2.57	69.07
Kagisano	0.81	6.35	1.03	1.71	0.39	0.49	1.38	28.60
Naledi	1.61	15.53	1.88	3.79	1.40	2.76	1.97	69.47
Mamusa	1.02	5.41	0.36	0.25	1.42	0.82	1.22	14.16
Greater Taung	1.31	12.75	0.65	0.34	1.34	1.45	4.80	94.70
Molopo	0.10	1.11	0.04	0.00	0.00	0.04	0.14	1.31
Lekwa-Teemane	0.79	7.43	1.42	1.30	0.38	0.49	0.69	13.42

Ventersdorp	0.73	6.09	0.55	0.33	1.58	0.29	0.92	18.50
Potchefstroom	4.40	68.48	4.29	5.06	7.02	8.28	9.83	303.69
City of Matlosana	17.22	143.21	12.71	13.75	12.98	12.10	14.42	295.65
Maquassi Hills	3.10	26.60	1.05	0.94	1.87	1.04	1.99	28.50
Merafong City	7.34	64.02	4.41	4.41	7.34	4.71	7.21	130.93

Table 7: Tertiary sector employment per local municipality in the NWP in 2011

	Employment in 2011 (number)							
Local municipality	**Trade**	**Catering and accommodation**	**Transport and storage**	**Communication**	**Finance and insurance**	**Business services**	**CSPS**	**General government**
Moretele	8210	631	763	79	459	4041	6508	6740
Madibeng	21089	2145	2807	491	1188	11362	12622	11582
Rustenburg	22957	2116	3393	485	1985	13015	16141	14496
Kgetlengrivier	2031	144	151	29	102	881	815	417
Moses Kotane	6535	3656	1622	140	664	5378	6158	6708
Ratlou	1875	75	30	3	63	182	1136	960
Tswaing	3096	117	351	52	113	711	3240	2230
Mafikeng	13442	1170	1055	474	1236	8704	8288	20618
Ditsobotla	9142	601	644	109	924	3553	7002	5035
Ramotshere Moiloa	4871	374	222	37	236	1291	2713	3838
Kagisano	1119	64	208	49	57	373	1439	1833
Naledi	3606	174	284	114	175	1282	2586	2835
Mamusa	1935	45	62	8	160	678	1785	830

Greater Taung	2557	186	98	11	162	1188	4611	5840
Molopo	239	17	10	0	-	36	272	68
Lekwa-Teemane	1756	100	197	35	43	360	1044	776
Ventersdorp	1396	86	106	9	111	273	1504	1074
Potchefstroom	7925	770	578	136	693	6181	7905	13146
City of Matlosana	25366	1274	1526	408	1628	8857	16001	14677
Maquassi Hills	3492	288	205	28	199	894	2808	1548
Merafong City	10786	648	785	129	760	3694	8608	6178

APPENDIX B: STRUCTURAL PATH ANALYSIS FOR THE IDENTIFIED POTENTIAL CLUSTERS FOR THE NWP

Table 1: Structural path analysis for the communication cluster

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Origin	**Destination**	**Global influence**	**Elementary paths**	**Direct influence**	**Path multiplier**	**Total influence**	**Total/ global (in %)**	**Accumulated proportion (%)**
Communication	Building and other construction	0.0182	Communication / trade / building and other construction	0.0018	1.7081	0.0032	17.3	17.3
			Communication / trade / real estate / building and other construction	0.0011	1.9523	0.0022	12.1	29.5
			Communication / real estate / building and other construction	0.0004	1.9577	0.0008	4.5	33.9
			Communication / trade / building and other construction	0.0004	1.7081	0.0008	4.2	38.1
			Communication / real estate / building and other construction	0.0003	1.9434	0.0006	3.1	41.2
			Communication / real estate / building and other construction	0.0003	1.9523	0.0005	3.0	44.1
			Communication / communication / trade / real estate / building and other construction	0.0003	1.9523	0.0005	2.9	47.1
			Communication / real estate / building and other construction	0.0003	1.9635	0.0005	2.9	50.0
			Communication /transport / real estate / building and other construction	0.0003	1.8791	0.0005	2.8	52.8
			Communication / electricity / building and other construction	0.0003	1.5957	0.0005	2.6	55.4
			Communication / transport / building and other construction	0.0003	1.6113	0.0004	2.4	57.8
			Communication / real estate / building and other construction	0.0002	1.8342	0.0004	2.0	59.8
			Communication / real estate / building and other construction	0.0002	1.9480	0.0003	1.9	61.6
			Communication / real estate / building and other construction	0.0001	1.8657	0.0002	1.3	62.9
			Communication / real estate / building and other construction	0.0001	1.9046	0.0002	1.2	64.2
			Communication / real estate / building and other construction	0.0001	1.8838	0.0002	1.0	65.2
			Communication / real estate /building and other construction	0.0001	1.8935	0.0002	0.9	66.1
			Communication / trade / real estate / building and other construction	0.0001	2.0571	0.0002	0.9	67.0
			Communication / trade / real estate / building and other construction	0.0001	2.0500	0.0002	0.9	67.9

			Communication / trade / real estate / building and other construction	0.0001	2.0667	0.0002	0.9	68.7
			Communication / real estate / building and other construction	0.0001	1.9176	0.0001	0.8	69.5
			Communication / real estate / building and other construction	0.0001	1.8820	0.0001	0.7	70.2
			Communication / real estate / building and other construction	0.0001	1.9040	0.0001	0.6	70.8
			Communication / real estate / building and other construction	0.0001	1.8991	0.0001	0.6	71.4
			Communication / trade / transport / real estate / building and other construction	0.0001	1.9871	0.0001	0.6	72.0
			Communication / trade / transport / building and other construction	0.0001	1.7434	0.0001	0.5	72.5

Table 2: Structural path analysis for the real estate cluster

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Origin	**Destination**	**Global influence**	**Elementary paths**	**Direct influence**	**Path multiplier**	**Total influence**	**Total/ global (in %)**	**Accumulated proportion**
Real estate	Communication	0.098716	Real estate / communication	0.0413	1.5339	0.0633	64.2	64.2
			Real estate / trade / communication	0.0073	1.6373	0.0119	12.1	76.2
			Real estate / community, social and personal services / communication	0.0014	1.5792	0.0022	2.2	78.5
			Real estate /trade / communication	0.0012	1.6373	0.0020	2.1	80.5
			Real estate / insurance / communication	0.0009	1.5857	0.0015	1.5	82.0
			Real estate / business services / communication	0.0008	1.5655	0.0013	1.3	83.3
			Real estate / communication	0.0006	1.6378	0.0010	1.0	84.3
			Real estate / building and other construction / trade / communication	0.0004	1.9523	0.0009	0.9	85.1
			Real estate / building and other construction / trade / communication	0.0004	1.9523	0.0008	0.8	86.0
			Real estate / building and other construction / communication	0.0003	1.8342	0.0006	0.6	86.6

Table 3: Structural path analysis: Grain mill, bakery and animal feeds products cluster

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Origin	**Destination**	**Global influence**	**Elementary paths**	**Direct influence**	**Path multiplier**	**Total influence**	**Total/ global (in %)**	**Accumulated proportion**
Grain mill, bakery and animal feeds products	Communication	0.0251	Grain mill etc./ Communication	0.0022	1.3692	0.0030	12.0	12.0
			Grain mill etc. / agriculture / trade / communication	0.0016	1.5613	0.0025	9.8	21.8
			Grain mill etc. / trade / communication	0.0013	1.5020	0.0019	7.5	29.3
			Grain mill etc./ agriculture / transport / communication	0.0006	1.4666	0.0008	3.3	32.6
			Grain mill etc. / agriculture / communication	0.0004	1.5695	0.0006	2.5	35.1
			Grain mill etc. / community, social and personal services / communication	0.0004	1.4170	0.0005	2.2	37.3
			Grain mill etc. / agriculture/ real estate / communication	0.0002	1.6797	0.0004	1.6	38.9
			Grain mill etc. / communication	0.0002	1.5179	0.0003	1.3	40.2
			Grain mill etc. / business services / communication	0.0002	1.4059	0.0003	1.2	41.4
			Grain mill etc. / trade / communication	0.0002	1.5020	0.0003	1.2	42.6
			Grain mill etc. / real estate / communication	0.0002	1.6148	0.0003	1.1	43.7
			Grain mill etc. / agriculture / communication	0.0002	1.4257	0.0002	0.9	44.6
			Grain mill etc. / communication	0.0001	1.5021	0.0002	0.9	45.4
			Grain mill etc. / communication	0.0001	1.5236	0.0002	0.9	46.3
			Grain mill etc. / agriculture / trade / communication	0.0001	1.5613	0.0002	0.9	47.2
			Grain mill etc. / agriculture / transport / trade / communication	0.0001	1.5924	0.0002	0.8	48.0
			Grain mill etc. / agriculture / chemicals & chemical products (incl. plastic products) / trade / communication	0.0001	1.7729	0.0002	0.8	48.8
			Grain mill etc. / agriculture / communication	0.0001	1.5757	0.0002	0.8	49.6
			Grain mill etc. / agriculture / community, social and	0.0001	1.4742	0.0002	0.8	50.4

			personal services / communication					
			Grain mill etc. / agriculture / communication	0.0001	1.5643	0.0002	0.7	51.1
			Grain mill etc. / communication	0.0001	1.5113	0.0002	0.7	51.9
			Grain mill etc. / dairy products / communication	0.0001	1.7195	0.0002	0.7	52.6
			Grain mill etc. / agriculture / communication	0.0001	1.5560	0.0002	0.7	53.2
			Grain mill etc. / agriculture / communication	0.0001	1.5144	0.0002	0.7	53.9
			Grain mill etc. / dairy products / trade / communication	0.0001	1.8844	0.0001	0.5	54.4
			Grain mill etc. / agriculture / dairy products / communication	0.0001	1.7520	0.0001	0.5	55.0
			Grain mill etc. / real estate / communication	0.0001	1.7198	0.0001	0.5	55.5
			Grain mill etc. / agriculture / trade / real estate / communication	0.0001	1.7895	0.0001	0.5	56.1
			Grain mill etc. / communication	0.0001	1.4453	0.0001	0.5	56.6

Table 4: Structural path analysis for the building and other construction cluster

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Origin	**Destination**	**Global influence**	**Elementary paths**	**Direct influence**	**Path multiplier**	**Total influence**	**Total/ global (in %)**	**Accumulated proportion**
Building and other construction	Communication	0.0437	Building and other construction / trade / communication	0.0052	1.7081	0.0088	20.1	20.1
			Building and other construction / trade / communication	0.0049	1.7081	0.0084	19.3	39.4
			Building and other construction / communication	0.0038	1.5654	0.0059	13.5	52.9
			Building and other construction / non-metallic mineral products / trade /communication	0.0005	1.8669	0.0009	2.1	55.0
			Building and other construction / non-metallic mineral products / communication	0.0004	1.7123	0.0007	1.7	56.7
			Building and other construction / trade / real estate / communication	0.0002	1.9523	0.0005	1.1	57.8
			Building and other construction / communication	0.0003	1.7256	0.0005	1.1	58.9
			Building and other construction / communication	0.0003	1.7401	0.0005	1.1	59.9
			Building and other construction / trade / real estate /	0.0002	1.9523	0.0005	1.1	61.0

			communication					
			Building and other construction / communication	0.0003	1.7148	0.0004	1.0	62.0
			Building and other construction / structural metal products / communication	0.0002	1.6222	0.0003	0.8	62.8
			Building and other construction/ electrical machinery & apparatus/ trade /communication	0.0002	1.8107	0.0003	0.8	63.6
			Building and other construction / communication	0.0002	1.7339	0.0003	0.7	64.3
			Building and other construction / communication	0.0002	1.6530	0.0003	0.7	64.9
			Building and other construction / electrical machinery & apparatus / communication	0.0002	1.6612	0.0003	0.6	65.6
			Building and other construction / non-metallic mineral products / community, social and personal services / communication	0.0001	1.7711	0.0002	0.6	66.1

Table 5: Structural path analysis for the basic metal products cluster

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Origin	**Destination**	**Global influence**	**Elementary paths**	**Direct influence**	**Path multiplier**	**Total influence**	**Total /global (in %)**	**Accumulated proportion**
Basic metal products	Communication	0.0317	Basic metal products / trade / communication	0.0039	1.7352	0.0067	21.3	21.3
			Basic metal products / communication	0.0031	1.5817	0.0049	15.5	36.7
			Basic metal products / real estate / communication	0.0008	1.8649	0.0015	4.6	41.4
			Basic metal products /transport / communication	0.0007	1.6288	0.0011	3.6	44.9
			Basic metal products / other mining / trade / communication	0.0004	1.7668	0.0006	2.0	47.0
			Basic metal products /other mining / transport / communication	0.0003	1.6578	0.0005	1.6	48.6
			Basic metal products / other mining / community, social and personal services / communication	0.0002	1.6669	0.0004	1.3	49.9

			Basic metal products / trade / real estate / communication	0.0002	1.9897	0.0004	1.2	51.0
			Basic metal products / communication	0.0002	1.7567	0.0003	1.1	52.1
			Basic metal products / communication	0.0002	1.7371	0.0003	1.1	53.2
			Basic metal products / communication	0.0002	1.7634	0.0003	1.1	54.2
			Basic metal products / business services / communication	0.0002	1.6243	0.0003	1.0	55.2
			Basic metal products / transport / trade / communication	0.0002	1.7713	0.0003	0.9	56.1
			Basic metal products / communication	0.0002	1.7484	0.0003	0.9	57.0
			Basic metal products / transport / real estate / communication	0.0001	1.9104	0.0003	0.9	57.9
			Basic metal products / real estate / trade / communication	0.0001	1.9897	0.0003	0.9	58.7
			Basic metal products / other mining / communication	0.0002	1.6109	0.0003	0.8	59.6
			Basic metal products / chemicals & chemical products (incl. plastic products) / trade / communication	0.0001	1.9729	0.0002	0.7	60.3
			Basic metal products / communication	0.0001	1.6727	0.0002	0.6	60.9
			Basic metal products / trade / communication	0.0001	1.7352	0.0002	0.6	61.5
			Basic metal products / other mining / communication	0.0001	1.7881	0.0002	0.5	62.0

Table 6: Structural path analysis for the other food products cluster

(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Origin	**Destination**	**Global influence**	**Elementary paths**	**Direct influence**	**Path multiplier**	**Total influence**	**Total/ global (in %)**	**Accumulated proportion**
Other food products	Communication	0.0199	Other food products / agriculture / trade / communication	0.0006	1.5927	0.0009	4.8	4.8
			Other food products / trade / communication	0.0005	1.4758	0.0008	4.0	8.8

			Other food products / communication	0.0005	1.4929	0.0007	3.7	12.4
			Other food products / dairy products / communication	0.0004	1.6853	0.0007	3.5	16.0
			Other food products / dairy products / trade / communication	0.0003	1.8479	0.0005	2.8	18.7
			Other food products / communication	0.0003	1.4766	0.0005	2.4	21.2
			Other food products / communication	0.0003	1.4985	0.0005	2.4	23.6
			Other food products / dairy products / community, social and personal services / communication	0.0002	1.7421	0.0004	2.1	25.7
			Other food products / communication	0.0003	1.4860	0.0004	2.0	27.7
			Other food products / agriculture / transport / communication	0.0002	1.4959	0.0003	1.6	29.3
			Other food products / real estate / communication	0.0002	1.6916	0.0003	1.5	30.9
			Other food products / communication	0.0002	1.4213	0.0003	1.5	32.3
			Other food products / communication	0.0002	1.3447	0.0003	1.4	33.7
			Other food products / agriculture / communication	0.0002	1.6011	0.0002	1.2	35.0
			Other food products / dairy products / agriculture / trade / communication	0.0001	1.9511	0.0002	1.2	36.1
			Other food products / real estate / communication	0.0001	1.6797	0.0002	1.0	37.1
			Other food products / real estate / communication	0.0001	1.6965	0.0002	1.0	38.1
			Other food products / communication	0.0001	1.4398	0.0002	1.0	39.1
			Other food products / real estate / communication	0.0001	1.6872	0.0002	0.8	39.9
			Other food products / agriculture / real estate / communication	0.0001	1.7134	0.0002	0.8	40.7
			Other food products / communication	0.0001	1.4138	0.0001	0.6	41.3

Table 7: Structural path analysis for the agriculture cluster

(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**

Origin	Destination	Global influence	Elementary paths	Direct influence	Path multiplier	Total influence	Total/ global (in %)	Accumulated proportion
Agriculture	Communication	0.0268	Agriculture / trade / communication	0.0033	1.5509	0.0051	18.9	18.9
			Agriculture / transport / communication	0.0012	1.4565	0.0017	6.4	25.3
			Agriculture / communication	0.0008	1.5601	0.0013	4.8	30.0
			Agriculture / real estate / communication	0.0005	1.6684	0.0008	3.1	33.2
			Agriculture / real estate / communication	0.0003	1.7672	0.0005	2.0	35.2
			Agriculture / communication	0.0003	1.4159	0.0005	1.7	36.9
			Agriculture / trade / communication	0.0003	1.5509	0.0004	1.7	38.6
			Agriculture / transport/ trade / communication	0.0003	1.5818	0.0004	1.6	40.2
			Agriculture / transport / real estate / communication	0.0002	1.7075	0.0004	1.6	41.8
			Agriculture / chemicals & chemical products (incl. plastic products) / trade / communication	0.0002	1.7612	0.0004	1.6	43.3
			Agriculture / communication	0.0003	1.5664	0.0004	1.5	44.8
			Agriculture / community, social and personal services / communication	0.0003	1.4643	0.0004	1.5	46.4
			Agriculture / communication	0.0002	1.5548	0.0004	1.4	47.8
			Agriculture / communication	0.0002	1.5463	0.0003	1.3	49.1
			Agriculture / communication	0.0002	1.5053	0.0003	1.3	50.3
			Agriculture / dairy products / communication	0.0002	1.7403	0.0003	1.0	51.4
			Agriculture / trade / real estate / communication	0.0002	1.7777	0.0003	1.0	52.4
			Agriculture /communication	0.0002	1.4882	0.0003	0.9	53.3
			Agriculture / grain mill, bakery and animal feed products / communication	0.0002	1.4257	0.0002	0.9	54.3
			Agriculture / chemicals & chemical products (incl. plastic products) / communication	0.0001	1.6133	0.0002	0.9	55.1

			Agriculture / dairy products / trade / communication	0.0001	1.9051	0.0002	0.8	56.0
			Agriculture / real estate / communication	0.0001	1.7729	0.0002	0.6	56.6
			Agriculture / dairy products / community, social and personal services / communication	0.0001	1.7977	0.0002	0.6	57.2
			Agriculture / real estate / communication	0.0001	1.7646	0.0002	0.6	57.8
			Agriculture / real estate / trade / communication	0.0001	1.7777	0.0002	0.6	58.4
			Agriculture / grain mill, bakery and animal feed products / trade / communication	0.0001	1.5613	0.0002	0.6	59.0
			Agriculture/ community, social and personal services / communication	0.0001	1.5781	0.0002	0.6	59.5
			Agriculture / machinery & equipment/ trade / communication	0.0001	1.6412	0.0001	0.6	60.1
			Agriculture /transport / trade / communication	0.0001	1.5818	0.0001	0.6	60.6
			Agriculture / real estate / communication	0.0001	1.7583	0.0001	0.5	61.2

Table 8: Structural path analysis for the non-metallic mineral products cluster

(1) Origin	(2) Destination	(3) Global influence	(4) Elementary paths	(5) Direct influence	(6) Path multiplier	(7) Total influence	(8) Total/ global (in %)	(9) Accumulated proportion
Non-metallic mineral products	Communication	0.038061	Non-metallic mineral products / trade / communication	0.0048	1.5615	0.0075	19.7	19.7
			Non-metallic mineral products / communication	0.0042	1.4241	0.0059	15.6	35.3
			Non-metallic mineral products / community, social and personal services / communication	0.0014	1.4736	0.0020	5.3	40.6
			Non-metallic mineral products / transport / communication	0.0010	1.4660	0.0014	3.7	44.3
			Non-metallic mineral products / communication	0.0007	1.5799	0.0011	2.8	47.2
			Non-metallic mineral products / communication	0.0005	1.5624	0.0007	1.9	49.0
			Non-metallic mineral products / communication	0.0005	1.5858	0.0007	1.9	50.9

			Non-metallic mineral products / business services / communication	0.0005	1.4623	0.0007	1.8	52.7
			Non-metallic mineral products / communication	0.0004	1.5725	0.0006	1.6	54.3
			Non-metallic mineral products / real estate / communication	0.0002	1.7880	0.0004	1.2	55.5
			Non-metallic mineral products / real estate / communication	0.0003	1.6758	0.0004	1.2	56.6
			Non-metallic mineral products / communication	0.0003	1.5051	0.0004	1.2	57.8
			Non-metallic mineral products / community, social and personal services / trade / communication	0.0003	1.6068	0.0004	1.1	58.9
			Non-metallic mineral products / trade / real estate / communication	0.0002	1.7879	0.0004	1.1	60.0
			Non-metallic mineral products /transport / trade / communication	0.0002	1.5935	0.0004	1.0	61.0
			Non-metallic mineral products / transport / real estate / communication	0.0002	1.7167	0.0003	0.9	61.9
			Non-metallic mineral products / real estate / communication	0.0002	1.7752	0.0003	0.8	62.6
			Non-metallic mineral products / real estate / communication	0.0002	1.7934	0.0003	0.8	63.4
			Non-metallic mineral products / communication	0.0002	1.5246	0.0003	0.7	64.2
			Non-metallic mineral products /real estate / communication	0.0001	1.7832	0.0002	0.7	64.8
			Non-metallic mineral products / trade / communication	0.0002	1.5615	0.0002	0.6	65.5
			Non-metallic mineral products / other mining / trade / communication	0.0001	1.5925	0.0002	0.6	66.1

Table 9: Structural path analysis for the trade cluster

(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**

Origin	Destination	Global influence	Elementary paths	Direct influence	Path multiplier	Total influence	Total/global (in %)	Accumulated proportion
Trade	Basic metal products	0.0092	Trade / communication / basic metal products	0.0007	1.7352	0.0013	14.2	14.2
			Trade / basic metal products	0.0007	1.3731	0.0009	10.3	24.5
			Trade / machinery & equipment / basic metal products	0.0003	1.4517	0.0004	4.2	28.7
			Trade / chemicals & chemical products (incl. plastic products) / basic metal products	0.0002	1.5617	0.0003	3.3	32.0
			Trade / building and other construction / basic metal products	0.0002	1.6427	0.0003	3.3	35.3
			Trade / furniture / basic metal products	0.0002	1.4720	0.0002	2.5	37.8
			Trade / real estate / building and other construction / basic metal products	0.0001	1.8824	0.0002	2.3	40.1
			Trade / communication / machinery & equipment / basic metal products	0.0001	1.8345	0.0001	1.4	41.5
			Trade / electrical machinery & apparatus / basic metal products	0.0001	1.4547	0.0001	1.4	42.9
			Trade / manufacturing of transport equipment / basic metal products	0.0001	1.5857	0.0001	1.4	44.3
			Trade / manufacturing of transport equipment / basic metal products	0.0001	1.4490	0.0001	1.3	45.5
			Trade / real estate / electrical machinery & apparatus / basic metal products	0.0001	1.6720	0.0001	1.0	46.5
			Trade / electrical machinery & apparatus / basic metal products	0.0001	1.5913	0.0001	1.0	47.5
			Trade / manufacturing of transport equipment / basic metal products	0.0001	1.5787	0.0001	1.0	48.5
			Trade / real estate / basic metal products	0.0001	1.5789	0.0001	1.0	49.5
			Trade / manufacturing of transport equipment / basic metal products	0.0001	1.5707	0.0001	1.0	50.5
			Trade / manufacturing of transport equipment / basic metal products	0.0001	1.5902	0.0001	0.9	51.4
			Trade / building and other construction / structural metal	0.0001	1.7021	0.0001	0.9	52.4

			products / basic metal products					
			Trade / electrical machinery & apparatus / basic metal products	0.0001	1.5243	0.0001	0.8	53.2
			Trade / building and other construction / electrical machinery & apparatus /basic metal products	0.0000	1.7401	0.0001	0.8	54.0
			Trade / electrical machinery & apparatus / basic metal products	0.0000	1.5146	0.0001	0.8	54.9
			Trade/ other fabricated metal products / basic metal products	0.0001	1.3823	0.0001	0.8	55.6
			Trade / real estate / communication/ basic metal products	0.0000	1.9897	0.0001	0.8	56.4
			Trade / electrical machinery & apparatus / basic metal products	0.0000	1.5843	0.0001	0.7	57.2
			Trade / electrical machinery & apparatus / basic metal products	0.0000	1.5765	0.0001	0.7	57.9
			Trade / electrical machinery & apparatus / basic metal products	0.0000	1.5955	0.0001	0.7	58.6
			Trade / structural metal products / basic metal products	0.0000	1.4230	0.0001	0.7	59.2
			Trade / rubber products / basic metal products	0.0000	1.3894	0.0001	0.7	59.9
			Trade / transport / basic metal products	0.0000	1.4043	0.0001	0.6	60.5
			Trade / communication / electrical machinery & apparatus / basic metal products	0.0000	1.8382	0.0001	0.6	61.1
			Trade / real estate / other fabricated metal products / basic metal products	0.0000	1.5894	0.0001	0.6	61.7
			Trade / electrical machinery & apparatus / basic metal products	0.0000	1.5019	0.0001	0.6	62.3
			Trade / transport / chemicals & chemical products (incl. plastic products) / basic metal products	0.0000	1.5911	0.0001	0.6	62.9
			Trade / electrical machinery & apparatus / basic metal products	0.0000	1.5309	0.0000	0.5	63.5
			Trade / electrical machinery & apparatus / basic metal products	0.0000	1.5427	0.0000	0.5	64.0

Table 10: Structural path analysis for the dairy products cluster

(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**

Origin	Destination	Global influence	Elementary paths	Direct influence	Path multiplier	Total influence	Total/ global (in %)	Accumulated proportion.
Dairy products	Communication	0.0394	Dairy products / communication	0.0045	1.6362	0.0074	18.7	18.7
			Dairy products / community, social and personal services / communication	0.0026	1.6916	0.0044	11.1	29.8
			Dairy products / agriculture / trade / communication	0.0013	1.9051	0.0025	6.3	36.1
			Dairy products / trade / communication	0.0006	1.7950	0.0010	2.7	38.8
			Dairy products / community, social and personal services / trade / communication	0.0005	1.8455	0.0009	2.4	41.2
			Dairy products / business services / communication	0.0005	1.6798	0.0009	2.3	43.5
			Dairy products / agriculture / transport / communication	0.0005	1.7895	0.0008	2.1	45.6
			Dairy products / agriculture / communication	0.0003	1.9148	0.0006	1.6	47.2
			Dairy products / trade / communication	0.0003	1.7949	0.0006	1.6	48.8
			Dairy products / real estate / communication	0.0003	1.9297	0.0005	1.3	50.1
			Dairy products / communication	0.0003	1.8147	0.0005	1.3	51.4
			Dairy products / agriculture / real estate / communication	0.0002	2.0496	0.0004	1.0	52.4
			Dairy products / communication	0.0002	1.7952	0.0003	0.9	53.3
			Dairy products / communication	0.0002	1.8215	0.0003	0.9	54.1
			Dairy products / communication	0.0002	1.8065	0.0003	0.7	54.8
			Dairy products / agriculture / communication	0.0001	1.7398	0.0002	0.6	55.4
			Dairy products / agriculture / trade / communication	0.0001	1.9051	0.0002	0.6	56.0
			Dairy products / agriculture / transport / trade / communication	0.0001	1.9430	0.0002	0.5	56.5
			Dairy products / real estate /communication	0.0001	2.0559	0.0002	0.5	57.1
			Dairy products / agriculture /transport /real estate / communication	0.0001	2.0975	0.0002	0.5	57.6

			Dairy products / communication	0.0001	1.7281	0.0002	0.5	58.1
			Dairy products / agriculture / chemicals & chemical products (incl. plastic products) / trade / communication	0.0001	2.1629	0.0002	0.5	58.6
			Dairy products / agriculture / communication	0.0001	1.9223	0.0002	0.5	59.1
			Dairy products / agriculture / community, social and personal services / communication	0.0001	1.7972	0.0002	0.5	59.6

APPENDIX C: FULL LIST OF CORRESPONDING PRODUCT AND SERVICE CODES

Table 1: HS 2 chapters and corresponding descriptions

HS 2 and corresponding description
01 – Live animals
02 – Meat and edible meat offal
03 – Fish and crustaceans, molluscs and other aquatic invertebrates
04 – Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
05 – Products of animal origin, not elsewhere specified or included
06 – Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage
07 – Edible vegetables and certain roots and tubers
08 – Edible fruit and nuts; peel of citrus fruits or melons
09 – Coffee, tea, maté and spices
10 – Cereals
11 – Products of the milling industry; malt; starches; inulin; wheat gluten
12 – Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal plants; straw and fodder
13 – Lac; gums, resins and other vegetable saps and extracts
14 – Vegetable plaiting materials; vegetable products not elsewhere specified or included
15 – Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes
16 – Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates
17 – Sugars and sugar confectionery
18 – Cocoa and cocoa preparations
19 – Preparations of cereals, flour, starch or milk; pastry cooks' products
20 – Preparations of vegetables, fruit, nuts or other parts of plants
21 – Miscellaneous edible preparations
22 – Beverages, spirits and vinegar
23 – Residues and waste from the food industries; prepared animal fodder
24 – Tobacco and manufactured tobacco substitutes
25 – Salt; sulphur; earths and stone; plastering materials, lime and cement
26 – Ores, slag and ash
27 – Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes
28 – Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes
29 – Organic chemicals
30 – Pharmaceutical products
31 – Fertilisers
32 – Tanning or dyeing extracts; tannins and their derivatives; dyes, pigments and other colouring matter; paints and varnishes; putty and other mastics; inks
33 – Essential oils and resinoids; perfumery, cosmetic or toilet preparations
34 – Soap, organic surface-active agents, washing preparations, lubricating preparations, artificial waxes, prepared waxes, polishing or scouring preparations, candles and similar articles, modelling pastes, 'dental waxes' and dental preparations with a basis of plaster
35 – Albuminoidal substances; modified starches; glues; enzymes
36 – Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations
37 – Photographic or cinematographic goods
38 – Miscellaneous chemical products
39 – Plastics and articles thereof
40 – Rubber and articles thereof
41 – Raw hides and skins (other than fur skins) and leather
42 - Articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silkworm gut)
43 – Fur skins and artificial fur; manufactures thereof
44 – Wood and articles of wood; wood charcoal
45 – Cork and articles of cork
46 – Manufactures of straw, of esparto or of other plaiting materials; basket ware and wickerwork
47 – Pulp of wood or of other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard
48 – Paper and paperboard; articles of paper pulp, of paper or of paperboard
49 – Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans

50 – Silk
51 – Wool, fine or coarse animal hair; horsehair yarn and woven fabric
52 – Cotton
53 – Other vegetable textile fibres; paper yarn and woven fabrics of paper yarn
54 – Man-made filaments
55 – Man-made staple fibres
56 – Wadding, felt and nonwovens; special yarns; twine, cordage, ropes and cables and articles thereof
57 – Carpets and other textile floor coverings
58 – Special woven fabrics; tufted textile fabrics; lace; tapestries; trimmings; embroidery
59 – Impregnated, coated, covered or laminated textile fabrics; textile articles of a kind suitable for industrial use
60 – Knitted or crocheted fabrics
61 – Articles of apparel and clothing accessories, knitted or crocheted
62 – Articles of apparel and clothing accessories, not knitted or crocheted
63 – Other made-up textile articles; sets; worn clothing and worn textile articles; rags
64 – Footwear, gaiters and the like; parts of such articles
65 – Headgear and parts thereof
66 – Umbrellas, sun umbrellas, walking-sticks, seat-sticks, whips, riding-crops and parts thereof
67 – Prepared feathers and down and articles made of feathers or of down; artificial flowers; articles of human hair
68 – Articles of stone, plaster, cement, asbestos, mica or similar materials
69 – Ceramic products
70 – Glass and glassware
71 – Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin
72 – Iron and steel
73 – Articles of iron or steel
74 – Copper and articles thereof
75 – Nickel and articles thereof

76 – Aluminium and articles thereof
78 – Lead and articles thereof
79 – Zinc and articles thereof
80 – Tin and articles thereof
81 – Other base metals; cermets; articles thereof
82 – Tools, implements, cutlery, spoons and forks, of base metal; parts thereof of base metal
83 – Miscellaneous articles of base metal
84 – Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof
85 – Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles
86 – Railway or tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; mechanical (including electro-mechanical) traffic signalling equipment of all kinds
87 – Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof
88 – Aircraft, spacecraft, and parts thereof
89 – Ships, boats and floating structures
90 – Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof
91 – Clocks and watches and parts thereof
92 – Musical instruments; parts and accessories of such articles
93 – Arms and ammunition; parts and accessories thereof
94 – Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, not elsewhere specified or included; illuminated signs, illuminated name-plates and the like; prefabricated buildings
95 – Toys, games and sports requisites; parts and accessories thereof
96 – Miscellaneous manufactured articles
97 – Works of art, collectors' pieces and antiques
98 – Commodities specified at chapter level only
99 – Commodities not elsewhere specified

Table 2: Extended Balance of Payments Services classification (EBOPS 2002)

EBOPS standard items

Code	Description
200	**Total EBOPS Services**
205	**1 Transportation**
206	1.1 Sea transport
207	1.1.1 Passenger
208	1.1.2 Freight
209	1.1.3 Other
210	1.2 Air transport
211	1.2.1 Passenger
212	1.2.2 Freight
213	1.2.3 Other
214	1.3 Other transport
215	1.3.1 Passenger
216	1.3.2 Freight
217	1.3.3 Other
218	1.4 Other transport of which: Space transport
219	1.5 Other transport of which: Rail transport
220	1.5.1 Passenger
221	1.5.2 Freight
222	1.5.3 Other
223	1.6 Other transport of which: Road transport
224	1.6.1 Passenger
225	1.6.2 Freight
226	1.6.3 Other
227	1.7 Other transport of which: Inland waterway transport
228	1.7.1 Passenger
229	1.7.2 Freight
230	1.7.3 Other
231	1.8 Other transport of which: Pipeline transport and electricity transmission
232	1.9 Other transport of which: Other supporting and auxiliary transport services
236	**2 Travel**
237	2.1 Business travel
238	2.1.1 Expenditure by seasonal and border workers
239	2.1.2 Other
240	2.2 Personal travel
241	2.2.1 Health-related expenditure
242	2.2.2 Education-related expenditure
243	2.2.3 Other
245	**3 Communications services**
246	3.1 Postal and courier services
247	3.2 Telecommunications services
249	**4 Construction services**
250	4.1 Construction abroad
251	4.2 Construction in the compiling economy
253	**5 Insurance services**
254	5.1 Life insurance and pension funding
255	5.2 Freight insurance
256	5.3 Other direct insurance
257	5.4 Reinsurance
258	5.5 Auxiliary services
260	**6 Financial services**
262	**7 Computer and information services**
263	7.1 Computer services
264	7.2 Information services
889	7.2.1 News agency services
890	7.2.2 Other information provision services
266	**8 Royalties and license fees**
891	8.1 Franchises and similar rights

892	8.2 Other royalties and license fees
268	**9 Other business services**
269	9.1 Merchanting and other trade-related services
270	9.1.1 Merchanting
271	9.1.2 Other trade-related services
272	9.2 Operational leasing services
273	9.3 Miscellaneous business, professional, and technical services
274	9.3.1 Legal, accounting, management consulting, and public relations
275	9.3.1.1 Legal services
276	9.3.1.2 Accounting, auditing, bookkeeping, and tax consulting services
277	9.3.1.3 Business and management consulting and public relations services
278	9.3.2 Advertising, market research, and public opinion polling
279	9.3.3 Research and development
280	9.3.4 Architectural, engineering, and other technical services
281	9.3.5 Agricultural, mining, and on-site processing services
282	9.3.5.1 Waste treatment and depollution
283	9.3.5.2 Agricultural, mining, and other on-site processing services
284	9.3.6 Other business services
285	9.3.7 Services between related enterprises, n.i.e.
287	**10 Personal, cultural, and recreational services**
288	10.1 Audio-visual and related services
289	10.2 Other personal, cultural, and recreational services
895	10.2.1 Education services
896	10.2.2 Health services
897	10.2.3 Other
291	**11 Government services, n.i.e.**
292	11.1 Embassies and consulates
293	11.2 Military units and agencies
294	11.3 Other government services
983	Services not allocated

EBOPS memorandum items

Code	Description
950	1 Freight transportation on merchandise, valued on a transaction basis
951	1.1 Sea freight
952	1.2 Air freight
858	1.3 Other freight
862	1.4 Space freight
863	1.5 Rail freight
953	1.6 Road freight
865	1.7 Inland waterway freight
868	1.8 Pipeline freight
956	2.1 Travel – Expenditure on goods
957	2.2 Travel – Expenditure on accommodation and food and beverage serving services
871	2.3 Travel – All other travel expenditure
960	3 Gross insurance premiums
972	3.1 Gross premiums – life insurance
974	3.2 Gross premiums – freight insurance
976	3.3 Gross premiums – other direct insurance
961	4 Gross insurance claims
973	4.1 Gross claims – life insurance
975	4.2 Gross claims – freight insurance
977	4.3 Gross claims – other direct insurance
887	5 Financial intermediation services indirectly measured (FISIM)
888	6 Financial services including FISIM
962	7 Merchanting gross flows
894	8a Audio-visual transactions

EBOPS supplementary items

Code	Description
310	Compensation of employees
391	Workers' remittances
431	Migrants' transfers
500	Direct investment

Table 3: CPC classifications

	SECTORS AND SUB-SECTORS	CORRESPONDING CENTRAL PRODUCT CLASSIFICATION
1.	**BUSINESS SERVICES**	
A.	**Professional services**	
a.	Legal services	861
b.	Accounting, auditing and bookkeeping services	862
c.	Taxation services	863
d.	Architectural services	8671
e.	Engineering services	8672
f.	Integrated engineering services	8673
g.	Urban planning and landscape architectural services	8674
h.	Medical and dental services	9312
i.	Veterinary services	932
j.	Services provided by midwives, nurses, physiotherapists and para-medical personnel	93191
k.	Other	
B.	**Computer and related services**	
a.	Consultancy services related to the installation of computer hardware	841
b.	Software implementation services	842
c.	Data processing services	843
d.	Database services	844
e.	Other	845+849
C.	**Research and development services**	
a.	R&D services on natural sciences	851
b.	R&D services on social sciences and humanities	852
c.	Interdisciplinary R&D services	853
D.	**Real estate services**	
a.	Involving own or leased property	821
b.	On a fee or contract basis	822
E.	**Rental/leasing services without operators**	
a.	Relating to ships	83103
b.	Relating to aircraft	83104
c.	Relating to other transport equipment	83101+83102+83105
d.	Relating to other machinery and equipment	83106–83109
e.	Other	832
F.	**Other business services**	
a.	Advertising services	871
b.	Market research and public-opinion polling services	864
c.	Management consulting service	865
d.	Services related to management consulting	866
e.	Technical testing and analysis services	8676
f.	Services incidental to agriculture, hunting and forestry	881
g.	Services incidental to fishing	882

h.	Services incidental to mining	883+5115
i.	Services incidental to manufacturing	884+885
j.	Services incidental to energy distribution	887
k.	Placement and supply services of personnel	872
l.	Investigation and security	873
m.	Related scientific and technical consulting services	8675
n.	Maintenance and repair of equipment (not incl. maritime vessels,	8861–8866
	aircraft or other transport equipment	633+
o.	Building-cleaning services	874
p.	Photographic services	875
q.	Packaging services	876
r.	Printing, publishing	88442
s.	Convention services	87909*
t.	Other	8790
2.	**COMMUNICATION SERVICES**	
A.	**Postal services**	**7511**
B.	**Courier services**	**7512**
C.	**Telecommunication services**	
a.	Voice telephone services	7521
b.	Packet-switched data transmission services	7523**
c.	Circuit-switched data transmission services	7523**
d.	Telex services	7523**
e.	Telegraph services	7522
f.	Facsimile services	7521**+7529**
g.	Private leased circuit services	7522**+7523**
h.	Electronic mail	7523**
i.	Voicemail	7523**
j.	On-line information and database retrieval	7523**
k.	Electronic data interchange	7523**
l.	Enhanced/value-added facsimile services, incl. store and forward, store and retrieve	7523**
m.	Code and protocol conversion	n.a.
n.	On-line information and/or data processing incl. transaction proc.	843**
o.	Other	

* Indicates that the service specified is a component of a more aggregated CPC item specified elsewhere in this classification list.

** Indicates that the service specified constitutes only a part of the total range of activities covered by the CPC concordance (e.g. voice mail is only a component of CPC item 7523).

D.	**Audiovisual services**	
a.	Motion picture and video tape production and distribution services	9611
b.	Motion picture projection service	9612
c.	Radio and television services	9613
d.	Radio and television transmission services	7524
e.	Sound recording	n.a.
f.	Other	
E.	**Other communication services**	
3.	**CONSTRUCTION AND RELATED ENGINEERING SERVICES**	
A.	**General construction work for buildings**	**512**
B.	**General construction work for civil engineering**	**513**
C.	**Installation and assembly work**	**514+516**
D.	**Building completion and finishing work**	**517**
E.	**Other construction and related engineering services**	**511+515+518**
4.	**DISTRIBUTION SERVICES**	
A.	**Commission agents' services**	**621**
B.	**Wholesale trade services**	**622**
C.	**Retailing services**	**631+632**
D.	**Franchising**	**6111+6113+6121**
E.	**Other distribution services**	**8929**
5.	**EDUCATIONAL SERVICES**	
A.	**Primary education services**	**921**
B.	**Secondary education services**	**922**
C.	**Higher education services**	**923**
D.	**Adult education**	**924**
E.	**Other educational services**	**929**
6.	**ENVIRONMENTAL SERVICES**	
A.	**Sewage services**	**9401**
B.	**Refuse disposal services**	**9402**
C.	**Sanitation and similar services**	**9403**
D.	**Other environmental services**	
7.	**FINANCIAL SERVICES**	
A.	**All insurance and insurance-related services**	**812****
a.	Life, accident and health insurance services	8121
b.	Non-life insurance services	8129
c.	Reinsurance and retrocession	81299*
d.	Services auxiliary to insurance (including broking and agency services)	8140
B.	**Banking and other financial services (excl. insurance)**	
a.	Acceptance of deposits and other repayable funds from the public	81115–81119
b.	Lending of all types, incl. consumer credit, mortgage credit, factoring	8113

	and financing of commercial transaction	
c.	Financial leasing	8112
d.	All payment and money transmission services	81339**
e.	Guarantees and commitments	81199**
f.	Trading for own account or for account of customers, whether on an exchange, in an over-the-counter market or otherwise, the following:	
	- money market instruments (cheques, bills, certificate of deposits)	81339**
	- foreign exchange	81333
	- derivative products incl., but not limited to, futures and options	81339**
	- exchange rate and interest rate instruments, incl. products such as swaps, forward rate agreements, etc.	81339**
	- transferable securities	81321*
	- other negotiable instruments and financial assets, incl. bullion	81339**
g.	Participation in issues of all kinds of securities, incl. underwriting and placement as agent (whether publicly or privately) and provision of service related to such issues	8132
h.	Money broking	81339**
i.	Asset management, such as cash or portfolio management, all	8119+**
	forms of collective investment management, pension fund management, custodial depository and trust services	81323*
j.	Settlement and clearing services for financial assets incl.	81339** or
	securities, derivative products, and other negotiable instruments	81319**
k.	Advisory and other auxiliary financial services on all the activities	8131 or
	listed in Article 1B of MTN.TNC/W/50, incl. credit reference and analysis, investment and portfolio research and advice, advice on acquisitions and on corporate restructuring and strategy	8133
l.	Provision and transfer of financial information, and financial data processing and related software by providers of other financial services	8131
C.	**Other financial services**	
8.	**HEALTH-RELATED AND SOCIAL SERVICES (other than those listed under 1.A.h–j)**	
A.	**Hospital services**	**9311**
B.	**Other human health services**	**9319**
C.	**Social services**	**933**
D.	**Other health-related and social services**	
9.	**TOURISM AND TRAVEL-RELATED SERVICES**	
A.	**Hotels and restaurants, incl. catering**	**641–643**
B.	**Travel agencies and tour operators services**	**7471**
C.	**Tourist guides services**	**7472**
D.	**Other tourism and travel-related services**	
10.	**RECREATIONAL, CULTURAL AND SPORTING SERVICES (other than audiovisual services)**	
A.	**Entertainment services (including theatre, live bands and circus services)**	**9619**
B.	**News agency services**	**962**

C.	**Libraries, archives, museums and other cultural services**	**963**
D.	**Sporting and other recreational services**	**964**
E.	**Other recreational, cultural and sporting services**	
11.	**TRANSPORT SERVICES**	
A.	**Maritime transport services**	
a.	Passenger transportation	7211
b.	Freight transportation	7212
c.	Rental of vessels with crew	7213
d.	Maintenance and repair of vessels	8868**
e.	Pushing and towing services	7214
f.	Supporting services for maritime transport	745**
B.	**Internal waterways transport**	
a.	Passenger transportation	7221
b.	Freight transportation	7222
c.	Rental of vessels with crew	7223
d.	Maintenance and repair of vessels	8868**
e.	Pushing and towing services	7224
f.	Supporting services for internal waterway transport	745**
C.	**Air transport services**	
a.	Passenger transportation	731
b.	Freight transportation	732
c.	Rental of aircraft with crew	734
d.	Maintenance and repair of aircraft	8868**
e.	Supporting services for air transport	746
D.	**Space transport**	**733**
E.	**Rail transport services**	
a.	Passenger transportation	7111
b.	Freight transportation	7112
c.	Pushing and towing services	7113
d.	Maintenance and repair of rail transport equipment	8868**
e.	Supporting services for rail transport services	743
F.	**Road transport services**	
a.	Passenger transportation	7121+7122
b.	Freight transportation	7123
c.	Rental of commercial vehicles with operator	7124
d.	Maintenance and repair of road transport equipment	6112+8867
e.	Supporting services for road transport services	744
G.	**Pipeline transport**	
a.	Transportation of fuels	7131
b.	Transportation of other goods	7139
H.	**Services auxiliary to all modes of transport**	
a.	Cargo-handling services	741
b.	Storage and warehouse services	742
c.	Freight transport agency services	748

d.	Other	749
I.	**Other transport services**	
12.	**OTHER SERVICES N.I.E.**	**95+97+98+99**

Source: WTO, 1991

APPENDIX D: REOS ACCORDING TO THE DSM FOR PRODUCTS AND DSM FOR SERVICES

Table 1: Full list of product clusters with REOs

Cluster	**Corresponding HS 2**	**HS 2**	**HS 6-digit product category**	**Product ranking according to potential export values**	**Product ranking according to number of export opportunities**	**Potential export value (US$ thousands)**	**Number of countrie s for which the product is selected**
Grain mill, bakery and animal feed products	11, 23	11	110313 – Maize (corn) grouts or meal	784	812	$12,691	9
Basic metal products	72-81	74	740311 – Copper cathodes and sections of cathodes unwrought	4	519	$9,904,077	19
		72	720241 – Ferrochromium, >4% carbon	24	513	$2,227,206	19
		73	731210 – Stranded steel wire/cable/etc., no electric insulation	107	47	$413,000	39
		73	730840 – Props etc. for scaffold, shuttering, pits, iron/steel	113	79	$398,120	36
		73	730799 – Fittings, pipe or tube, iron or steel, nes	128	306	$358,940	26
		75	750400 – Nickel powders and flakes	143	698	$335,857	14
		72	720292 – Ferrovanadium	148	449	$314,135	21
		72	720249 – Ferrochromium, <4% carbon	156	372	$294,997	24
		72	720219 – Ferromanganese, <2% carbon	157	371	$290,666	24
		75	750220 – Nickel unwrought, alloyed	175	783	$265,413	11
		74	741999 – Articles of copper, nes	185	109	$250,356	34
		73	730830 – Doors, windows, frames of iron or steel	209	108	$226,781	34
		73	730490 – Iron or steel tubes, pipes or hollow profiles, nes	326	450	$115,636	21
		72	720299 – Ferroalloys, nes	334	414	$113,201	22
		73	731029 – Cans, iron or steel, capacity <50 litres nes	336	143	$112,257	32
		72	722860 – Bar/rod, alloy steel nes	365	141	$99,237	32

		72	721790 – Wire, iron n-a steel, nes	417	91	$79,426	35
		73	731010 – Tank, cask or container, iron/steel, capacity 50-300l	465	275	$63,887	27
		73	731512 – Chain, articulated link, iron or steel, except roller	466	338	$63,674	25
		72	721590 – Bar/rod, iron or non-alloy steel, nes	498	184	$59,910	30
		73	731582 – Chain, welded link, iron or steel	536	571	$49,604	18
		72	722880 – Hollow drill bars and rods of alloy/non-alloy steel	712	614	$21,514	17
		72	721669 – Angles, shapes and section	725	304	$19,908	26
Other food products	08-10, 17-19		N/A	N/A	N/A	N/A	N/A
Agriculture	01, 06, 08	06	060210 – Cuttings and slips, not rooted	505	251	$57,629	27
		06	060390 – Cut flowers and flower buds for bouquets, dried, etc.	804	708	$10,745	13
		06	060240 – Roses	857	707	$5,840	13
		01	010420 – Goats, live	963	954	$4	1
Non-metallic mineral products	25-40, 68-71	71	710231 – Diamonds (jewellery) unworked or simply sawn, cleaved	6	849	$7,500,043	8
		71	711031 – Rhodium unwrought or in powder form	18	850	$2,592,926	8
		71	711019 – Platinum in semi-manufactured forms	27	512	$1,849,013	19
		40	401120 – Pneumatic tyres new of rubber for buses or lorries	35	134	$1,391,740	32
		71	711021 – Palladium unwrought or in powder form	38	825	$1,208,851	9
		32	321519 – Printing ink, other than black	62	7	$689,962	46
		31	310520 – Nitrogen-phosphorus-potassium fertilisers, pack >10kg	70	70	$617,563	36
		35	350790 – Enzymes nes, prepared enzymes nes, except rennet	95	8	$472,197	46
		71	711029 – Palladium in semi-manufactured forms	122	826	$363,815	9
		38	381590 – Reaction initiators, accelerators, catalysts, nes	133	180	$346,771	30
		39	392329 – Plastic sacks, bags, cone except of ethylene polymers	163	76	$281,275	36
		40	401199 – Pneumatic tyres new of rubber nes	174	60	$266,605	37
		68	680223 – Cut or sawn slabs of granite	211	19	$224,188	44
		68	681599 – Articles of stone or of other mineral substances nes	225	123	$193,735	33
		28	284990 – Carbides except calcium and silicon	229	409	$192,220	22
		34	340490 – Artificial and prepared waxes, nes	256	293	$166,775	26
		70	700711 – Safety glass (tempered) for vehicles, aircraft, etc.	275	166	$156,266	31

		68	680422 – Grindstones etc., agglomerated abrasives or ceramics	278	78	$151,168	36
		39	391739 – Plastic tube, pipe or hose, flexible, nes	279	132	$151,137	32
		36	360300 – Safety or detonating fuses, detonators, igniters	283	203	$149,185	29
		39	391723 – Tube, pipe or hose, rigid, of polyvinyl chloride	304	396	$135,403	23
		32	320990 – Polymer based paints & varnishes nes, aqueous medium	319	292	$119,850	26
		32	321290 – Pigments for paints, dyes, etc. packaged for retail	321	99	$117,934	34
		28	285000 – Hydrides, nitrides, asides, silicates and borides	349	662	$106,240	15
		35	350699 – Glues or adhesives, prepared nes, package > 1kg	364	117	$99,630	33
		71	711049 – Iridium, osmium and ruthenium, semi-manufactured	395	938	$86,623	3
		39	391721 – Tube, pipe or hose, rigid, of polyethylene	398	327	$85,902	25
		39	391729 – Plastic tube, pipe or hose, rigid, nes	439	328	$71,830	25
		28	283324 – Nickel sulphates	449	501	$69,343	19
		40	401019 – Conveyor belts nes	460	43	$65,490	39
		34	340219 – Organic surface-active agents, nes	467	27	$63,416	43
		39	391731 – Plastic tube, pipe or hose, flexible, map > 27.6 MPa	497	294	$60,007	26
		31	310590 – Fertilisers, mixes, nes	519	439	$53,824	21
		28	282530 – Vanadium oxides and hydroxides	525	918	$52,863	4
		71	711039 – Rhodium in semi-manufactured forms	568	953	$42,954	2
		40	401390 – Inner tubes of rubber except bicycle or motor vehicle	589	233	$39,463	28
		32	320620 – Pigments and preparations based on chromium compounds	611	158	$36,017	31
		33	330119 – Essential oils of citrus fruits, nes	615	440	$35,251	21
		32	321100 – Prepared driers	714	71	$21,206	36
		36	360490 – Signalling flares, fog signals, other pyrotechnics	726	600	$19,882	17
		31	310390 – Phosphatic fertilisers, mixes, nes, pack >10kg	743	859	$17,678	7
		31	310290 – Nitrogenous fertilisers, mixes, nes, pack >10kg	823	505	$8,673	19
Dairy products	04	N/A	N/A	N/A	N/A	N/A	N/A

Table 2: Full list of services clusters with REOs

Cluster	**EBOPS code**	**Sub-sector**	**Country**	**Cell classification**	**Total import value in 2007 (USD thousands)**
Communication	246	3.1 Communications Services - Postal and courier services	Canada	3	864347
	246	3.1 Communications Services - Postal and courier services	Estonia	17	960
	246	3.1 Communications Services - Postal and courier services	Hong Kong	11	739000
	246	3.1 Communications Services - Postal and courier services	Latvia	17	3840
	246	3.1 Communications Services - Postal and courier services	Norway	12	92722
	246	3.1 Communications Services - Postal and courier services	Poland	17	105055
	246	3.1 Communications Services - Postal and courier services	Slovakia	12	3978
	246	3.1 Communications Services - Postal and courier services	United States	6	560000
	246	3.1 Communications Services - Postal and courier services	Viet Nam	12	8647
	247	3.2 Communications Services - Telecommunication services	Belgium	15	1145308
	247	3.2 Communications Services - Telecommunication services	Bulgaria	17	12483
	247	3.2 Communications Services - Telecommunication services	Egypt	12	383703
	247	3.2 Communications Services - Telecommunication services	France	3	925937
	247	3.2 Communications Services - Telecommunication services	Germany	11	1611661
	247	3.2 Communications Services - Telecommunication services	Hungary	17	13990
	247	3.2 Communications Services - Telecommunication services	Italy	1	776341
	247	3.2 Communications Services - Telecommunication services	Latvia	12	15636
	247	3.2 Communications Services - Telecommunication services	Malaysia	12	854970
	247	3.2 Communications Services - Telecommunication services	Netherlands	11	371710
	247	3.2 Communications Services - Telecommunication services	Poland	12	54053
	247	3.2 Communications Services - Telecommunication services	Russia	8	1271352
	247	3.2 Communications Services - Telecommunication services	Serbia	12	76680
	247	3.2 Communications Services - Telecommunication services	Spain	13	708903
	247	3.2 Communications Services -	Sweden	11	485106

		Telecommunication services			
	247	3.2 Communications Services - Telecommunication services	United Kingdom	1	1836357
	247	3.2 Communications Services - Telecommunication services	United States	1	7339980
	247	3.2 Communications Services - Telecommunication services	Venezuela	2	177000
	247	3.2 Communications Services - Telecommunication services	Viet Nam	17	38053
Real estate	N/A	N/A	N/A	N/A	N/A
Building and other construction	250	4.1 Construction Services - Construction abroad	Austria	3	188697
	250	4.1 Construction Services - Construction abroad	Germany	1	4123107
	250	4.1 Construction Services - Construction abroad	Italy	1	1994343
	250	4.1 Construction Services - Construction abroad	Netherlands	1	774009
	250	4.1 Construction Services - Construction abroad	Saudi Arabia	8	2607266
	250	4.1 Construction Services - Construction abroad	Spain	4	246380
	250	4.1 Construction Services - Construction abroad	United Kingdom	5	261373
	251	4.2 Construction Services - Construction in the compiling economy	Albania	7	28570
	251	4.2 Construction Services - Construction in the compiling economy	Azerbaijan	16	1471110
	251	4.2 Construction Services - Construction in the compiling economy	Canada	7	128390
	251	4.2 Construction Services - Construction in the compiling economy	Germany	1	185171
	251	4.2 Construction Services - Construction in the compiling economy	Italy	2	93271
	251	4.2 Construction Services - Construction in the compiling economy	Kazakhstan	4	4352110
	251	4.2 Construction Services - Construction in the compiling economy	Latvia	7	0
	251	4.2 Construction Services - Construction in the compiling economy	Netherlands Antilles	2	51860
	251	4.2 Construction Services - Construction in the compiling economy	New Caledonia	7	322080
	251	4.2 Construction Services - Construction in the compiling economy	Romania	7	5163344
	251	4.2 Construction Services - Construction in the compiling economy	Russia	4	6454180
	251	4.2 Construction Services - Construction in the compiling economy	Saudi Arabia	8	3714544
	251	4.2 Construction Services - Construction in the compiling economy	Slovenia	7	53063

	251	4.2 Construction Services - Construction in the compiling economy	Spain	5	435661
	251	4.2 Construction Services - Construction in the compiling economy	Zambia	2	282400
Trade	N/A	N/A	N/A	N/A	N/A

APPENDIX E

Table 1: Description of abbreviations in Table 6.1

Abbreviation	Description
AGRI	Agriculture
BASICMET	Basic Metal Products
BUILD	Building and Other Construction
BUS	Business Services
CHEM	Chemicals & Chemical Products (incl. Plastic Products)
CSPS	Community, Social and Personal Services
DAIRY	Dairy products
ELEMACH	Electrical Machinery & Apparatus
ELE	Electricity
FURN	Furniture
GRAIN ETC	Grain Mill, Bakery and Animal Feed Products
INSU	Insurance
MACH & EQUIP	Machinery & Equipment
MAN TRANS	Manufacturing of Transport Equipment
NMET	Non-Metallic Mineral Products
OFMET	Other Manufacturing & Recycling
OFOOD	Other food products
OMINE	Other Mining
REAL	Real Estate
RUBBER	Rubber Products
STRUMET	Structural Metal Products
TRAD	Trade
TRANS	Transport

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