Research proposal for the partial fulfilment of the requirement for the degree of Masters of Business Administration, submitted to the University of Pretoria's Gordon Institute of Business Science.

Title:

South Africa as a Strategic Operations Destination for Chemical Manufactures

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Abstract

The decision to expand the operational base of the company into developing markets is but one of the many decisions that executives of multinational companies should be considering in today's age of increased globalisation. As foreign direct investment can provide excellent alternatives to formal development capital, developing economies are increasingly leveraging this option to develop their home economy and industries within it. This research paper investigates the determinants of foreign direct investment by multinational United States based chemical companies into the chemical industries of the world. This offers a potential solution as to what the strategic reasons for this investment may be, as well as determines what the local country can do better to improve its position. The research clusters 26 variables into five cluster groupings that include the value of human capital, level of country infrastructure, industry performance factors, governance indicators and environmental compliance indicators. The variables within the cluster groupings are subjected to a regression analysis with the investment of US multinational companies into worldwide chemical industries as the constant variable. The results yield a model with a R^2 value for the regression of over 0.8 with six variables considered significant contributors to the model.

Declaration

"I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Maser of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research."

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Marc Serrurier Date

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1. Introduction / Aim / Purpose

Multinational profit maximising firms need to ensure that they have a well-configured operations strategy in order to compete effectively in today's global business environment. Firms today have to ensure that they match their "production, logistics, marketing, services, procurement, technologies, human resources and information systems" (Prasad & Babbar, 2000, p. 215) with the requirements and differences faced in differing conditions throughout the world and regions in which they operate. In order to achieve manufacturing flexibility, multinational firms need to understand how to make the most out of their operations chain.

Competitive advantage through operations strategy has historically been based upon a niche market-offering segment of any one or more of the following: cost; quality; speed; or product differentiation. Increasingly, firms have to show value offerings across at least two of these strategies (Pretorius, 2008). Where previously these strategies were seen as trade-offs to achieve one of these imperatives, synergies are increasingly seen to be simultaneously attainable. This is achieved through continual improvement in one area, facilitating improvement in another. Thus cost, quality, speed or product differentiation are no longer seen as strategically mutually exclusive, but rather collectively desirable to create competitive advantages (Prasad, Babbar, & Motwani, 2001).

Risks associated with strategic errors are much greater today than was the case in the past. The chemical industry contributes significantly to the world economy and can offset other investment risk choices such as in financial institutions; a balanced portfolio of investment requires some investment into

many different fac fore fundamental that a company wishing to compete in the international chemical manufacturing environment has to set up and adhere to a good strategy (Prasad & Babbar, 2000).

There are many unanswered questions relating to the academic contribution towards international operations strategy. Home countries that establish an offshore manufacturing centre view this as increasing their operational boundaries, while the country into which that investment is going, sees this as Foreign Direct Investment (FDI). The decision to expand internationally should not be taken lightly as there are many risks posed to the country into which the potential investment is going. Should the risks be too high the investment choice may fail. Senior executives who are investigating such options would require as much information to base their decisions on as is possible. The executives are likely to consider what these tradeoffs may be and how they justify the country investment choice (Prasad et al., 2001).

Information that needs to be added to the literature on international operations strategy should include “regulations, attitudes, policies and practices that impede international operations strategy efforts” (Prasad et al., 2001). There are further issues concerning measurement of success and dealing with international failures that need to be investigated. Regarding measurement, firms seeking to expand internationally have no common measurement tool that can measure the level of success of their international operations strategy, other than the improved return to shareholder value.

The investment spe ting up new operations in different world regions, and the subsequent transfer of goods and services, has an enormous effect on the economies of many countries and regions(Prasad & Babbar, 2000). The literature on international operations strategy has largely been focused on industrialised countries. In order to fill the gaps related to international operations management research, more information needs to be gathered from the developing world (Prasad & Babbar, 2000).

South Africa, through the Accelerated Shared Growth Initiative (ASGISA), needs more labour absorbing economic activities in order to drive economic growth (Department of The Presidency, 2007). Manufacturing is one such area, with the chemical manufacturing industry being a part thereof. In addition to these labour-absorbing industries, Business Process Outsourcing (BPO) is another strategic growth area identified in ASGISA (Department of The Presidency, 2007). International operations investment, and thus FDI, is in line with these initiatives, to enable a growing South African Economy.

South Africa has a few large multinational chemical companies which have operational units in different parts of the world. In order to understand how best these companies can contribute more to the nation, it is important to understand what advantages could be leveraged out of an international operations strategy depending on where in the world the new operation would be situated. Surely there should be some value-adding benefits to be gained, otherwise companies would not be setting up operational units in different regions of the world. Part of the purpose of this research is to determine how an international chemical company's operations strategy can add value to the company's shareholders, particularly looking at South Africa as this destination of choice.

Investigating the S destination for chemical operations development, and resultant FDI, should also ask how does it compare with the rest of the world? South Africa requires foreign direct investment into labour absorbing industries like manufacturing. How well has it positioned itself in terms of attracting multinationals into this market? The other aim of this research project is to investigate the chemical manufacturing market conditions and the potential opportunities and threats that are faced by multinational companies seeking investment into stock and capital.

South Africa as a developing country is grappling with the ill effects of the apartheid regime and the forced discrepancies in education and resultant income. Foreign Direct Investment is seen as a viable alternative to traditional sources of capital investment and the country should seek ways to encourage this investment choice (Jenkins & Thomas, 2002). As the chemical industry is one such cog in the economic machine, but arguably one of the most profitable and most capital intensive, development into this area is likely to improve the per capita well-being of the people involved in that industry. At a country level, the research is important to understand the manner in which a local recipient country of Foreign Direct Investment may benefit from and be able to influence the amount of FDI that it receives.

This study contributes to the knowledge of literature around decisions of investment into foreign counties by multinational organisations, but particularly into the chemical industry. It does this by reviewing the literature, determining a number of potentially contributing variables that may influence the investment decision, and assessing the relevance that these variables have in terms of the decisions taken by other multinational organisations.

2. Literatur

The literature review moves through the literature from the company perspective, through the operations management sector, the internationalisation of this and the developing world. Following on from this, the literature review determines what models are available to help measure or monitor decisions made previously, attempting to answer whether there are any plausible arguments to use why a business owner should invest internationally or not.

The literature then starts to investigate the regional context, specifically relating to the developing world and to South Africa. At the country level, the developing countries are seeking to develop and achieve a higher state of economic growth, while individual companies are seeking new investment opportunities. The role of FDI is discussed in some detail and the importance that it has for South Africa. The chemical industry is specifically investigated to provide reasons for attracting specific investment and what the potential contributors to investment choices may be. Factors that are likely to influence this is are the sector and the country into which the investment is being made. The better the performance of that sector, the more likely it is that new entrants into the sector will succeed. To this extent an understanding of what the conditions are that may be necessary for that sector to evolve sustainably requires investigation.

The purpose behind this approach is to determine what country specific conditions are required for a chemical firm to invest into that country's chemical sector. Before the investment will occur, the firm needs to satisfy itself that, it will be able to operate a sustainable business in that area. Within a new market and regional area, various factors that the multinational is not familiar with come

into play. Issues ab ɔerty rights, availability of raw materials and different legislation all play a contributing role in the unpredictability of the new environment. The more predictable, the easier it is for firms to make informed investment choices.

2.1. International Operations Management and the developing world

A number of articles have been published that focus specifically on the review of literature in the operations management and international operations management field (Gupta, Verma, & Victorino, 2006, Prasad et al., 2001, Prasad, Babbar, & Calis, 2000, Prasad & Babbar, 2000). These articles have assessed the literature published in the major operations management journals from the period of 1984 until 2005. While they highlight a number of factors in the research and proposals for future research direction, they all declare that in terms of international operations strategy, contributions from the developing world is lacking.

In the globalised economy of today, with new markets opening up every day, trade barriers are breaking down, and firms that want to stay competitive need to internationalise their operations (Prasad et al., 2000). With many of the natural resources remaining in the developing economies, multinationals will be looking towards the developing economies to leverage strategic advantages and exploit some of these resources. A country's openness to trade allows for a country to benefit from its abundant resource factors and for its population employed within this sector to benefit economically through this (Krugman & Obstfeld, 2000). The Heckscher-Ohlin model of resources and trade describes how incomes within countries that are resource rich, and can trade as such,

benefit from these ıount of trade increases within the country, so can the competitiveness of that country.

To this extent, the total trade as a percentage of GDP shows the country's dependency on trade. The Heckscher-Ohlin model has been used to explain the investment into the developing world by the developed world with good effect (Krugman & Obstfeld, 2000), and for a developing nation, openness to trade should show improved competitiveness for that country.

With trade, issues associated with that country that include cultural and resource issues or constraints need to be considered as these make up some of the factors of production. "Along with raw materials, capital and machinery, the employee is another factor of production" (Grobler, Wärnich, Carrell, Elbert, & Hatfield, 2006, p. 3). The ability of a firm to be able to convert the factors of production that it has at its disposal into shareholder value gives that firm its competitive edge. The importance of understanding the advantages or benefits that developing economies offer in terms of operations management on the international circuit will therefore become increasingly important as risk takers moving into developing economies may be able to deliver increased economic returns for their shareholders.

The use of technologically advanced communications systems allows multinational firms to be able to operate almost seamlessly throughout the world (Gupta et al., 2006). As the technological infrastructure in the developing world improves, so should multinationals' ability to operate throughout the world and in particular into these developing areas. Understanding how the developing

world performs in te · an operational set up for manufacturing firms could give a firm a competitive advantage over its rivals.

Communication and other development infrastructure, such as road and rail networks, required by businesses within a country, among other factors, provides the enabling environment for business to flourish. The better the infrastructure, the better the investment position into that country is likely to be. This argument is based on the principles of the neoclassical economic theory whereby a profit maximising firm will utilise its labour, investment and other factor inputs that include host country infrastructure, to maximise its investment position (Hirschey, 2006).

High value adding industries help to grow an economy through providing improved value creation per worker (Krugman & Obstfeld, 2000). The issue with governments creating high value adding industries is that it takes a significant amount of capital investment into, among others, infrastructure to ensure that the industry is sustainable. Developing economies often suffer from a lack of development funds and thus are unable to attract multinational corporations that require a relative degree of development in order to do business.

Multinationals seeking investment opportunities abroad and specifically into developing economies are going to be looking for certain levels of development that will accommodate their ability to do business. Telecommunications and data transfer systems, as mentioned by Gupta et al., (2006) are necessary for the communication of information from the multinational's head office to the regional centres. The internet and peoples' use of the internet in that regional country are likely to be good indicators of the country's level of

telecommunications enabling draw card for a potential multinational to invest into that country. In addition to the communications infrastructure, the level of openness to trade and the local human capital are also significant contributors to the foreign firms investment decisions.

2.2. International operations strategy

When unpacking the issue of international operations management strategy, it is important to note the relevance of strategy in terms of broader operations management. Three themes were traditionally identified as forming a firm's operations strategy, namely the content variables of quality, productivity (including costs and delivery), and technology (including flexibility) (Pretorius, 2008). In examining these content variabls, process and performance variables inherent in these need to be investigated in order to provide a holistic view of operations strategy (Adam Jr & Swamidass, 1989).

The strategic notion that a firm must grow or die, suggests that if the home based market is not big enough, a firm should look at overseas regions to establish new operating plants. This comes with its own intricacies in the management of these offshore entities. According to Adam Jr & Swamidass, (1989), the management of international factory networks that are utilised as part of the production chain of multinational companies have not historically, received much academic attention within the field of operations management. In order to assist multinational companies with identifying opportunities and perfecting their international operations strategy, more research into the field needs to be undertaken (Armistead, 1989).

The need for this is to secure order winners through an improved operations strategy (Adam Jr & Swamidass, 1989). Within the chemical industry, which is in most respects considered a mature industry, price and quality can very often be the order winners for operations firms. Should a firm be able to leverage cheaper labour, source raw materials more cheaply and rely on first world technology through its network, an operation in a developing economy could provide it with a strategic advantage over its competitors. The strategic advantage would be based upon price, if the quality remains the same.

Skinner (1969 in (Adam Jr & Swamidass, 1989)) historically argues that the manufacturing aspect of a firm should be employed as a strategic weapon for the competitive advantage of the firm; a narrowly focused, niche operation will fare better than a broad-spectrum operations firm will; and cost and efficiency are not sufficient goals to which a manufacturer should aspire. Thus the operations manager should look at all alternatives that may provide a unique strategic advantage from which the whole firm may be able to leverage.

The focused firm may however be missing opportunities open to it through some core competencies that it has developed and which can be transferred into new sectors within new economies. Increasing its opportunities by investing in new markets may reveal new doors that could open up new avenues for the firm to sustainably grow into the future.

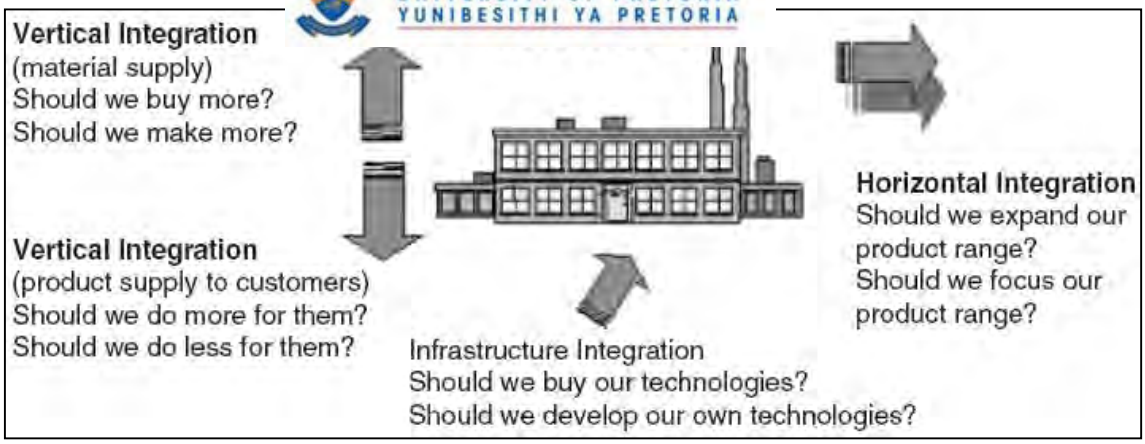

Figure 1: Operations Strategy Key Questions. Source: **(Philpott, Hamblin, Baines, & Kay, 2004, p. 204)**

In terms of the strategy of the operations of a firm, Figure 1 above portrays the strategy options open to the operations section of a firm. In terms of the model above, the depiction of the factory shows the competitive area in which a company plays its strategic game (Philpott et al, 2004).

2.3. International operations strategy and competitiveness

The environment in which a firm operates is a core determinant of its capabilities and its access to resources that contribute to the firm's international competitiveness (Ward, et al, 1995). Research into the environment in which firms operate has been neglected, which is concerning in light of the fact that these environmental factors shape and influence businesses differently in differing regions of the globe. For the sake of completeness, the environment is referred to as both the biophysical (plants, animals and land) as well as socio-economic (people's interaction with each other and the biophysical environment) environment.

Strategy choices a onmental conditions that exist within the region in which a business operates. Specifically, issues such as labour availability, the specific market dynamics and levels of competitiveness / hostility shape the strategy of businesses in that environment (Ward, et al, 1995). It would make sense then that differing regions of the world, with different holistic environments, would need a different strategy. However, the question is whether a multinational operating across different regions can increase its advantages by being able to have different strategies for different regions, when a firm's competitiveness lies in its competencies and available resources (De Toni & Tonchia, 2003).

An international operations strategy is but the first step into new competitive markets, realisation of the advantages that can be gained still need to be made (Gould, 2008). The development of international units and staffing of these units are some of the key concerns that have been raised in literature (Stratman, 2008). The field of competitive capability in terms of international operations management has to be explored to add value to the research.

Determinants of national advantage are important considerations in developing an international strategy. These include the demand conditions of the market; related and supporting industries, including suppliers; the individual firm's structure, strategy and competitive rivalry; and the relevant factors of production needed to ensure delivery of final product (Gould, 2008). Once established, an international network of factories provides a multinational company with strategic opportunities that can increase its international competitiveness (Meijboom & Vos, 2004).

When developing ial multinational entities should consider at least the following: identify potential international opportunities; explore resources and capabilities from both the firm as well as destination perspective; assess core competencies of the business in order to determine the competitive advantages to be gained from foreign investment (Gould, 2008).

Once the firm has realised that there is a strategic advantage in establishing an international network of factories that can provide it with specific access to markets and innovation, the firm is rewarded with an increased market share and increased profits (Ferdows, 1997). It, however, takes this realisation that the factory can provide a strategic function to the company in order to leverage off it, otherwise a narrow focus on the factory will not realise an improved strategic advantage (Ferdows, 1997).

International operations managers require a conducive operating environment in which their businesses will thrive. Without this, the international sector will not be able to contribute significantly to the local business and thus following an international operations strategy would not be worth the investment (Gupta et al., 2006).

One of these enabling factors is the availability and the type of the energy supply. The type of the energy utilised in the intended investment country can provide an indication as to the level of industrial sophistication within that country. Competitive countries tend to be economically more sophisticated than less competitive countries (Porter, 2008) and are the preferred choices for firms to develop new offshore operations. Economies dependant on pure agriculture

are unlikely to sudd ɔrld dominant Information Technology cluster, for example. Fossil fuel burning power stations are the most prolific form of power generation, however the alternatives are more sophisticated and include nuclear and renewable energy.

An concern with renewable energy, however, is that it is more expensive to generate the required quantities of electricity. The operational costs of relying on renewable energy sources will therefore increase (Feiock, 2000). So, while the levels of sophistication may be improved, the costs will be higher and the decision by the Operations Manager would involve a cost benefit analysis on the required outcomes of the investment choice.

Bénassy-Quéré, Coupet, & Mayer, (2007) argue that strong environmental protectionism may hamper FDI into the host country as it is believed to be more expensive to develop an environmentally compliant operations plant than a plant that is less environmentally friendly. It would unfortunately be expected that an economy that does not have good environmental protection may attract environmentally damaging industries as the profit maximizing firm would seek to leverage any opportunity it could to increase its profits (Hirschey, 2006). A country that utilises high levels of renewable energy is likely to be more environmentally conscious than countries that do not. As a result, the international operations manager may shy away from areas where these issues are high up the specific country's agenda.

The international operations manager has to also look at the supply chain of the country into which he / she intends developing a new operation. The roads network within a country allows goods and materials to be transported around

that country with rel ‹, the easier and cheaper it is to move raw materials from source to the manufacturing plant, and get the finished goods to market. Many goods, particularly heavy goods are transported by rail and thus the better developed this infrastructure, the better the environment will be for the supply chain to prosper (Ferdows, 2003).

2.4. Measurement tools of international operations strategy:

Tools have been developed to assess the differences in the strategic roles that individual operational units play in their support of their multinational parents (Gould, 2008 and Meijboom & Vos, 2004). The tools and the research around these tools assist in determining individual site competencies and help businesses understand how to leverage their international production chains (Meijboom & Vos, 2004).

The theory is, however, not very substantial, as the “strategic role of the factory” in the role of a multinational company has only quite recently become recognised (Meijboom & Vos, 2004). According to Ferdows (1997), there are six strategic roles that a foreign factory can adopt: Offshore Factory, Source Factory, Server Factory, Contributor Factory, Outpost Factory, and Lead Factory.

Offshore Factories are established to take advantage of low wages or other low cost production functions.

Source Factories are established to take advantage of low production cost functions, but do produce some of the global supply network products for the multinational.

Server Factories su[illegible] arkets.

Contributor Factories serve both a local market and also customise products, improve processes, improve products and develop new products for the multinational company for the area in which it operates.

Outpost Factories gain access to necessary skills and or knowledge in a specific area of expertise for the organisation.

Lead Factories take innovation to the next level in all aspects of manufacturing, including product and process innovations and technologies for the multinational.

Ferdows (1997) explains that in order to determine the site's strategic role, two questions must be answered: "What is the primary strategic reason for the factory's location? and What is the scope of its current activities?" (Ferdows, 1997, p. 77). Based upon these two questions, the current role of the factory can be determined within one of the six strategic roles, as posed above. Should the management of the multinational wish to do so, the future role of the factory should be investigated in order to determine ways in which a company can leverage the strategic advantages from the factory network. Figure 2 below places the different factory stages into a matrix for comparative purposes.

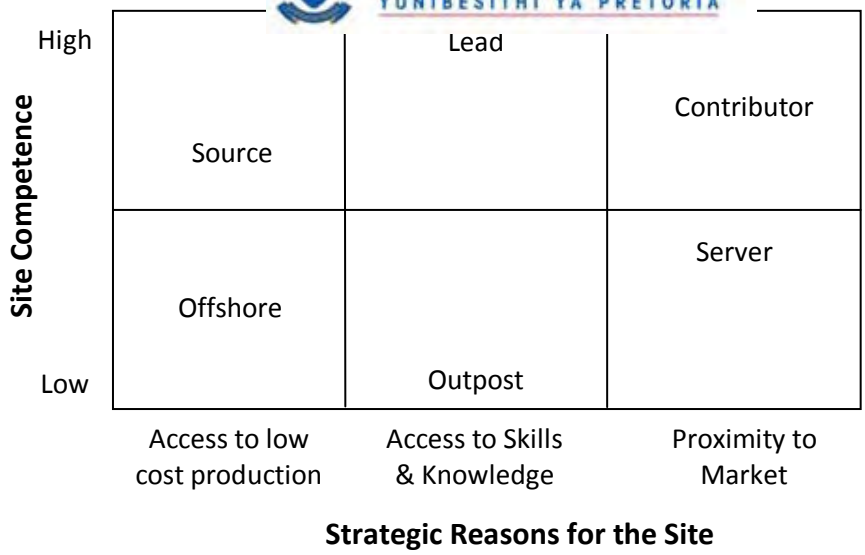

Figure 2: Strategic matrix for the Roles of Foreign Factories (Source: adapted from Ferdows, 1997 pg 77)

As global trade agreements evolve and open up new markets, as well as make existing markets more competitive to do business in, so the role of the factory in the armoury of the multinational can and should change. Ferdows (1997) argues that there is a hierarchy of factory strategy that an individual factory should aim to move through. Should this take place, the competitiveness of the multinational as a whole should increase. This movement is determined by Ferdows (1997) in his description of “Paths to Higher Strategic Roles” (Ferdows, 1997, p. 79).

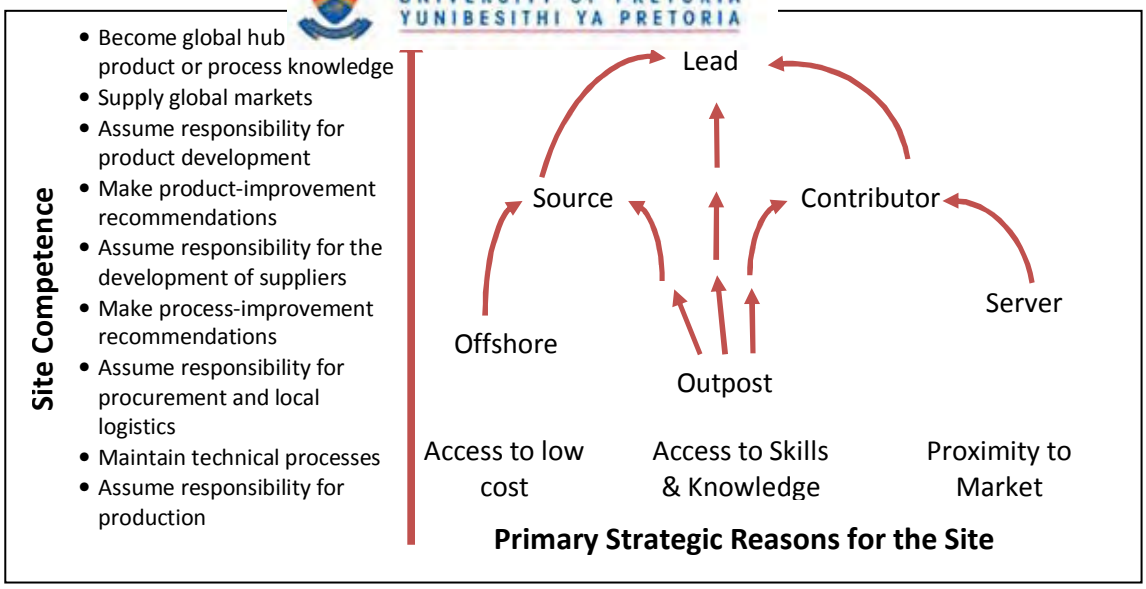

Figure 3: Paths to Higher Strategic Roles (Source: Ferdows, 1997 pg 79)

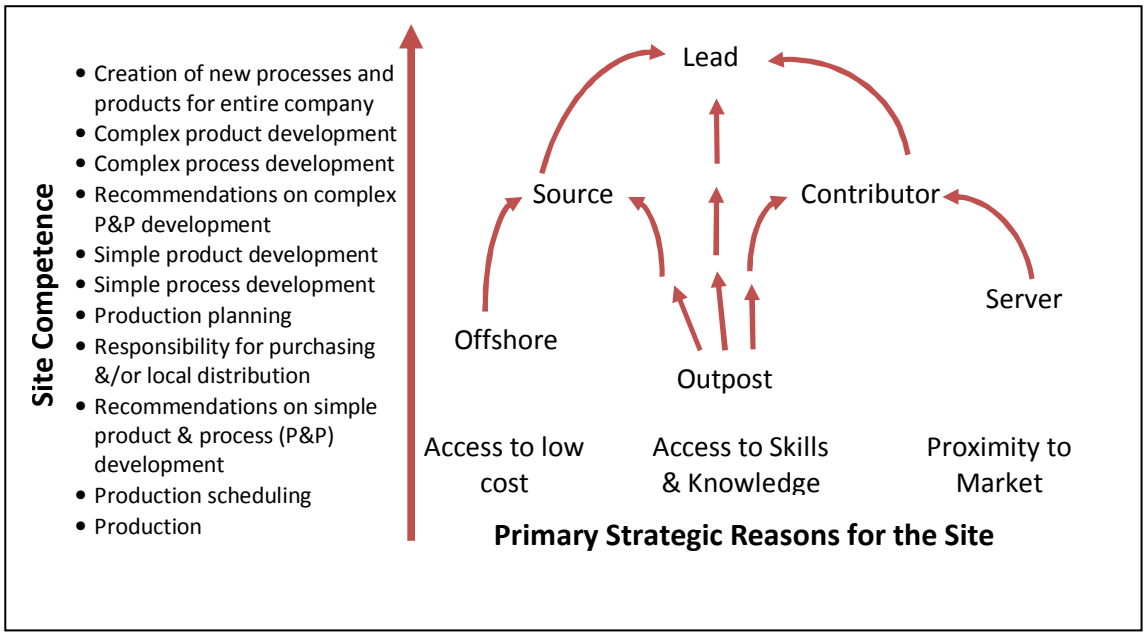

Figure 4: Improved Paths to Higher Strategic Roles (Source: Meijboom and Vos, 2004 pg 130)

Meijboom and Vos (2004) have argued and tested a different set of parameters for the vertical (y axis) of Ferdows' model. The model is less ambiguous than Ferdows' and is an easier method for analysis of the dynamic changes of the roles that a factory has in the international network of a multinational (Meijboom & Vos, 2004). This is due to the increased detail in the explanation of the

makeup of the comp sier for an executive of a multinational operations unit determine where their company fits into the model as a result of these guiding explanations.

2.5. Importance of international operations development to South Africa

South Africa, like many developing economies, suffers from a high level of unemployment. As identified by the ASGISA authors, labour intensive industries are required to help bring about economic growth to those who need it (Department of The Presidency, 2007). Developing economies are known to provide cheap sources of labour (Amoako-Gyampaha & Boye, 2001), but South Africa offers more than cheaper labour, with better infrastructure than its underdeveloped neighbours. This should give it a competitive advantage in the Southern African region.

Multinational companies look for countries, regions and areas that can provide them with opportunities to improve their strategic competitive advantage. Strategically knowledgeable operations companies seek to find operational areas in which they can get more than just cheap labour, trade protection incentives and lower logistical costs. These multinationals are seeking countries where they can fully leverage their strategic advantage by being able to get closer to their customers, attract and retain the best skills in the world and generally offer more to their customers and shareholders (Ferdows, 1997).

The skills and technologies that accompany a multinational operations company, provided they are transferred correctly to the local people, will empower these locals and through time develop the country and economy as a

whole. This movem als within the country can make the total economy more competitive (Porter, 2008). This is due to the skills transfer taking place and the ability of an individual to earn more for their hour of labour than others in similar countries do. Thus, in order for South Africa to be able to pull itself up to a new level of development and bring the huge number of its population still stuck in poverty out, skills and knowledge transfer through attracting multinationals with operational units throughout the world has to take place.

2.6. Foreign Direct Investment

Developing countries have, since the 1980's, found it more and more difficult to obtain funding from the traditional sources of capital, particularly through banks (Biswas, 2002). Direct investment from investors in the form of multinational companies became a desired and well considered alternative to the formal channels of capital, for instance borrowing money from banks for development. Traditional demand factors determining the level of FDI in a country, such as "wage rates, capital costs, market size and proximity to markets" (Biswas, 2002, p. 492) have only accounted for a correlation coefficient (R^2) of between 0.30 and 0.55 (Biswas, 2002). To understand the determinants of FDI into a country from multinationals entering into the market, an investigator needs to look at both the theoretical and empirical information available. Quality infrastructure, type and duration of the political regime and the issue of free property rights reflect more highly on the radar screen for investors seeking out foreign destinations in which to invest (Biswas, 2002). In addition to these issues, other institutional determinants such as civil rights, political freedom and lower levels

of corruption contrib ıntry as a destination for private capital (Bénassy-Quéré, *et al.*, 2007).

Wage rates are not as important as has traditionally been observed due to historical regressions with country infrastructure only being able to explain between 30% and 55% of the reasons for inward FDI into other countries (Biswas, 2002). In addition to this, the notion posed by Porter (2008) that low wages do not make a country sustainably competitive, means that wage rates will not be focused on in this research.

Foreign Direct Investment into a country helps it outperform other countries in similar stages of economic development or transformation (Baniak, Cukrowski, & Herczynski, 2005). Therefore, in order to ensure a competitive edge over other competing countries in the same development segment, a country should look at ways of increasing FDI. In order to understand the components of the investment into the country, the government of that country needs to understand the drivers of the FDI inflows. Specific industries are likely to have different drivers of FDI. For instance, the IT industry would require high speed and low cost data infrastructure, while an aluminium smelter would require access to cheap and reliable electricity. At the time of compiling this research a local South African project for a new aluminium smelter was withdrawn due to the local electricity supplier being unable to guarantee the availability and price of the required electricity for the smelter.

For the government to be able to focus specifically on attracting FDI into the country, niche models are required for the government to be able to prioritise the scarce resources that it has available. A focused contribution into the drivers

of FDI into specific [illegible]ove the generic drivers of FDI into an economy. Having concluded this, a set of prerequisite conditions is likely to exist as well, although the specific industry dictates how relevant these pre-requisites are to influencing investment decisions within that host country (Galan & Gonzalez-Benito, 2006).

2.7. Foreign Direct Investment into Emerging / Developing economies

Research into the determinants of FDI inflows into developing economic regions such as South America has shown that political stability and levels of human rights abuses have influenced the degree to which FDI has infiltrated into those regions (Montero 2008 as cited in Tuman, 2009). Adding to this debate, however, is the origin of the foreign investment. Tuman (2009) argues that a number of home based factors (issues that are important at home, e.g. in the US decisions about investing in Europe) are necessary to be included into the determinants of investment into foreign countries. These included stakeholders such as unions, consumer groups and the home State (Tuman, 2009). The stronger the opinions of these stakeholders about differing issues related to political sentiment, human rights abuses, regime types etc. the more they have an influence on the countries in which the multinational ultimately invests (Tuman, 2009). Therefore, the information and data that is used to determine FDI should "disaggregate flows by the home market of the multinational firm" (Tuman, 2009, p. 192). Further to the traditional sources of FDI determinants in terms of economic predictors, together with a country's current account, as claimed by Montero (2008) (cited by Tuman, 2009), Tuman (2009) highlights that growth in GDP per capita, secondary education enrolment and trade ratios

are statistically sig Direct Investment of US based firms into Latin America.

Developing economies can benefit greatly from Foreign Direct Investment (Naudé & Krugell, 2007 & Bénassy-Quéré, et al., 2007). According to Baniak et al. (2005) for every 1% increase of FDI per unit of GDP, per capita income increases by 0.8% in emerging economies. The reason for this is that FDI brings with it not only direct financial capital inflows, but also new technologies, skills and access to new export markets (Baniak et al., 2005). These allow the country to sustain the growth it needs to pull itself through the developing stages of economic growth and reform. Baniak et al. (2005) add to the debate of contributory factors that influence FDI into emerging economies by concluding that, in addition to macro-economic stability, legal stability is a necessary contributor to the attractiveness of a country for FDI by multinational companies.

The custodian of the legal system within any country is the government. As governments shape the country they are in custody of, one of the functions of government is to create an enabling environment in which businesses may flourish. Governments are also responsible for developing and maintaining much of the public infrastructure that allows its citizens to get to work and earn the taxes necessary to keep the country running. The more effective the government is at providing these services, the more likely a foreign multinational is to invest into that country (Porter, 2008).

A country's capital lies in its people and the more competitive they are, the more competitive the country is going to be (Grobler *et al.,* 2006). The more highly educated the country's population, the more competitive the people

within in that co the country's level of competitiveness increases (Porter, 2008).

2.8. Foreign Direct Investment into South Africa

Few studies have investigated foreign direct investment into Africa, compared with the abundance of literature found on the topic for other areas (Naudé & Krugell, 2007). The information that does exist has tried to explain the reasons for the relative lack of investment into Africa, with some suggesting that countries in Africa are tainted simply by being African (Jenkins & Thomas, 2002) and that perceptions about instability of particular nations within Africa affect other African countries (Naudé & Krugell, 2007). It is argued that policy making that can reduce the levels of inherent business risk and improve the business environment and levels of openness to trade are seen as enabling factors of FDI flows into African countries (Naudé & Krugell, 2007).

2.9. Chemical industry and economic development within South Africa

The manufacturing industry in South Africa, of which the chemical industry is one component, contributes to approximately 15% of total employment within the country (StatsSA, 2008). The sector has, however, shown very little real growth, in terms of total people employed in the sector between 2001 and 2007 (StatsSA, 2008). ASGISA has identified the manufacturing sector as one of the industry sectors targeted for increased contributions to employment (Department of The Presidency, 2007). The chemical industry is clustered into the industry labelled "Petroleum, Chemical Products, and Rubber and Plastic Products", within the manufacturing cluster of the economy, by the national statistics body, Statistics South Africa (StatsSA). This sector is responsible for

employing 11% of acturing sector (StatsSA, 2006). Evidence from the developed world suggests that the chemical manufacturing industry reached maturity as far back as the early 1980's, with a shift in production to the developing world where cheap labour buoyed the recovery of the industry (Ilgen, 1983). Nearly three decades later, has the developing world reached a state of maturity in terms of its value offering of cheap labour, begging the question, what more needs to be done to be sustainably competitive going forward?

There is scope for entry into the manufacturing, and specifically the chemical sector, of the economy. This is due to the chemical industry traditionally experiencing high profit margins (Suer, 1995). These profit margins have been protected by high barriers to entry, mostly through the need to protect high research and development (R&D) costs in the form of stringent intellectual property protection (Suer, 1995). As the chemical industry requires higher skills and more scientists, the level of education and R&D into the sector is considered important. It would be expected that a country with many scientists and engineers would be more likely to sustain a chemical manufacturing business, than a country without. This should then promote FDI investment and not detract from it.

Similar to the role that technical students play in being an enabler to industrial sectoral development, the total level of education of the entire population enables country competitiveness (Porter, 2008). The more technically challenging the industry, the more highly skilled workers are required to work in that industry. It would therefore be expected that the higher the education index of the country, the more likely it is to attract companies investing in technically

challenging industri to the demand on semi-skilled labour required to keep any operational plant running.

The availability of natural resources enables industries to form and develop, but the longevity of the industry is in the hands of the industrialists to convert this endowment into a sustainable revenue stream (Porter, 2008). In the age of being able to transport mineral wealth around the world, the natural mineral endowment may not be necessary in order for an industry to flourish. In this instance, developed capabilities to turn a mineral into a higher yielding commodity may be more competitive than the mere endowment of the mineral. Chemical industries require raw material inputs. Availability of raw materials would enable a firm to attract investment more than the lack of available sources of raw materials. These raw material inputs are part of the consideration of the "traditional" demand factors as highlighted by Biswas (2002). In terms of being able to identify particular commodity types that may provide an indication as to the amount of raw materials consumed in any country, the chemical industry should be separated out of the industry. Fertilisers are large users of raw chemical material inputs including ammonia and nitric acid that are combined to form the base of all fertilisers, being ammonium nitrate. An economy with a large abundance of raw materials has the potential to extract greater value out of this material by using its labour and capital to increase the usefulness of the product (Porter, 2008).

Porter's (2008) argument about competitiveness of nations suggests that some countries are more competitive than others. This would suggest that within each country, some industries would be more competitive than others. To this extent, the more competitive the industry, the more likely an investor of foreign capital

is to invest. In tering industry, the more competitive the entire industry is the more likely it is to attract the FDI into that country.

As the chemical manufacturing or processing industry is often an environmentally degrading industry, the regulatory costs of compliance to national and international environmental laws and treaties can hamper the competitiveness of that country (Feiock, 2000). According to Feiock, (2000) economists believe that this regulatory compliance hampers growth and increases production costs within the industry, thereby lowering competitiveness. In addition to these company specific costs, the industry experiences barriers to entry due to high capital costs of complying with regulatory environmental controls (Feiock, 2000) as well as the high costs of R&D and the protection of this R&D through protection of the resultant intellectual property (Suer, 1995).

It is reasonable to assume from the argument above, that profit maximizing chemical firms wishing to establish new facilities are likely to do so in areas where regulatory controls are less severe, or where there is some form of incentive that will offset the costs of regulatory compliance. The evidence of this working can be seen through the achievement of Korea from the period of 1960 up until 2002, where manufacturing output due to the chemical and heavy industry grew from 23% to 79% (Mah, 2007). This was made possible on the back of significant government intervention though fiscal and financial support into selected industries. In the 1980's Korea switched its direct support into specific industries to "function oriented support" (Mah, 2007, p. 89) where focus on generic R&D investment took the form of economic planning in Korea post

1980 (Mah, 2007). Korean government were however contrary to the current regulations imposed by the World Trade Organisation (WTO) (Mah, 2007). Therefore these may not be transferable to new developing economies, but they do nevertheless highlight what can be achieved through incentives designed to promote certain industries, particularly the chemical manufacturing sector. The interventions highlight that regulatory control that hampers business development, such as environmental compliance costs, if they were removed, the industry would flourish economically in the short term.

As the manufacturing of chemicals can be environmentally destructive, and environmental governance is considered to hamper development, a look into the host country's environmental compliance is necessary. From a profit maximising perspective of the individual firm, a firm is more likely to locate in an area where there is little or no environmental compliance requirements (Krugman & Obstfeld, 2000). This is so that they are able to maximise revenues from not incurring the costs of environmental compliance (Feiock, 2000).

As environmental matters and concerns become more important in the daily functioning of any business, so a country's commitment to improving the environment for its citizens becomes apparent. For many countries merely belonging to, or being signatories to, various environmental commitments, does not necessarily translate into a proactive environmental State.

Nongovernmental organisations and environmental action groups have been hard at work in the home countries of many multinationals and have exposed their operations in the developing world that do not meet the requirements of

the home country. increased shift towards improved corporate governance and social responsibility, there may be a move to set up operations in countries that have good environmental protection, going against the theory of the economic neoclassical profit maximising theory of the firm. Should this be the case, an environmental management standard that would ensure the governance of the environmental protection would probably be in place. The International Organisation for Standardisation's (ISO) 14001 Management System is a set of conditions with which an environmentally responsible company must comply in order to show that it is operating in an environmentally sustainable manner (ISO, 2009).

As chemical manufactures produce large amounts of hazardous waste that needs to be disposed of, all chemical manufacturers within that country will need to comply with the Basel Convention, if the country is a signatory. The Basel Convention came into effect in 1992 and to date has 172 participating parties (UNEP, 2009a). It is arguably the most comprehensive global environmental agreement on hazardous and other waste and controls the movement across borders of this waste and the disposal thereof. The Convention aims to protect the environmental and human health against the impacts resulting from the incorrect management of disposal and movements of hazardous and other waste.

2.10. Co-evolution theory

Murmann (2003) proposes that firms co-evolve within the country and sector in which they find themselves. He argues that the total industry or cluster (Porter, 2008) is dependent on more than just the firm's strategic competitiveness. The

larger social enviro n the competitiveness of industries and the firms that operate within them (Murmann, 2003).

Firms that operate in continually changing environments might find themselves competitively stronger than some firms that are not. “Dutch disease” has colloquially become associated with firms and countries who start out as resource rich countries, but who fail to make the transition through being resource rich to technologically rich. Industries that have had to struggle with a lack of natural resources can end up being more competitive due to innovations and evolution within the industry (Murmann, 2003).

Natural endowment of resources would be a sufficient enabler of the development of an industry, however it may not be necessary for the future longevity of the industry or the firm (Murmann, 2003). Co-evolution takes place through the interaction of technology; industry; and national institutions like education systems (Murmann, 2003).

An industry or sector will only co-evolve if at least two aspects as identified above “both have a significant causal impact on each other’s ability to persist” (Murmann, 2003, p. 210). Therefore, one component of the industry will not develop faster than the other if they do not leverage off themselves.

Porter’s diamond model (Porter, 2008) is perhaps more complete in its analysis of the interrelated nature of an industry or cluster and the impact that the environment and surrounds has on individual firm performance. The use of factor and demand conditions to explain the firm’s position, supporting and enabling industries, institutions for collaboration and a context for firm rivalry, in

order to promote co ore recently explains this interrelated structure of the industrial cluster.

The possible difference between Porter's (2008) and Murmann's (2003) models is that clusters can develop across boundaries and therefore the political component of the governments that contribute to the cluster may or may not have an influence on the performance of the cluster.

Co-evolution suggests that through the evolutionary process, some firms will prosper hugely, while others will die out. Technology, or the lack of development thereof, much like a natural catastrophe, can wipe out an entire industry. Murmann (2003) uses the example of the development of the synthetic dye industry at the turn of the 20th Century. Many firms and industries developed to produce natural dyes and included the dye extraction companies as well as the farming industry that grew the plants from where the natural dye was extracted. With the discovery of the synthetic dye manufacturing process, the farmers as well as the dye extraction companies mostly went out of business. In India alone, approximately 3000 firms linked with the natural dye industry existed before the start of the First World War, while only approximately 85 synthetic dye producers existed. The mass extinction of firms from an industry is inevitable as the technology within the industry evolves. If the firm does not co-evolve with the technology, it is going to be left behind.

The academic support within the sector is argued by Murmann (2003) as being critical to the success of a nation in a specific industry. In his analysis of the synthetic dye industry, Germany became the world dominant player, taking over from the United Kingdom. This is argued to be due to the strength of the

universities in Germ mistry at the time. This allowed the academic institutions to collaborate with the firms within the German synthetic dye industry to develop new and improved dyes. The academic institutions co-evolved with the firms to develop new formulas while the firms were able to operationalise the new formulas. The learning was two-way and chemists in the university often were involved in the industry and chemists in the industry often went and taught at the universities. Through this collaboration, the Germans were able to bring new formulas into production much faster than their British counterparts.

Porter's (2008) notion of institutions for collaboration is important for the benefit of the total industry. Here firms and institutions can lobby government for improved incentives for doing business, increased funding for academic institutions and to lobby lawmakers to ensure protection of the industry.

While Murmann (2003) argues that these sectors need to co-evolve with each other, Porter (2008) suggests that the institutions for collaboration and the context for firm strategy and rivalry are necessary conditions for cluster competitiveness. Either way, they are important to the competitiveness of the industry in order to evolve within a given geographical location.

Innovation is a key driver of the chemical industry (Murmann, 2003) and in order to innovate, companies and industries need to invest in R&D. It is likely, however, that the population of the research people in any economy is likely to follow the strength of the sectoral lines of the economy. Thus the stronger an industry is, the more researchers there are likely to be in that industry compared with the other industries. An example is the relative strength of South African

deep level mining en the world, resulting in the South African gold mining industry being able to extract ore from deeper levels than competing countries. With a strong sense of innovation, the country should be able to be more competitive in terms of the chemical industry (Murmann, 2003) and would likely to attract greater FDI.

2.11. Governance in FDI attractiveness

The level of governance and the host country's ability to govern is at the heart of Biswas' (2002) and Bénassy-Quéré et als'. (2007) arguments of the determinants of FDI attractiveness. If these issues are significant decision making concerns for all FDI into the world's markets, then they should also be significant concerns for the chemical industry.

In order to determine the impact that governance or mis-governance has on the economic activity of a nation, the performance of a government must be measured (Kaufmann, Kraay, & Zoido-Lobatón, 1999).

Kaufmann, Kraay, & Mastruzzi, (2009) have constructed six aggregated indicators that "are based on hundreds of specific and disaggregated individual variables measuring various dimensions of governance, taken from 35 data sources provided by 33 different organizations. The data reflects the views on governance of public sector, private sector and NGO experts, as well as thousands of citizen and firm survey respondents worldwide" (Kaufmann *et al.*, 2009, p. 1). The six measures are as follows: Voice and Accountability; Political Stability and Absence of Violence/Terrorism; Government Effectiveness; Regulatory Quality; Rule of Law; and Control of Corruption.

The better the gove ifferent indices, the more enabling the environment in which businesses can flourish (The World Bank Group, 2009a). The enabling environment should lead to improved competitiveness and ultimately enhance the attractiveness of FDI into that country.

In terms of foreign companies seeking to do business in host economies the more highly corrupt the country the less the FDI it attracts (Bénassy-Quéré, et al., 2007). This is due to the notion that the strength of the institutions to protect the physical and intellectual property rights of the company investing into that country is reflected by the law makers' ability to ensure the controls are in place. If they are corrupt, there may be no guarantee that the property rights of companies will be protected (Biswas, 2002). This lack of property rights will deter investors into the host economy.

2.12. Summary of literature review

The literature brings together a variety of questions that require consideration, both from an attracting investment position as well as seeking investment opportunities. There are some factors that have been raised as being quite common across the board that help explain the FDI options into different countries that relate to traditional as well as non-traditional concerns. These are industry requirement factors and country enabling factors. Industry requirement factors are those components necessary for an industry to exist and the better these requirements are, the stronger the industry performance is likely to be. Country enabling factors are those aspects of the individual country that improve its global competitiveness and provide it with strategic advantages over other countries of the world.

The literature has a reas that an international chemicals operations manager should investigate about the country in which he / she intends investing. These issues can be clustered into five overarching themes, being:

- The competitiveness of the country's human capital
- Levels of infrastructure within the country
- Performance of the chemical industry within that country
- Levels and effectiveness of governance within the investment country
- Levels of environmental control and compliance requirements within that country.

3. Researcl

This research aims to provide answers to the research questions listed in the following section. The questions have been developed to assist operations managers of chemical process plants in South Africa, as well as governmental policy makers, understand the international determinants of FDI into the worldwide chemical industry. In addition, the research aims to assist foreign multinational companies intending to establishing new operations in South Africa understand the South African specific competitive offerings for offshore subsidiaries in the chemical industry.

3.1. Hypothesis 1

Is the South African chemical manufacturing industry an attractive destination for foreign direct investment (Bénassy-Quéré et al., 2007)?

To measure this, the level that South Africa achieves in both its assessed value and the rank that it falls into when considered against the rest of the world will be assessed. Should South Africa show that it can attract a more than average level of FDI into its chemical industry, then it would be competitive. If it attracts active FDI into its chemical industry equating to the top 25% of all FDI flows in the world's chemical industries, this would highlight that South Africa would be more competitive than the size of its GDP would assume.

3.2. Hypothes

What are the main determinants of investment (Biswas, 2002) by foreign multinationals into chemical industries of local countries and how does South Africa compare?

Biswas (2002) concludes that both traditional and non-traditional factors influence the invested amount of FDI into any given country. These relate in particular to:

- Quality of infrastructure
- Political regime type and duration of power
- Property rights index.

The factors listed above relate generically to the determinants of FDI into different countries. In order to determine the specific determinants into the chemical manufacturing sector, the determinants listed below were identified during the literature review to be significant determinants of FDI into the chemical manufacturing industry. These will be the units measured as the factors listed by Biswas (2002) are included into these components:

- The competitiveness of the country's human capital
- Levels of infrastructure within the country
- Performance of the chemical industry within that country
- Levels and effectiveness of governance within the investment country
- Levels of environmental control and compliance requirements within that country.

These determinants of FDI into the chemical manufacturing industry worldwide should help to be able to answer the overarching question of “How does South Africa measure up internationally regarding the provision of an environment conducive to the provision of these operational requisites and as such its ability to attract FDI?”

4. Methodo

This study used quantitative analysis of existing secondary data based on the FDI stock flows into countries. Specific contributors into the chemical manufacturing industry were used to determine the correlation coefficient of the components that influence investment decision choices by multinational firms investing offshore. This was assessed to view how attractive South Africa's chemical industry is to Foreign Direct Investors.

The purpose of the study was to determine the attractiveness of South Africa to foreign multinationals wishing to invest in a chemical manufacturing facility, or to establish an operational unit in the chemical manufacturing industry within South Africa. The research questions, as identified in the previous section, shaped the research design. The methodology of this study related to the theoretical models developed by Bénassy-Quéré, et al. (2007) and Biswas, (2002). They have ascertained that the determinants of foreign direct investment into a country relate to 'traditional' as well as 'non-traditional' factors. Both of these types of factors were considered in order to determine South Africa's competitiveness in terms of attracting FDI. The models of Bénassy-Quéré, et al. (2007) and Biswas (2002) were based on regression analyses of a number of different traditional and non traditional sources of FDI.

Specific requirements needed to create a competitive market in the chemical manufacturing industry must still be determined. Literature reviewed relates to issued to the value of the human capital in the host country, governance including the protection of property rights, both physical and intellectual rights, supporting infrastructure for production enablement, the competitiveness of the

industry, and the re , including environmental regulations within the sector (Mah, 2007, Feiock, 2000, & Ilgen, 1983). Data related to these attributes was collected and analysed to determine its fit into the model.

Information gathered from existing data sources, made use of previous investigations into the subject of FDI flows into countries. To this extent, the information related to the studies performed by Bénassy-Quéré et al., 2007 and Biswas, 2002 was used. The objective was to determine the correlation coefficient of the South African specific conditions to those that were identified during the aforementioned study, through the use of regression models.

The information gathered for the research was grouped into five different clusters that represent components of the traditional and the non-traditional factors as suggested by Biswas (2002). These related to elements of the value of the host country's human infrastructure, the levels of physical infrastructure within the host country, the host country's specific industrial performance, governance indicators and compliance to environmental management principles. The components of these five different categories are discussed in more detail in the sections to come.

4.1. Research design

Statistical analysis of data from existing available data sources was used to determine the flows of FDI into South Africa (UNCTAD, 2009). Within the manufacturing sector, available public data (StatsSA, 2009) was analysed to show the attractiveness of the chemical manufacturing industry to shareholders

of multinational com e South African chemical industry.

The metrics used related to capital stock flows that are believed to be of greater importance to long term foreign direct investment than pure financial investment (Bénassy-Quéré et al.,2007).

In order to determine the attractiveness of South Africa for FDI into the chemical manufacturing sector, the model utilised by Bénassy-Quéré et al., (2007) was altered from an industry specific perspective, to add the industry prerequisites (Pretorius, 2008) for effective functioning of the industry. Aspects as identified in chapter 2 and above, being protection of property rights, including physical and intellectual rights, supporting industries for production enablement and the relative degree of regulatory control within the sector, environmental compliance and the value of the human capital, were correlated against the dependent variable, capital flows into the chemical manufacturing market, to determine the market competitiveness.

The model posed by Bénassy-Quéré et al., (2007) is complex and was not easily replicated. The data collected in this study was used as a determinant of FDI attractiveness into the chemical manufacturing industries throughout the world, with a ranking being applied and South Africa included into the overall ranking.

4.2. Data collection and Statistical analysis

The collection of accurate and reliable data for analysis was the cornerstone of this research. The United Nations has extensive information related to flows of

investment into diff | (UNCTAD, 2009). This information formed the basis of the analysis of FDI flows into the chemical industry of South Africa. The Bureau of Economic Analysis (US Department of Commerce, 2009) listed the flows of investment out of the United States of America into all other countries by sector. This was a useful source of information to have in order to utilise as the dependent variable for the study.

The data utilised originated from a number of distinct data sets that are discussed in more detail in the sections below. Most of the independent variables were sourced from the major international development organisations such as the World Bank and the United Nations, who have different programs relating to different specific issues. Where the necessary data required for the analysis was not found in these databases, specific specialist databases were sought to provide the answers, such as the United States Bureau of Economic Analysis and the World Intellectual Property Organisation. Some action groups, such as Transparency International, provide indicators that were useful analytical tools.

The specific contributions to the different variables are included in the next section and include the development of the dependent variable and the independent variables for the regression analysis. The independent variables are sorted into the five different clusters as described previously.

4.2.1. The dependent variable

The variable used for the analysis of the data related to FDI into chemical manufacturers. The United Nations Foreign Direct Investment Handbook

(UNCTAD, 2009) do e chemical manufacturing sector of individual countries.

The United States Bureau of Economic Analysis (US Department of Commerce, 2009) provides data on the investment of US firms investing into various sectors of the world's economies. Within this database is the dataset "U.S. Direct Investment Position Abroad on a Historical-Cost Basis: Country Detail by Industry, 2008" (http://www.bea.gov/international/xls/pos_long_08.xls). Within this dataset, there is a list of the flows of capital into the chemical industries of the world. The average number for the years from 2004 to 2008 was used as the dependent variable in this research.

The dataset contains 83 countries for which there is a non zero United States investment into that country's chemical industry number. South Africa was part of this dataset. There were an additional 90 countries that were included in the dataset, the values of which were zero. This indicated that there was inactive investment into that industry by US multinationals. These countries were excluded from the regression analysis on determinants of FDI, but were included in some instances where South Africa was compared to the rest of the world.

One particular concern about using this dataset as the dependent variable was that it introduced certain home country investment bias (Eaton & Tamura, 1994) & (Levchenko, 2007). This is unfortunately unavoidable as there is insufficient secondary information around total Foreign Direct Investment into all countries by industry.

4.2.2. The inde

The literature review highlighted that five major factors contributed to the determinants of FDI into the chemical manufacturing industry. These were: the competitiveness of the country's human capital; the levels of infrastructure within the country; the performance of the chemical industry within that country; the levels and effectiveness of governance within the investment country; and the levels of environmental control and compliance requirements within that country.

The data for the independent variables was sourced from a number of different databases that included the UN Development Program (UNDP) Foreign Direct Investment Database, the World Development Report and The Human Development Report. Other UN programs where data was collected included the UN Environmental Program (UNEP), the UN Industrial Development Organisation (UNIDO) and the UN Conference on Trade and Development (UNCTAD). The World Intellectual Property Organisation (WIPO) provided data on the registration and protection of intellectual property rights around the world. The World Bank Development Data (The World Bank, 2009) provided information on a number of the World Bank partners, specifically looking at development data and statistics.

The independent variables and their origins are listed in the table below. The individual variables were segregated into the five, category determining influences, of FDI flow into the Chemical Industries of differing countries. These relate to the value of human capital, the level of host country infrastructure, the

specific industry per : country governance and performance of that government, as well as environmental compliance.

Table 1: List of Independent variable clusters

Independent Variable		**Source of variable**
Value of Human Capital	Tertiary students in science, engineering, manufacturing and construction (% of tertiary students)	(UNDP, 2008), http://hdrstats.undp.org/en/indicators
	Researchers in R&D per million people of population	(UNDP, 2008), http://hdrstats.undp.org/en/indicators
	Education Index	(UNDP, 2008), http://hdrstats.undp.org/en/indicators
Country Infrastructure	Internet users per 1000 people in population	(UNDP, 2008), http://hdrstats.undp.org/en/indicators
	Nuclear power (% of total primary energy supply)	(UNDP, 2008), http://hdrstats.undp.org/en/indicators
	Hydro, solar, wind and geothermal power (% of total primary energy supply)	(UNDP, 2008), http://hdrstats.undp.org/en/indicators
	Roads - Total Network	(UNEP, 2009b) http://geodata.grid.unep.ch/

Industry Performance Factors	Production and consumption of selected raw mineral commodities	(UNDP, 2008); http://stats.unctad.org/Handbook/TableViewer/tableView.aspx?ReportId=1919
	Manufacturing competitiveness	(UNIDO, 2007) http://www.unido.org/index.php?id=5058
	Patent filing information and stats	(WIPO, 2009) http://www.wipo.int/ipstats/en/statistics/patents/index.html
	Fertilizer Consumption	(UNEP, 2009b) http://geodata.grid.unep.ch/
	Trade - Percent of GDP	(UNEP, 2009b) http://geodata.grid.unep.ch/
Governance Indicators	Voice and Accountability	(The World Bank Group, 2009) http://info.worldbank.org/governance/wgi/index.asp
	Political Stability	(The World Bank Group, 2009) http://info.worldbank.org/governance/wgi/index.asp
	Government Effectiveness	(The World Bank Group, 2009) http://info.worldbank.org/governance/wgi/index.asp
	Regulatory Quality	(The World Bank Group, 2009) http://info.worldbank.org/governance/wgi/index.asp
	Rule of Law	(The World Bank Group, 2009) http://info.worldbank.org/governance/wgi/index.asp
	Control of Corruption	(The World Bank Group, 2009) http://info.worldbank.org/governance/wgi/

	Corruption perception index	(Transparancy International, 2009) http://www.transparency.org/ policy_research/surveys_indices/ cpi/2008
Environmental Compliance	ISO 14001 Certifications	(UNEP, 2009b) http://geodata.grid.unep.ch/
	Signatory to the Basel Convention	(UNEP, 2009b) http://geodata.grid.unep.ch/

The information from these databases, while reporting on all countries in the world, are missing certain data associated with some of the countries for different aspects requiring measurement. However, the 83 countries assessed by the dependent variable constrained the data more than this missing information did.

Details of the variables within the groups are provided in the following section.

Value of Human Capital

Tertiary students in science, engineering, manufacturing and construction (% of tertiary students) – data sourced from the United Nations Human Development Report (UNHDR) for 2008 and listed the total number of students enrolled in the disciplines described, as a percentage of the total tertiary student population.

Researchers in R&D per million people of population – data sourced from the UNHDR for 2008, and listed the number of researchers in the Research and Development field within that country, per million people of the population.

Education Index – t ıe UNHDR for 2008, and provided an index of the level of education within each country in the database. As it is an index, all countries were normalised and competed against each other fairly.

Country Infrastructure

Internet users per 1000 people in population – this data was sourced from the UNHDR and represents the total number of internet users per 1000 people in the population. As this is a measure of development, the per capital normalising information already included into the dataset ensured uniformity.

Nuclear power (% of total primary energy supply) – this data was sourced from the UNHDR and represented the total nuclear power used by the country as a percentage of its total energy use. As the data represented the level of sophistication of the infrastructure through the percentage of total generated power, no normalisation needed to take place.

Hydro, solar, wind and geothermal power (% of total primary energy supply) – this data was sourced from the UNHDR and represented the total renewable energy used by the country as a percentage of its total energy use. As the data represented the percentage to which energy costs may be higher than other countries, through the percentage of total generated power being more expensive as it is renewable, no normalisation needed to take place.

Total network of roads – the data was sourced from the UNEP database and detailed the total kilometres of road network in each country. In order to normalise the data, the GDP per capita for each country from The World Bank's

development data a The World Bank, 2009a). The relevant years were put togther to ensure that they corresponded with the years performance.

Industry Performance Factors

Production and consumption of selected raw mineral commodities – the data for this function was sourced from UNCTAD Handbook of Statistics. The information contained in the data set consisted of two distinct sets. The production component summated a country's production of the following: unwrought aluminium; copper ores and concentrates; unrefined copper; and refined copper. The consumption component summated a country's consumption of unwrought aluminium and refined copper. The measurement was in millions of tons and the original data spanned the period of 2004 to 2006. The average of the years was used as a single unit of measurement for the period, which was normalised using per capita GDP figures from The World Bank's development data and statistics database (The World Bank, 2009a).

Manufacturing competitiveness – the data for this variable was sourced from the United Nations Industrial Development Organisation's statistical database. The industrial competitiveness scoreboard of the United Nations ranks the individual country's Competitive Industrial Performance (CIP) index (UNIDO, 2007). The index analyses the industrial activity in terms of its competitiveness at the country level. Country competitiveness was assessed in terms of the industry's liberalisation and globalisation using four variables. These variables are: manufacturing value added per capita, manufacturing exports per capita,

industrialisation inte nit of measurement is an index, no normalisation was required.

Patent filing information and stats – this data was sourced from the World Intellectual Property Organisation's Economic Studies, Statistics and Analysis Division (WIPO, 2009). The data used was the total number of patents filed through the host country's patent office. In order to normalise the data for the size of the economy, the total number of patents filed through the country's patent office was divided by the country's population to provide a patents filed per capita number.

Fertilizer Consumption – the data for this dataset was sourced from the UNEP database. In terms of this analysis, and to account for boom and bust years, two variables were utilised, namely a 10 year average of total tonnage as well as a 5 year average of total tonnage. This attempted to remove the seasonal fluctuations of fertiliser usage that is due to meteorological changes. The data was normalised with GDP per capita average figures from the same two time periods to allow for consistency.

Trade as a percentage of GDP – this data was sourced from the UNEP database and it analysed the percentage of total trade of a country as a percentage of its total GDP. As it is a percentage, no normalisation needed to be considered.

Governance Indicators

For all six of the data variables listed below, except for the corruption perception index, an aggregate of the preceding six years (2003 to 2008) was assessed.

The data was take rnance Indicators (WGI) dataset (The World Bank Group, 2009).

Voice and accountability – this measured the perceptions of the population of a country to participate in selecting its government. Freedom of expression, association and freedom of the media are also measures that were included in this component (Kaufmann et al., 2009).

Political Stability and Absence of Violence/Terrorism – this captured the perceptions of citizens and worldwide analysts of the probability that the host country's government may be overthrown in an unconstitutional manner. This includeed military violence, politically motivated violence as well as terrorism (Kaufmann et al., 2009).

Government Effectiveness – this measured government's ability to deliver. It captured aspects such as quality of public services, quality of civil services, degree of independence of the civil service from political pressure, quality of policy formulation, policy implementation, and the government's real commitment to these policies (Kaufmann et al., 2009).

Regulatory Quality – this measured a government's ability to implement the policies and regulations required for the private sector to thrive (Kaufmann et al., 2009).

Rule of law – this captured a participant's perceptions of the country citizens abiding by the rules of society. In particular the enforcement of contracts, property rights, the police and the courts' effectiveness. The likelihood of violence and crime were also included into this index (Kaufmann et al., 2009).

Control of corruptio f the respondents to how they see public power as being exercised for personal or financial gain. This included all types of corruption from petty bribery to grand forms of corruption. In addition, the index measured the extent to which the state is held in the hands of the elite and private interests (Kaufmann et al., 2009).

Corruption perception index - the data was sourced from Transparency International. This index was different from the index posed by Kaufmann et al. (2009) above and was used as another measure of potential deterrent from investment into an economy.

Environmental Compliance

ISO 14001 Certifications – this data was sourced from the UNEP database and contains all ISO 14001 certifications obtained in the host country for the years 1998 to 2006. The data represents the total sum of the certifications obtained for the period. This was then normalised using the population statistics to provide for the number of ISO certifications per capita.

Signatory to the Basel Convention – this data was also sourced from the UNEP database and details whether the listed country is a signatory to the Basel Convention or not. If the country was a signatory, a value of 1 was assigned, if not a value of 0 was assigned.

4.2.3. Normalis

Some of the independent variables may not have been intrinsically suited to being assessed against each other. In order to ensure that they are able to be assessed, a normalising variable was to be introduced.

Depending on the required outcome and the variable that was being assessed, three different normalising variables were used. For variables measuring levels of economic development, the GDP per capita was utilised, while in order to assess the market attractiveness, the GDP figure was used. The total population figure was used to normalise access to resources.

4.3. Statistical analysis

The following section describes the process through which the data was analysed to help determine the outcomes for the research questions posed in chapter 3.

The dependent variable used to determine what the chemical industry investment flows are, was attained from the Bureau of Economic Analysis. The identified independent variables were grouped into five different cluster groupings that represent, the value of human capital, country infrastructure, industry performance, governance indicators, and environmental compliance. These five clusters took into account the factors addressed by Biswas (2002), Feiock (2000) and Suer (1995) which included, protection of property rights, including physical and intellectual rights; supporting industries for production enablement; and the relative degree of regulatory control within the. These variables were subjected to a regression analysis to determine their significance

related to the indus ɔn of fit (Zikmund, 2003) into the model allowed for an understanding of the contributors of the chemical industry specific parameters into the overall model.

The regression analysis of the data collected was based on the Bénassy-Quéré, et al. (2007) study, which determined the significant components that influence investment decisions by US multinationals investing into the chemical industries of the world. From this, the level of FDI competitiveness and attractiveness of South Africa as a capital investment destination could be determined based upon South Africa's performance in the world. The positional value and the rank of South Africa in the results determined the level of its competitiveness in the world economy.

The regression analysis used to determine the overall fit of the model (Rudestam & Newton, 2001) assessed the correlation coefficient of determination (R^2) (Zikmund, 2003). The five different clusters were subjected to a regression analysis to determine the cluster's contribution to investment decisions by US multinational corporations investing in the chemical industry. Where the R^2 value came out as less than 0.3, the particular cluster was considered to not be statistically significant enough to contribute to the investment decisions of US multinational operations managers decisions to invest in international markets. This was due to traditional FDI models being able to explain FDI decisions by between 0.3 and 0.55 (Biswas 2002). Therefore should anything be less than the lower limit, it would not have contributed to the development of an improved model.

The higher the beta measured that determine the investment factors into the chemical manufacturing industry in the world, the higher the determination of these as significant areas for government to focus on should be (Zikmund, 2003). Where β is negative, so this should be reversed to allow an industry to flourish. An example of this would be that should the β of the variable regulatory control = -0.8, this would indicate that a high negative correlation exists between FDI investment and high regulatory control. While it may not be prudent to make the assumption, as correlations do not prove causation, should the South African Government wish to create a more enticing chemical manufacturing environment, they could consider looking at ways to overcome the levels of regulatory control being experienced by the industry.

A decision criteria was utilised to include or exclude the data variable to ensure parsimony was attained. The variables were excluded from the model until the least number of variables provided the highest return, or there was no reason to exclude them based upon the include or exclude decision criteria.

4.3.1. Analysis for research question 1

Is the South African chemical manufacturing industry an attractive destination for foreign direct investment?

The US investment into the chemical industries of the various world economies data was used to determine where South Africa ranks in terms of ability to attract investment. The normalised variant of the data that took into account the data was normalised using the GDP per capita information to provide the new ratio.

Table 2: Descriptive l Investment Data

One Variable Summary	US Chemical Investment (US$)
Mean	0.1105
Variance	0.0705
Std. Dev.	0.2654
Skewness	4.4125
Kurtosis	25.2982
Median	0.0163
Mean Abs. Dev.	0.1392
Minimum	-0.0695
Maximum	1.7606
Range	1.8300
Count	83
Sum	9.1710
1st Quartile	0.0028
3rd Quartile	0.0859
Interquartile Range	0.0831
South Africa	0.06189297
South Africa Rank	29

In order to normalise the data due to economy sizes, the US investment into foreign country data (Chem_Invest) was divided by the average GDP per capita for 2004 to 2008 in line with the chem_invest_ave (GDP_Per_Cap_ave), to provide a comparative ratio. The descriptive information for the dataset is included in the table above and is referred to as Chem_invest_GDP/Cap_Ratio. The figure for South Africa is provided, as well as South Africa's rank in terms of the data set. The table above indicates that the data is not evenly distributed and is positively and significantly skewed. This accounts for the great difference between the mean and the median.

The unit of analysis is US Dollars for GDP per capita. The ratios are similarly dollar based.

A single tailed hypothesis test was conducted on the data, to ascertain whether the South African figure of 0.06189297 was greater than or equal to the mean of

the data. A 95% co ermine the level of fit into the hypothesis.

4.3.2. Analysis for research question 2

What are the main competitive determinants (Biswas, 2002) offered by South Africa to a foreign company investing in a chemical operation locally?

In order to answer this question, the variables identified through the literature review were identified and were found within the various data sources available on the internet (refer to 4.2 for information on the variables). The data sources were grouped into five categories that were individually analysed.

The specific details of the independent variables are included in Table 1 but the descriptive analysis of the different variables by grouping are included in the tables below.

Table 3: Descriptive summary of value of human capital variables

One Variable Summary	Tertiary Students in science & Engineering	Researchers in R&D	Education Index
Mean	23.672	1939.22	0.8769
Variance	38.259	3583862.27	0.0128
Std. Dev.	6.185	1893.11	0.1131
Skewness	0.8801	1.0361	-1.5058
Kurtosis	3.3932	3.5928	5.3954
Median	23.000	1434.00	0.9040
Mean Abs. Dev.	4.903	1559.88	0.0847
Minimum	15.000	47.00	0.4660
Maximum	40.000	7832.00	0.9930
Range	25.000	7785.00	0.5270
Count	58	60	80
Sum	1373.000	116353.00	70.1520
1st Quartile	19.000	287.00	0.8270
3rd Quartile	27.000	3187.00	0.9580
Interquartile	8.000	2900.00	0.1310

Range		

The three variables assessed in the table above were similarly distributed, while the education index was skewed to the left compared with the others that were skewed to the right. The count of the variables differed quite significantly with the Tertiary students enrolled in science and engineering only having 58 data points compared with the education index of 80.

Table 4: Descriptive summary of infrastructure variables

One Variable Summary	Internet	Nuclear Power	Renewable Energy	Road Network GDP/CAP Ratio	Km of Roads / Capita
Mean	292.96	4.591	6.32	110.59	0.00971
Variance	52858.32	81.644	121.29	274938.13	0.00012
Std. Dev.	229.91	9.036	11.01	524.35	0.01080
Skewness	0.6335	2.2668	3.8591	8.2676	2.1109
Kurtosis	2.2122	8.1039	21.6799	74.7894	7.4016
Median	206.00	0.000	2.50	11.88	0.00628
Mean Abs. Dev.	200.06	6.602	6.48	160.37	0.00750
Minimum	14.00	0.000	0.00	0.00	0.00000
Maximum	869.00	42.600	72.60	4666.17	0.04702
Range	855.00	42.600	72.60	4666.17	0.04702
Count	80	76	75	83	83
Sum	23437.00	348.900	474.10	9178.94	0.80619
1st Quartile	85.00	0.000	0.70	2.86	0.00251
3rd Quartile	473.00	2.800	5.90	42.68	0.01327
Interquartile Range	388.00	2.800	5.20	39.82	0.01075

The variables in the infrastructure cluster showed significant differences in the Road Network GDP/Cap ratio and the Renewable Energy variables. These two variables were not normally distributed as can be determined by the Kurtosis and skewness values. .

Table 5: Descriptive factors

One Variable Summary	Raw material production GDP/Cap Ratio	Raw material consumption GDP/Cap Ratio	Net Raw Material Usage GDP/Cap Ratio	Industrial competitiveness index
Mean	0.2037	0.1287	0.0750	0.3391
Variance	0.7158	0.4556	0.0655	0.0358
Std. Dev.	0.8460	0.6750	0.2560	0.1892
Skewness	6.9264	8.0237	3.3273	0.8029
Kurtosis	56.3135	70.6754	14.1366	3.2967
Median	0.0075	0.0074	0.0000	0.2908
Mean Abs. Dev.	0.3187	0.1971	0.1378	0.1543
Minimum	0.0000	0.0000	-0.2136	0.0563
Maximum	7.0202	5.9020	1.3109	0.8954
Range	7.0202	5.9020	1.5245	0.8391
Count	83	83	83	76
Sum	16.9090	10.6851	6.2239	25.7719
1st Quartile	0.0000	0.0000	-0.0029	0.2012
3rd Quartile	0.0624	0.0353	0.0195	0.4602
Interquartile Range	0.0624	0.0353	0.0224	0.2590

In the table above, the two variables of raw material consumption and production were quite similar in their descriptive make up. The industrial competitiveness index very closely follows the normal distribution curve.

Table 6: Descriptive summary of industry performance factors (Cont.)

One Variable Summary	Fertiliser 10yr Ave/ Capita Ratio	Fertiliser 5yr Ave/ Capita Ratio	Patent Applications /Capita	Trade as a % of GDP 5yr Average
Mean	26315.26	26381.17	3054.14	88.39
Variance	903182130.72	941348454.32	35825190.57	3219.68
Std. Dev.	30052.99	30681.40	5985.41	56.74
Skewness	3.0155	3.2231	2.9544	2.7273
Kurtosis	14.5439	16.3090	12.3063	15.1880
Median	16982.69	17221.21	713.51	76.43
Mean Abs. Dev.	18782.29	18715.91	3704.35	37.03
Minimum	0.00	0.00	0.00	0.00
Maximum	176081.70	192726.01	32508.49	404.78

Range			32508.49	404.78
Count	83	83	83	81
Sum	2184166.43	2189637.12	253493.65	7159.55
1st Quartile	10221.18	9936.32	121.44	56.34
3rd Quartile	32663.61	32634.78	2574.09	102.49
Interquartile Range	22442.44	22698.47	2452.65	46.15

The second table of the industry performance indicators are all similarly distributed.

Table 7: Descriptive summary of governance indicators

One Variable Summary	Voice Accountability	Political Stability	Governement Effectiveness	Regulatory quality
Mean	0.4421	0.1762	0.5891	0.5650
Variance	0.7432	0.8258	0.8823	0.7082
Std. Dev.	0.8621	0.9087	0.9393	0.8415
Skewness	-0.4873	-0.5703	0.2260	-0.1308
Kurtosis	2.3371	2.3498	1.8187	1.8817
Median	0.5652	0.3496	0.5112	0.6368
Mean Abs. Dev.	0.7323	0.7651	0.8106	0.7229
Minimum	-1.6044	-1.9991	-0.9555	-1.2793
Maximum	1.6271	1.5682	2.3027	1.8701
Range	3.2315	3.5673	3.2582	3.1494
Count	83	83	83	83
Sum	36.6969	14.6261	48.8993	46.8956
1st Quartile	-0.2338	-0.6397	-0.2408	-0.2084
3rd Quartile	1.0906	0.9203	1.2275	1.2327
Interquartile Range	1.3245	1.5600	1.4683	1.4411

Table 8: Descriptive summary of governance indicators (Cont.)

One Variable Summary	Rule of Law	Control of Corruption	Corruption perception Index
Mean	0.4250	0.485	5.215
Variance	0.9524	1.086	5.066
Std. Dev.	0.9759	1.042	2.251
Skewness	0.0552	0.3404	0.3702

Kurtosis		9253	1.8643
Median	0.4886	0.344	5.000
Mean Abs. Dev.	0.8393	0.892	1.940
Minimum	-1.3606	-1.184	1.900
Maximum	2.0446	2.460	9.300
Range	3.4053	3.644	7.400
Count	83	83	81
Sum	35.2717	40.219	422.400
1st Quartile	-0.4864	-0.347	3.400
3rd Quartile	1.1905	1.246	6.900
Interquartile Range	1.6770	1.593	3.500

The descriptive statistics from the governance indicators group of variables did not highlight any substantial differences that need noting. Of interest and worth considering is the similarity between the two corruption variables, considering that they are from different sources, they are very similarly distributed.

Table 9: Descriptive summary of environmental compliance indicators

One Variable Summary	Signatory to Basel	Average ISO certifications GDP/Cap Ratio	Total ISO certifications GDP/Cap Ratio
Mean	0.9759	0.0950	0.851
Variance	0.0238	0.1794	14.535
Std. Dev.	0.1543	0.4235	3.812
Skewness	-6.3217	7.9793	7.9772
Kurtosis	41.9003	70.4315	70.4055
Median	1.0000	0.0120	0.084
Mean Abs. Dev.	0.0470	0.1304	1.175
Minimum	0.0000	0.0000	0.000
Maximum	1.0000	3.7158	33.442
Range	1.0000	3.7158	33.442
Count	83	83	83
Sum	81.0000	7.8811	70.596
1st Quartile	1.0000	0.0032	0.022
3rd Quartile	1.0000	0.0569	0.512
Interquartile Range	0.0000	0.0537	0.490

The descriptive stati ance factors revealed that there were only 2 countries that were not signatories to the Basel Convention, but which attracted active FDI into their chemical industries by US multinationals. The data was not very evenly distributed, as can be seen by the high Kurtosis values and levels of skewness.

A regression analysis was run on the different clusters of variables to determine the correlation coefficient of the data to the model. Each cluster of variables was analysed separately to provide an indication of the level of fit that the information has into the model.

Within the different models, the variables that contributed significantly to the regression with a P value of less than 0.2, were added into another regression to provide an improved model. The results of these regressions are included into the following section and will be discussed in more detail in the sections to come.

5. Results

5.1. Introduction to results

The previous section described the methodology behind the analysis of the variables determined for the analysis. The variables were chosen based upon the research questions posed in chapter 3 in order to help determine what the factors are that shape the investment decisions of foreign multinationals into different country's chemical manufacturing industries.

During the process of gathering the data and analysing it a number of exploratory tests were undertaken using different variables and different normalising variables. An example of this was during one of the first analyses of the dependent variable, Chemical Investment by US multinationals data series (Chem_Invest). The year 2008 proved to have insufficient information to be able to produce any meaningful results and so the average for the years from 2004 until 2008 was utilised. In order to normalise this data it had to be paired with sufficient other data and so the GDP per capita (GDP/CAP) for each country for the same time period was used to normalise this data that became the chemical investment by US multinationals GDP per Capita Ratio (Chem_Invest_GDP/Cap_Ratio).

5.2. South Africa as a competitive destination for chemical manufacturing

The first hypothesis in chapter 3 deals with this question and in order to determine South Africa's attractiveness, a single tailed hypothesis was utilised. South Africa, as can be seen in Table 2, ranks 29th out of 83 with a value of

0.06189297. The ra ıe top 50 percent of total countries, however in terms of being able to attract significant US investment of the total US FDI pie, it is a different story. The data in the tables below was analysed first in order to show the full picture.

In order to provide a better understanding of the data, the tables below summarised the dataset into four different quartiles in terms of their ranks, with their specific values. The dataset used was the normalised Chem_Invest_GDP/Cap_Ratio data (chemical investment by US multinationals GDP per Capita Ratio), that assesses the investment by US multinationals into the chemical industries of the world, paired with the GDP/Capita values of that country. Unless stated in the analysis by a change in the wording, this was the default dependant variable used.

Table 10: Upper quartile of Countries in Chem_Invest_GDP/Cap_Ratio

Country	Chem_invest_GDP /Cap_Ratio	Rank	Country	Chem_invest_GDP /Cap_Ratio	Rank
China	1.760562506	1	**Netherlands**	0.192239443	12
India	1.262759784	2	**Indonesia**	0.186567484	13
Brazil	0.892087958	3	**France**	0.160714214	14
Mexico	0.543207417	4	**Colombia**	0.160619302	15
Philippines	0.431680159	5	**Malaysia**	0.160062882	16
United Kingdom	0.39179904	6	**Germany**	0.134403833	17
Canada	0.349688489	7	**Venezuela**	0.129724642	18
Argentina	0.30063997	8	**Australia**	0.104181645	19
Thailand	0.27946602	9	**Turkey**	0.103705369	20
Belgium	0.221337463	10	**Japan**	0.088327889	21
Spain	0.209373821	11			

Table 11: Upper mic Invest_GDP/Cap_Ratio

Country	Chem_invest_GDP/Cap_Ratio	Rank	Country	Chem_invest_GDP/Cap_Ratio	Rank
Chile	0.085080471	22	Taiwan	0.049666619	32
Poland	0.084931758	23	Vietnam	0.031728253	33
Pakistan	0.080820603	24	Nigeria	0.029351123	34
Italy	0.080062617	25	Romania	0.027888164	35
Ireland	0.079319111	26	Costa Rica	0.025497346	36
Switzerland	0.077937299	27	Guatemala	0.024579358	37
Korea, Republic of	0.072936119	28	Russia	0.020843461	38
South Africa	0.061892972	29	Bolivia	0.020763084	39
Peru	0.053538944	30	Dominican Republic	0.019071827	40
Singapore	0.051215836	31	Kenya	0.018968153	41

Table 12: Lower middle quartile of Countries in Chem_Invest_GDP/Cap_Ratio

Country	Chem_invest_GDP/Cap_Ratio	Rank	Country	Chem_invest_GDP/Cap_Ratio	Rank
Morocco	0.017960804	42	Honduras	0.006420765	53
Czech Republic	0.014551357	43	Panama	0.006380081	54
Saudi Arabia	0.011914784	44	New Zealand	0.005964905	55
Hungary	0.011668293	45	Portugal	0.005852284	56
Trinidad and Tobago	0.010990495	46	Serbia	0.005648977	57
Hong Kong	0.010366478	47	Austria	0.005520461	58
Ecuador	0.010326045	48	Greece	0.005165029	59
Israel	0.00904505	49	Bulgaria	0.003761646	60
Uruguay	0.008875519	50	Paraguay	0.003652965	61
Sweden	0.008067947	51	Finland	0.002942986	62
El Salvador	0.006824363	52			

Table 13: Lower quartile of Countries in Chem_Invest_GDP/Cap_Ratio

Country	Chem_invest_GDP/Cap_Ratio	Rank	Country	Chem_invest_GDP/Cap_Ratio	Rank
United Arab Emirates	0.002896386	63	Botswana	0.000634189	74
Latvia	0.002337092	64	Netherlands	0.000596314	75

Norway	0.002183518	65	**Luxembourg**	0.000275049	76
Ghana	0.002106242	66	**Oman**	8.19228E-05	77
Fiji	0.001829645	67	**Cyprus**	7.3615E-05	78
Estonia	0.001519555	68	**Iceland**	3.97957E-05	79
Barbados	0.00101852	69	**Dominica**	-0.000341301	80
Slovakia	0.000955714	70	**Ukraine**	-0.004168396	81
Sri Lanka	0.000792979	71	**Algeria**	-0.004853613	82
Denmark	0.000686562	72	**Egypt**	-0.069473461	83
Slovenia	0.000677547	73			

Table 2 describes the Chem_Invest_GDP/Cap_Ratio data. The mean of the data lies at 0.1105 while the median equals 0.0163, which is approximately 15% of the mean. The reason for this is likely to be the discrepancy of 70% of US FDI going into the chemical industries of the top 10 countries. Tables 10 to 13 break up the individual countries into the different quartiles. South Africa (Highlighted in yellow of Table 11) ranks 29th and is in the upper middle quartile per rank, however the value of South Africa falls well below the mean of the dataset of 0.548. On its own, the mean would rank 4th in the table ahead of Mexico. This indicates that 50% of the total investment in chemical industries as a GDP per capita ratio goes to the top 4 countries.

The results from the hypothesis tests for different variants of active US FDI activity into the chemical industries of the world are included in Table 14 below. The hypothesised mean is the South African value for the variable.

Table 14: Hypothesis results for South Africa's competitiveness

Hypothesis Test	**Chemical investment GDP/Cap Ratio**	**Total Chemical investment by US multinational (US$m)**	**Average Chemical investment by US multinational (US$m)**	**10yr average of Chemical investment GDP Ratio**
Sample Size	83	83	83	83
Sample Mean	0.548	5985.16	1220.13	0.01526

Sample Std Dev			2613.53	0.02297
Hypothesized Mean	0.061893	1491	298.2	0.008352
Alternative Hypothesis	> 0.061893	> 1491	> 298.2	> 0.008352
Standard Error of Mean	0.145714086	1413.853719	286.8717014	0.002521795
Degrees of Freedom	82	82	82	82
t-Test Statistic	3.3340	3.1787	3.2137	2.7412
p-Value	0.0006	0.0010	0.0009	0.0038
Null Hypoth. at 10% Significance	Reject	Reject	Reject	Reject
Null Hypoth. at 5% Significance	Reject	Reject	Reject	Reject
Null Hypoth. at 1% Significance	Reject	Reject	Reject	Reject

Based on the information contained in the table above, the fact that the hypothesis test rejects the null hypothesis at all levels indicates that South Africa ranks well below the true mean and is thus not competitive.

In order to show the full picture of the areas in which the US chemical multinationals consider engaging with the rest of the world, the descriptive statistics and relevant hypothesis are included into Table 15 and Table 16 below. The data shows countries where there has been no activity through FDI flows into that country, but for which there was no missing data.

Table 15: Descriptive statistics for Chem Invest GDP/Cap Ratio data for all countries listed without missing data

One Variable Summary	**Chem_Invest_GDP_Per_Cap_Ratio_All (US$)**
Mean	0.0527
Variance	0.0365
Std. Dev.	0.1909
Median	0.0000
Mean Abs. Dev.	0.0823
Minimum	-0.0695
Maximum	1.7606

Range	300
Count	174
Sum	9.1710
1st Quartile	0.0000
3rd Quartile	0.0119
Interquartile Range	0.0119
South Africa	0.06189297
South Africa Rank	29

This table shows that the mean for the dataset has come down significantly from the mean of the Chem_Invest_GDP/Cap_Ratio data as listed in column 2 of Table 14 of 0.548 to 0.0527. South Africa's value is now above the mean of this dataset. This is mostly due to the fact that 90 countries with a value of 0 were included into the test and would bring the mean down substantially.

Table 16: Hypothesis results for South Africa's competitiveness for SA against all listed countries without missing data for Chem_Invest_GDP/Cap_Ratio

Hypothesis Test	**Chem_invest_ GDP/Cap_Ratio_All**
Sample Size	174
Sample Mean	0.0527
Sample Std Dev	0.1909
Hypothesized Mean	0.061893
Alternative Hypothesis	> 0.061893
Standard Error of Mean	0.014475274
Degrees of Freedom	173
t-Test Statistic	-0.6346
p-Value	0.7367
Null Hypoth. at 10% Significance	Don't Reject
Null Hypoth. at 5% Significance	Don't Reject
Null Hypoth. at 1% Significance	Don't Reject

The hypothesis does not reject that the sample mean is equal to the South African value that was used as the hypothesised mean. In addition to this, South Africa ranks in the top 17% (29 ÷ 174 × 100) compared with only being in the top 35% (29 ÷ 83 × 100) of the countries that receive active investment from the US multinational chemical companies.

The concern howev tive, the industry in which a corporation competes must be an active industry and thus the countries that have not attracted active FDI, that is that had an investment value of zero for the assessed period, were not considered to be players in the game. As a result the active investment figures of the Chem_Invest_GDP/Cap_Ratio (Table 14) is the better information against which to asses South Africa.

The first column in Table 14 provides the hypothesis information. The second, Chem_Invest_GDP/CAP_Ratio, represents the results of the hypothesis that the mean is equal to South Africa's value, 0.061893. The results of this are that the hypothesis suggests rejecting the null hypothesis that South Africa's value is not equal to the mean of the dataset. Inferring from the results of the hypothesis, the mean is substantially higher than this and has the value of 0.548.

The third column of Table 14 represents the value of the total investment into the different chemical industries throughout the world by US multinationals, (Chem_invest_Total). This dataset summated the values of investment for the years 2004 to 2008 to provide a true number of total investment. South Africa's value equalled US$ 1491 million for the period. This was used as the mean for the hypothesis that returned a "reject the null hypothesis at all significance levels". The true mean valued at US$ 5985.16 million.

The fourth column of Table 14 details the hypothesis test for the average total investment into chemical industries of the world by US multinationals. The figures are the average for the years 2004 to 2008. Again the South African

value was utilised a d again it was rejected to the 1% significance level. The true mean valued at US$ 1220.13 million.

The fifth column of Table 14 normalised the investment by US multinational firms into the chemical industries of the world by utilising the 10-year average of the host country's GDP. This was performed to reduce or negate any possible impact that population size may have had on the data, by using the GDP per Capita normalising data. In this hypothesis the South African value of 0.008352 was used as the mean and was rejected up to the 1% significance level. The true mean was valued at 0.01526.

As is stated in the hypothesis of the research question, active foreign investment is being measured. This is to say that only countries that had experienced either a positive or negative flow of FDI in the industry were included into the dataset. Table 15 and Table 16 provide the descriptive statistics and hypotheses for the Investment by US chemical multinationals into all the countries of the world. In this dataset there was a number of countries that had missing data that were excluded from the results, but more importantly the countries for which the investment value of 0.00 were also included. This was expected to bring down the mean substantially and provide a more realistic perspective of the worldwide chemical investments.

When South Africa's value of 0.061893 is posed as being the mean, the hypothesis does not reject the claim, even at a 10% significance level. The predicted mean rests at 0.0527.

5.3. South Af estment choices for US chemical manufacturing multinationals

The results of the analyses for the first component of the question of whether South Africa is an attractive destination, assessed South Africa to be below the mean for the Chem_Invest_GDP/Cap_Ratio (investment US multinational companies into chemical industries of the world, paired with GDP / Capita data) data. Based upon this result, South Africa does not stand in the top 25% of the attractive countries, even by rank, which ranks SA at 29 of the 83 countries in the dataset.

Table 17: Top quartile of Countries in Chem_Invest_GDP/Cap_Ratio

Country	Chem_invest_GDP /Cap_Ratio	Rank	Country	Chem_invest_GDP /Cap_Ratio	Rank
China	1.760562506	1	**Netherlands**	0.192239443	12
India	1.262759784	2	**Indonesia**	0.186567484	13
Brazil	0.892087958	3	**France**	0.160714214	14
Mexico	0.543207417	4	**Colombia**	0.160619302	15
Philippines	0.431680159	5	**Malaysia**	0.160062882	16
United Kingdom	0.39179904	6	**Germany**	0.134403833	17
Canada	0.349688489	7	**Venezuela**	0.129724642	18
Argentina	0.30063997	8	**Australia**	0.104181645	19
Thailand	0.27946602	9	**Turkey**	0.103705369	20
Belgium	0.221337463	10	**Japan**	0.088327889	21
Spain	0.209373821	11			

Table 17 above displays the countries in the top quartile that have attracted US FDI into their chemical industries for the years from 2004 until 2008 as a ratio of GDP per Capita. South Africa is not in this list. Therefore South Africa does not rank in the top 25% of investment choices for US chemical manufacturing multinationals.

5.4. The cont ...emical manufacturing industry by US multinational firms

The independent variables described in chapter 4 were analysed against the dependent variable in a regression model to attempt to determine what the significant contributors to investment by US multinational firms into worldwide chemical industries are. The independent variables were clustered into five industry predictive groupings. This was performed to gain a sense of the contribution of the "traditional and non-traditional" variables described in the literature (Biswas, 2002).

Following on from the regressions of the individual groups of variables, the significant determinants of the individual groups were extracted, based on a decision criteria developed and described below, and included into a single regression model to explain the whole dataset.

5.4.1. Regression analysis of predictive grouping clusters

The results of the regressions of the predictive clusters are included into the tables below.

Table 18: Value of Human Capital Regression

Summary	*Multiple R*	*R-Square*	*Adjusted R-Square*	*StErr of Estimate*
	0.3809	0.1451	0.0825	0.23500

ANOVA Table	*Degrees of Freedom*	*Sum of Squares*	*Mean of Squares*	*F-Ratio*	*p-Value*
Explained	3	0.38432	0.12811	2.3196	0.0895
Unexplained	41	2.26431	0.05523		

Regression Table	*Coefficient*	*Standard Error*	*t-Value*	*p-Value*	*Variance Inflation Factor*
Constant	0.88624	0.39700	2.2323	0.0311	
Tert_Stud_Sci_Eng	-0.00374	0.00555	-0.6737	0.5043	1.0092
Reas_R&D	-0.00002	0.00002	-0.7594	0.4519	1.4886
Educat	-0.68152	0.42938	-1.5872	0.1201	1.4908

The Value of Human Capital Regression did not explain the investment decisions by US multinationals into the chemical industries of the world very well. The R^2 value of 0.1451 without any significant concerns with multicollinearity indicated that this is not a significant model.

Table 19: Country Infrastructure Regression

Summary	**Multiple R**	**R-Square**	**Adjusted R-Square**	**StErr of Estimate**
	0.6485	0.4206	0.3786	0.2184

ANOVA Table	**Degrees of Freedom**	**Sum of Squares**	**Mean of Squares**	**F-Ratio**	**p-Value**
Explained	5	2.38982	0.47796	10.0173	< 0.0001
Unexplained	69	3.29226	0.04771		

Regression Table	**Coefficient**	**Standard Error**	**t-Value**	**p-Value**	*Variance Inflation Factor*
Constant	0.09088	0.04402	2.0647	0.0427	
Internet	-0.00002	0.00015	-0.1396	0.8894	1.7612
Nuc_Power	0.00047	0.00309	0.1532	0.8787	1.2061
Renew_Eng	0.00018	0.00254	0.0690	0.9452	1.2218
Road_Net_GDPCAP_Ratio	0.00032	0.00005	6.8726	< 0.0001	1.0345
Km_Roads_Cap	-0.59292	2.97727	-0.1991	0.8427	1.7120

The Country Infrastructure Regression did explain the investment decisions by US multinationals into the chemical industries of the world, to some extent. The R^2 value of 0.4206 without any significant concerns with multicollinearity indicated that there are possibly some variables within the model that do explain

the dependant vari[illegible]out is the Road Network GDP per Capita Ratio that has a very low p-Value.

Table 20: Industry Performance Factors Regression

Summary	**Multiple R**	**R-Square**	**Adjusted R-Square**	**StErr of Estimate**
	0.8422	0.7094	0.6880	0.15579

ANOVA Table	**Degrees of Freedom**	**Sum of Squares**	**Mean of Squares**	**F-Ratio**	**p-Value**
Explained	5	4.02833	0.80567	33.1960	< 0.0001
Unexplained	68	1.65035	0.02427		

Regression Table	**Coefficient**	**Standard Error**	**t-Value**	**p-Value**	***Variance Inflation Factor***
Constant	0.06789	0.04205	1.6147	0.1110	
Raw_Mat_Cons_GDPCAP_Ratio	0.31270	0.02578	12.1290	< 0.0001	1.1058
Indust_Comp_Index	0.30010	0.12851	2.3352	0.0225	1.8106
Fert_10yr_ave_PerCAP	0.00000	0.00000	-0.3244	0.7466	< 0.0001
Pat_Appl_perCap	0.00000	0.00000	-1.2789	0.2053	1.3595
Trade%_GDP_5_Yr_Ave	-0.00079	0.00036	-2.2035	0.0309	1.2894

The Industry Performance Regression explained the investment decisions by US multinationals into the chemical industries of the world very well. The R^2 value of 0.7094 without any significant concerns with multicollinearity indicated that this is a significant model. Within the model however, the Raw Material Consumption GDP/Cap ratio was the most significant contributor to the model.

Table 21: Governance Indicators Regression

Summary	**Multiple R**	**R-Square**	**Adjusted R-Square**	**StErr of Estimate**
	0.3599	0.1295	0.0461	0.26191

ANOVA Table	**Degrees of**	**Sum of**	**Mean of**	**F-Ratio**	**p-Value**

Explained	7	0.74521	0.10646	1.5519	0.1636
Unexplained	73	5.00773	0.06860		

Regression Table	**Coefficient**	**Standard Error**	**t-Value**	**p-Value**	***Variance Inflation Factor***
Constant	0.18979	0.36765	0.5162	0.6073	
Voice_Account_Aver	-0.03343	0.05776	-0.5787	0.5645	3.1213
Pol_Stab_Aver	-0.03859	0.06219	-0.6205	0.5369	4.2433
Gov_effect_Aver	0.44664	0.17398	2.5672	0.0123	32.8437
Regulat_Qual_Aver	-0.17890	0.12792	-1.3985	0.1662	14.0778
Rule_of_Law_Aver	0.01682	0.16614	0.1012	0.9196	35.2796
Contr_of_Corrupt_Aver	-0.20553	0.22785	-0.9020	0.3700	70.5278
Corrupt_percept	-0.02424	0.08837	-0.2743	0.7846	47.8281

The Governance Indicators Regression did not explain the investment decisions by US multinationals into the chemical industries of the world very well with an R^2 value of 0.1295. There were however significant concerns regarding multicollinearity that would suggest that some factors may contribute to the model well, provided that others were excluded from the model.

Table 22: Environmental Compliance Regression

Summary	**Multiple R**	**R-Square**	**Adjusted R-Square**	**StErr of Estimate**
	0.8381	0.7024	0.6911	0.14752

ANOVA Table	**Degrees of Freedom**	**Sum of Squares**	**Mean of Squares**	**F-Ratio**	**p-Value**
Explained	3	4.05831	1.35277	62.1656	< 0.0001
Unexplained	79	1.71910	0.02176		

Regression Table	**Coefficient**	**Standard Error**	**t-Value**	**p-Value**	***Variance Inflation Factor***
Constant	0.00410	0.10433	0.0393	0.9688	
Basel_Signatory_1 Yes_0No	0.06907	0.10578	0.6530	0.5157	1.0038
Average_No._ISO_ GDPCAP_Ratio	-21.81718	14.88546	-1.4657	0.1467	142336.022

					0
ISO_Sumif_Positive_GDPCAP_Ratio	2.48146	1.65357	1.5007	0.1374	142334.7545

The Environmental Compliance Regression did explain the investment decisions by US multinationals into the chemical industries of the world very well with an R^2 value of 0.7024. There is a problem, however, with multicollinearity in that the two ISO variables are themselves correlated. The average number of ISO certifications obtained as a ratio with GDP per capita will be removed as it has a negative coefficient and the p-value is higher, as is detailed in the following section.

5.4.2. Include – Exclude Decision criteria

In order to ensure that the explanatory variables (independent variables) contributed significantly to the model and to ensure that multicollinearity did not occur, some variables were excluded from the dataset. In the interests of parsimony a model should be fully explained by the variables contributing to that model. However, before being able to exclude the data from the model a decision criteria should be established(Albright, Winston, & Zappe, 2006).

Decision criteria 1: p-Value

If the p Value is above 0.1, the variable is not likely to be a significant contributor to the model and should be excluded

Decision criteria 2: t-value and p-value combined

Some variables are likely to have a very high correlation with the dependent variable. However, due to other better independent variables in the model, the

independent variabl contribution to the model is negligible (Albright et al., 2006). A variable with a low t-value and a high p-value may be reflective of this anomaly and should thus be excluded from the model.

Decision criteria 3: logical relationships

Some variables are very logically related and for this reason they should all be included, or excluded, as the specific case determines. Should this decision be considered, the individual t-values are less important than the partial F test. The larger the F-Ratio of the model and the lower the p-Value of the variable, the more significant the contribution of the variable to the model and therefore the more you should consider not dropping the variable from the equation. Regressions where the F-Ratio comes out at less than 2 will be considered to not significant, together with the R^2 value of that regression model.

Decision criteria 4: VIF value

Multicollinearity occurs when two or more of the explanatory variables are highly correlated (Albright et al., 2006). The Variance Inflation Factor (VIF) considers this relationship and for any value in excess of 10 indicates multicollinearity and should be rejected from the model.

5.4.3. Regression analysis of contributory variables

Based upon the decision criteria listed in section 5.4.2 above certain information was excluded from the total factor regression models that follow, because they did not contribute significantly to their original regression model. In the interests

of parsimony and an understanding of the variables, which contribute to US investment into chemical industries worldwide, the new regression models provided results that are more significant.

Table 23: Regression Summaries

Predictive cluster	***R-Squared***	***F-Ratio***	***P-Value***
Value of Human Capital	0.1451	2.3196	0.0895
Country Infrastructure	0.4206	10.0173	< 0.0001
Industry Performance Factors	0.7094	33.1960	< 0.0001
Governance Indicators	0.1295	1.5519	0.1636
Environmental Compliance	0.7024	62.1656	< 0.0001

Based upon Table 23 above, only three of the contributory clusters appeared to be substantial contributors to the explanation of variables that contribute to the influences of FDI inflows from US multinationals into other country's chemical industries. These are the infrastructure within that country, the performance of the industry in that country and the levels of environmental compliance within that country.

The value of human capital and levels of governance, except for the government effectiveness variable from the governance regression as this did not fail the include-exclude decision criteria, do not appear to be statistically significant. For this reason these variables were excluded from the following regression model. Other components that were excluded were based upon the

include-exclude dec ıto the model, they tested for multicollinearity and were therefore excluded.

Table 24: Regression of significant variables

Summary	**Multiple R**	**R-Square**	**Adjusted R-Square**	**StErr of Estimate**
	0.8909	0.7938	0.7758	0.13048

ANOVA Table	**Degrees of Freedom**	**Sum of Squares**	**Mean of Squares**	**F-Ratio**	**p-Value**
Explained	6	4.52143	0.75357	44.2659	< 0.0001
Unexplained	69	1.17464	0.01702		

Regression Table	**Coefficient**	**Standard Error**	**t-Value**	**p-Value**	*Variance Inflation Factor*
Constant	-0.00333	0.03624	-0.0919	0.9271	
Road_Net_GDPCAP_Ratio	0.00017	0.00003	5.3955	< 0.0001	4.4104
Indust_Comp_Index	0.21028	0.12193	1.7245	0.0891	0.3046
Fert_10yr_ave_PerCAP	0.00000	0.00000	0.8704	0.3871	<0.0001
Pat_Appl_perCap	0.00000	0.00000	-1.2494	0.2157	3.9404
Gov_effect_Aver	-0.01876	0.02712	-0.6918	0.4914	0.0515
ISO_Sumif_Positive_GDPCAP_Ratio	0.04565	0.00437	10.4482	< 0.0001	3.9187

The application of the include-exclude decision criteria and combining the significant variables that were left over provided a model that returns a R^2 value of 0.7938 and a F-Ratio of 44.2659 with a P-Value of less than 0.0001. Within this dataset however there are some further variables that could be extracted by following the include-exclude decision criteria again.

Table 25: Regression of revised significant variables

Summary	**Multiple R**	**R-Square**	**Adjusted R-Square**	**StErr of Estimate**
	0.8854	0.7839	0.7728	0.12653

ANOVA Table	**Degrees of**	**Sum of**	**Mean of**	**F-Ratio**	**p-Value**

Explained	4	4.52870	1.13217	70.7203	< 0.0001
Unexplained	78	1.24872	0.01601		

Regression Table	**Coefficient**	**Standard Error**	**t-Value**	**p-Value**	***Variance Inflation Factor***
Constant	0.04231	0.01939	2.1814	0.0322	
Road_Net_GDPCAP_Ratio	0.00017	0.00003	5.5638	< 0.0001	1.2933
Fert_10yr_ave_PerCAP	0.00000	0.00000	1.1748	0.2436	< 0.0001
Pat_Appl_perCap	0.00000	0.00000	-0.7462	0.4578	1.0821
ISO_Sumif_Positive_GDPCAP_Ratio	0.04715	0.00415	11.3600	< 0.0001	1.2814

This new regression results in the R^2 value coming down from 0.7938 to 0.7839, while the F-Ratio increased to 70.7203 and the P-Value remains at less than 0.0001. Within this dataset, there were still some variables that could be extracted by following the include-exclude decision criteria again.

Table 26: Regression of most significant variables

Summary	**Multiple R**	**R-Square**	**Adjusted R-Square**	**StErr of Estimate**
	0.8829	0.7795	0.7740	0.12619

ANOVA Table	**Degrees of Freedom**	**Sum of Squares**	**Mean of Squares**	**F-Ratio**	**p-Value**
Explained	2	4.50353	2.25177	141.4114	< 0.0001
Unexplained	80	1.27388	0.01592		

Regression Table	**Coefficient**	**Standard Error**	**t-Value**	**p-Value**	***Variance Inflation Factor***
Constant	0.05179	0.01429	3.6229	0.0005	
Road_Net_GDPCAP_Ratio	0.00017	0.00003	5.6000	< 0.0001	1.2790
ISO_Sumif_Positive_GDPCAP_Ratio	0.04713	0.00414	11.3955	< 0.0001	1.2790

Two variables, the Road Network GDP per Capita Ratio and the total ISO certifications per GDP/Capita Ratio provided a R^2 value of 0.7795, an F-Ratio of 141.4114 with a P-Value of less than 0.0001.

The high R^2 values here is some significance behind the variables utilised in the model. The possible reasons behind this are explained in the sections to come. South Africa's positioning in the identified model, Table 24, is highlighted again in Table 27.

5.5. South Africa Measuring up against the FDI into Chemical industries determinants

Based upon the results of the analysis in section 5.4 above, the positioning of South Africa in terms of these numbers was assessed. Without going into too much analysis, the absolute data speaks volumes of where South Africa is positioned.

Table 27: South African Position in terms of significant variable contributions

		South Africa	Mean	Median
Chem_invest_GDP/Cap_Ratio	Value	0.0619	0.1105	0.0180
	Rank	29	42	42
Road_Net_GDPCAP_Ratio	Value	75.6	110.6	11.9
	Rank	16	42	42
Indust_Comp_Index	Value	0.2592	0.3391	0.2945
	Rank	44	38.5	38.5
Fert_10yr_ave_PerCAP	Value	16612	26315	16983
	Rank	43	42	42
Pat_Appl_perCap	Value	624	3054	714
	Rank	46	41	42
Gov_effect_Aver	Value	0.7577	0.5891	0.5322
	Rank	35	42	42
ISO_Sumif_Positive_GDPCAP_Ratio	Value	0.5120	0.8506	0.0845
	Rank	21	42	42

The highlighted green block indicates that the South African value is above the mean of the dataset that it is assessed against, in this case, the Government Effectiveness average. The green text indicates the value of the South African position if the South African rank falls into the top quartile of the dataset. South

Africa ranks in the t GDP per Capita Ratio and for the Total ISO certifications obtained as a ratio with GDP per Capita. The red text displays South Africa's value for the variables where it scored below the median and was ranked below the 50th quartile. This was applicable to the patent applications per capita, the 10 year consumption of fertiliser average per capita and its industrial competitiveness index score.

From a cursory glance at this information and taking into consideration where South Africa features in terms of the two most significant variables, Road network total KM as a ratio of GDP per Capita and the total ISO 14001 certifications attained per GDP per Capita Ratio, it would have been expected that SA would feature slightly higher in the total industry competitiveness rankings. This is however purely an observation and has not had been based upon any statistical inference.

6. Discussi

6.1. Introduction to results

In this section the results presented in chapter 5 are analysed and discussed in more detail, especially pertaining to the research questions posed in chapter 3. The background to the discussion will be hinged on the theoretical underpinnings as described in chapter 2.

This research paper has attempted to determine if South Africa is a competitive destination for chemical manufacturers to establish new operational units. The paper investigated where South Africa currently compares with other countries that receives investment from US multinational chemical firms. It then went into the determinants of the FDI flows to determine what were significant contributors to these flows.

This methodology was used to build a model that could explain with some degree of satisfaction the determinants of FDI flows from US multinational companies investing in foreign chemical industries. Realistically, however, correlation does not imply causation and thus the components identified in the model cannot be inferred as being the sole reason for the decisions to invest into some countries, however it provides a good proxy.

Summary of results:

Q1. Is the South African chemical manufacturing industry an attractive destination for foreign direct investment?

A1. No

Q2. What are the Biswas, 2002) offered by South Africa to a foreign company investing in a chemical operation locally?

A2. The Number of ISO certifications obtained and the density of the road network.

6.2. Research question 1 – South Africa as an attractive destination for international chemical manufacturers

The research question posed two sub-questions related to the attractiveness of the South African chemical manufacturing industry as a destination for foreign direct investment. The first related to whether South Africa's attractiveness was greater than the mean of all the different countries within the world. The second was a follow on from the first, in that if it were an attractive industry, would it rank in the top quartile of countries that chemical manufacturers considered investing in?

The rationale behind the investigation related to a number of different considerations. South Africa is a developing African economy and as such is struggling to grapple with developing an economy, while at the same time creating employment for a largely unskilled population.

The Accelerated and Shared Growth Initiative of South Africa (ASGISA) is the South African government's plan to ensure continued growth within the economy of above 5% per annum until 2014. This is intended to ensure that unemployment is reduced to less than 15% and to halve the poverty rate to less than $\frac{1}{6}$ of all households(Department of The Presidency, 2008) by 2014. These

commitments were ngress during their 2004 electoral manifest, when they promised to halve unemployment and poverty within 10 years (before 2014).

The ASGISA initiative is based on the premise that sustained economic growth will promote job creation and will better the lives of most South Africans. In order to maintain a sustained growth rate in excess of 5% per annum, the South African Government identified a number of sectors within the economy that could be leveraged in order to support the accelerated growth. The entire manufacturing sector was identified as being a vital contributor to this initiative. As a part of the manufacturing sector, the chemical industry plays a significant role towards meeting the objectives of South Africa's government as it employs 11% of workers in the manufacturing sector and contributes the most in terms of revenue generated of all the manufacturing sectors (StatsSA, 2006).

The concern as identified by Ilgen (1983) is that, worldwide, the chemical industry has reached a state of maturity where high growth is an abnormal condition. This has been reflected in the slower growth rates of the South African manufacturing sector. The rationale behind the investigation into the attractiveness of South Africa as an international chemical manufacturing destination is to determine where South Africa is situated in terms of its competitiveness within the global chemical manufacturing environment. The level of competitiveness should provide the country with an indication of the chemical industry's specific potential contribution to sustained economic growth of 5% or more per annum.

Chapter 5.2 of this r[illegible]nat South Africa occupies in the United States Foreign Investment into Chemical Industries as a Per Capita of local GDP ratio. The hypotheses posed in chapter 3 are again provided below, in a more mathematical format.

> H_0: FDI investment into SA chemical industry < μ of total active foreign investment into worldwide chemical industries
>
> H_1: FDI investment into SA chemical industry ≥ μ of total active foreign investment into worldwide chemical industries

Table 14 provides the hypothesis for different variants of the Chem_Invest_GDP/CAP_Ratio. This was performed to show completeness in the analysis of the variable, Investment into foreign countries by United States Multinationals, per sector, chemical sector. The data was normalised by utilising the host country's GDP per capita.

Based upon the results of the hypotheses tested in Tables 14 and 16, the mean of the datasets where US multinational chemical companies are active, is higher than the South African value. South Africa is therefore not competitive in terms of being able to attract US foreign investment into its chemical industry.

South Africa's international rank of 29 should not be discredited. Table 10 to Table 13 list the dataset Chem_Invest_GDP/Cap_Ratio value and rank for all 83 countries in the dataset by rank into the different quartiles. South Africa ranks in the upper middle quartile at 29 out of 83 countries (top 35%).

The Pareto Principle poses the reasons for the difference in the mean and the rank of South Africa. Of all the investment from US multinationals into the

chemical industries 503 / 9.171) of it goes to 20% (16 / 83) of the total countries. The data is thus very skewed, but if South Africa wants to compete in this sector, it has to attract greater total sums of investment per capita to achieve the desired outcome of ASGISA. It should try to get itself into the top 20%, which it fails to do and is thus not competitive.

Twelve (12) other developing countries fall into the top 25% that include China (1), India (2), Brazil (3), Mexico (4), Philippines (5), Argentina (8) and Thailand (9). While the top three countries have economies and populations significantly larger than South Africa, they are still able to attract a greater proportion of the US investment into their chemical industries. As a result, they are likely to develop faster and become more competitive if they are able to sustain this development.

6.3. Research question 2 – what are the main determinants of investment by foreign multinationals into chemical industries of local countries and how does South Africa compare?

Determinants of FDI into the different countries throughout the world has been widely documented (Tuman, 2009), however the specific determinants of FDI into the chemical industry has not. Biswas (2002) has argued that traditional demand factors used within regression models have only explained the determinants of total FDI by at most 55%. When non-traditional measures are added to the regression, FDI can be explained by as much as 93% by the following particular factors; improved infrastructure, low wage rates, longer duration of regime, and an environment respectful of property and contractual rights leading to increased FDI (Biswas, 2002).

The process of det stment into the chemical industries of the world was an iterative one. The guideline provided by Biswas (2002) and Bénassy-Quéré et al. (2007) suggested that factors related to Human Capital, Governance and Country Infrastructure should be investigated. Industry specific performance would provide a better understanding of factors that affect the industry specifically and together with this, environmental compliance factors as described by Feiock (2000) should be considered to obtain as holistic an understanding of the nature of investment decisions as is possible.

A number of different variables were developed within each of these different categories. The explanation for the variable is included in the relevant section within chapter 4 and so this will not be re-explored here.

The results of the analysis of the regression models and the variables within these confirms that two specific variables contribute significantly to the overall model these are: The Number of ISO certifications obtained and the density of the road network. South Africa Ranks 21st and 16th in the world respectively.

6.4. Making sense of the results

The reasons for selecting the variables in the first instance was based upon the theoretical underpinnings of chapter 2 in this research. Had this theory been entirely correct, all variables should have contributed significantly to the model and a very high R^2 value would have been achieved. But they did not and below follows an explanation.

Prasad et al. (20(l firms from developed economies seek improved efficiencies from their operational units, they are likely to move towards areas where resources are rich and they can take advantage of these. This rationale would explain the high probability that components in the "industry performance factor" group of variables faired so well. Contrary to this is the argument posed by Gupta et al. (2006) that the more advanced the communications system is and the better the access to technology, the higher the FDI into that country is likely to be. This does not appear to contribute significantly to the model produced in this research paper. This is due to the internet users per 1000 people of the population not being a significant variable within the model. The variable however does not reflect the levels of sophistication required and nor is it mentioned in the literature. An example may be that a landline dial up modem may be sufficient in order to send and receive emails from the head office while a very fast and cheap data line would likely attract more users to the internet. This would be an enabling factor, but the use of the variable, internet users per 1000 population, may not be the best interpretation of the assumption that technological communication advancements will allow foreign owned factories to contribute more to their parent companies (Gupta et al., 2006).

When reviewing the results against the theory of international operations strategy, some of the theory is reflected in the results while others is not. What is reflected is the industry's need for raw materials (Adam Jr & Swamidass, 1989) and this is reflected in the raw material production and consumption ratios and particularly in the fertiliser production ratios. Another variable that supports the literature is the result of the industrial competitiveness index (ICI). This does highlight that the more competitive the country's industry, the more

investment it is likel s's (2008) argument that firms compete on three tiers of quality, productivity and technology. The ICI takes into account the manufacturing value added per capita, manufacturing exports per capita, industrialisation intensity, and export quality (UNIDO, 2007). Thus the ICI provides a single index to describe the components mentioned by Pretorius (2008).

A component that does not tie neatly into the theory is that of the trade percentages of GDP. According to Prasad et al. (2000), international operations strategy and location decisions should grow with the growth in trade and the liberalisation of the trade barriers, however with a P-value of 0.89, this is not a significant contributor to the model and does not indicate that trade as a percentage of GDP supports the US investment into the world-wide chemical industries.

A theme that came through quite strongly within the literature around the competitiveness being able to be leveraged by an international operations firm was around staffing of the foreign entity. De Toni & Tonchia (2003), Gould (2008) and Stratman (2008) indicate that a firm's performance is only as good as its ability to utilise its resources. One, and arguably the most important of these resources, is the human capital component. However the total regression of the human capital value regression yielded a R^2 of only 0.145, indicating that this is not as significant a contributor to the model as would have been expected. This may be because foreign firms are likely to staff the critical positions of the foreign entity with expats from its home based entities.

An aspect that was ɔrs that help to drive the industry forward (Gould, 2008). Both raw material consumption and the push of fertiliser production were significant contributors to the model. When assessing the results of this analysis against the strategic roles that foreign factories can provide within the multinational organisation (Ferdows, 1997), the role of foreign chemical plants appears to be more related to that of a “low site competence” and either having access to low cost production or being close to the market. This inference is based upon the lack of significance of R&D personnel in the model, that provide the higher levels of site competencies, the strength of the contribution that raw material inputs make to the model and the lack of influence made by the trade percentage figures. This would lead one to believe that foreign chemical plants are designed and built purely to convert local materials into goods for the local markets at the cheapest price possible. Figure 4 graphically portrays this relationship, with the foreign chemical operations units of US multinational companies fulfilling outside “wing” roles of being an offshore or server factory.

Another component of the results that was not expected, was the strong positive correlation with the environmental compliance of the countries. The theory of the profit maximising firm suggests that they are willing to do whatever it takes to reduce costs. ISO 14001 is the voluntary environmental management system developed by the International Organisation for Standardisation. The compliance to the standard does increase the costs of the business, as was argued by Feiock (2000), however the purported outcome of compliance to the standard is that over the long term, risks and thus associated costs are reduced. The strong R^2 value of this group may suggest a form of quality control and / or corporate governance requirement by the US host multinational.

Industries are suppo given the environment in which they are competing (Murmann, 2003). In addition to this, the enabling environment, supposed to be created by the government, and its effectiveness to deliver assists in fostering competitive industries (Porter, 2008). Murmann (2003) makes the point that at least two components of either technology within the industry, the industry, or national institutions need to have a significant causal impact on each other, for the industry to persist and co-evolve. The lack of the contribution to the model by the human capital factors and in specifically, the Science, Maths and Engineering students, and the R&D personnel per 1000 of population, together with the governance indicators factors, with the exception of government effectiveness, suggests that foreign investment by US multinationals into chemical industries of the world may not necessarily contribute to the sustainability of the industry. Should this assumption be true and / or verified in any manner, then FDI into the chemical industry should be viewed in the same light as short term capital flows as the investor is not willing to safeguard the industry, but rather to earn greater returns for shareholders while retaining the competitiveness of the home industry for the home country.

6.5. Concerns and or limitations

The dependent variable has undoubtedly introduced a significant amount of bias into the results as it comes from a single, Western, developed, capitalist country. As a result, the interpretation of the results obtained in this research should be viewed with this in mind. When interpreting the results from a “what to do to encourage investment” perspective, it should be viewed as how to encourage investment from US multinational companies. To some extent this may be applied (with circumspection) to other Western and capitalist oriented

countries, but is ul cision choices made by eastern, planned countries such as China.

Wage rates were specifically excluded from the analysis as they are believed to be a transient phenomenon that lasts only as long as the country is willing to keep itself undeveloped. The literature on the decision choices by worldwide multinational companies investing into foreign markets highlights that this is however a factor worth considering (Bénassy-Quéré et al., 2007). Thus for future research this may be a consideration to include into the analysis.

The model would have been a lot stronger had there been a single measure of worldwide FDI flows into worldwide chemical industries. Should this dataset be compiled in future, a greater level of inference may be made with greater accuracy, about the determinants of FDI into chemical industries of the world. With this information, South African policymakers can measure the local economy up against the giants of the world and understand better what the instruments they need to develop more to attract a slice of potential development and industry enabling pie.

7. Conclusi

South Africa is a land of contrast, on the one hand displaying many attributes of a developed country such as its sophisticated banking and legal systems, and on the other more than a quarter of its population lives in poverty (CIA, 2009). Changes within the structure of the ruling party, the African National Congress, have occurred due to a lack of service delivery and a growing sense of impatience from the electorate about their future. This has resulted in a more leftist approach to policymaking and has raised concerns from the rest of the world over the future of the nation as an investment centre (Bloomberg, 2009). This is due to the nation having to finance the social development initiatives required as part of this leftist movement, through increasing the budget deficit and increasing national debt levels (Bloomberg, 2009).

The promises of ASGISA have to date failed to materialise where it counts and this begs the question whether these promises are still valid, or whether a new government may be able to deliver on these promises. Now more than ever, the proponents of the ability of Foreign Direct Investment to provide the much needed financing should be making their voices heard as this is supposed to provide resources for the upliftment and / or development of an economy (Baniak et al., 2005, Naudé & Krugell, 2007 and Bénassy-Quéré et al. 2007). With an 80% return on per capita GDP for each unit of FDI investment into the country (Baniak et al., 2005), the maths would suggest that if you are short of funds to uplift your own economy, you should outsource the responsibility by promoting an environment conducive to foreign investment. Talks within the nation about the nationalisation of key private assets, a more militant and expensive labour force, deteriorating and unreliable infrastructure and an

expensive telecomm to encourage investors to provide the necessary funds to promote the investment required.

Chemicals are one of the major imported goods coming into the country (CIA, 2009), however there is an advanced chemical industry already established within the country. In order for a country to become more competitive, it needs to step up the value chain to provide greater value adding services (Porter, 2008). With the abundance of natural resources, South Africa should be looking to improve the value chain of this mineral wealth by extracting greater value from the natural bounty. To align this with individual per capita growth in income, understanding the factors that influence foreign investors interested in the manufacturing of chemicals in your host country should be an aspect of consideration to the policymakers.

A similar approach, but for different reasons, may be taken by local multinational chemical companies seeking new investment opportunities abroad. The operational unit does provide a strategic tool to be utilised to be able to provide increased returns to the shareholders and investors of that company (Gould, 2008) and (Stratman, 2008). Understanding what the factors are that positively support the establishment of a foreign factory to gain the advantages that the multinational are looking for, can assist that company in gaining greater revenues and ultimately profits for its shareholders. Should a local company not be able to effectively compete in its home market due to the environmental constraints being placed upon it by its location and the governance issues in place within that country, it should look across its borders to potentially greener pastures.

This research attem the factors that influence the investment into the chemical industries of the world. There has been widely publicised literature on the influences of Foreign Direct Investment into the different countries and regions of the world. Developing economies offer different advantages to developed economies for the investing organisation.

Within the chemical industry, the local infrastructure and availability of raw materials, together with a home market for the sale of the finished products, appear to be the major drivers behind the investments into the industry. Educational components do not statistically contribute to the investment decisions. This may be due to the multinational being able to export its technical capability and its brains trust to the new facility in the new part of the world.

Governance was considered to be a significant contributor to general Foreign Direct Investment (Biswas, 2002) however investment into the chemical industries of the world does not overwhelmingly support this notion, although it is highlighted as a consideration factor. The environmental compliance requirements was a surprise in the model as it indicated that improved compliance was positively correlated with increased FDI into the chemical industry. The literature reviewed suggested that the opposite should be true, however the issue of the home based investment choice and concerns by shareholders may have created a bias for this opinion as the data reflected investment choices by US multinationals and was not reflective of the world.

In answering the first research question, South Africa is not a competitive destination for attracting FDI into the chemical industry, as is proved within the data. When investigating the inputs into the determinants of investment into the

industry however, S significant contributors to the model. There should be some other factors that are drawing South Africa down the ranking table though and these are not evident. Amoako-Gyampaha & Boye (2001) suggest that being part of Africa is a handicap in terms of attracting FDI and this may be part of the reason why South Africa fares well in the determining factor stakes, but does not translate this into FDI value.

7.1. Future research

This research has contributed to the literature on Foreign Direct Investment into the industry specific areas and highlighted the positioning of South Africa as a developing economy within the global context of attracting FDI into the chemical industry. The drawbacks in the research were that the dependent variable came from an important and significant yet single, large and open market economy. This has most likely introduced an amount of bias into the research that was not accounted for and thus should be the starting point for any future research. The variable may be approximated to other open and developed economies, but caution about considering its applicability to investment choices being made by companies from developing economies should be exercised.

During the data gathering process numerous variables were discovered in the various databases used for the research that may have contributed significantly to the final regression model, however the researcher could not, due to time and resource constraints, fully investigate the potential of the wealth of data available. The datasets could be more fully explored and analysed to extract the most significant individual components likely to affect FDI into the chemical manufacturing industries of the world.

A variable that was model was that of wage rates. This may be considered a significant contributory variable to the model, should it be added. However due to the final outcome or purpose behind the desire to attract FDI into a country or sector, that being to develop the country and increase per capita GDP and overall country effectiveness, a low wage rate would be unsustainable. A better measure would be total employee productivity. Should this prove to be a lesser contributor than pure wage rates, the argument that foreign investment seeks to exploit the resources of the host country should be strengthened.

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