A Comparative Analysis of how the BRICS States have engaged with the Developmental State Model since 2006

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ABSTRACT

As the debate around a multipolar world order, and the blurring of the previously clear divide between the global north and south become ever more prevalent, the world becomes increasingly interested in what is known as BRICS. The international forum between Brazil, Russia, India, China, and South Africa is considered a potential source for new ideas to be infused into the global economy and international politics. This research report seeks to understand how the BRICS state have engaged with a human-centred, 21st century developmental state model since the forum's unofficial birth in 2006.

This research report uses South Africa and China as case studies of the BRICS nations, and compares their developmental strategies and priorities over the period of 2006 – 2015. The objective of this report is to identify how these two sample countries have engaged with the developmental state model, and whether any patterns of convergence or divergence are present over the past decade. The developmental state model in question is based on three central pillars; 1) the building up of human resources and improving human capabilities; 2) the development of a knowledge economy; and 3) improving state legitimacy and capacity. Considering these pillars, this research analyses policies around building up human resources and capabilities through education, and developing a knowledge economy through policies around building up national systems of innovation. This research report discusses how both South Africa and China, as sample countries of the BRICS forum, have actively engaged with the developmental state model since 2006 – as reflected in their policies and developmental strategies.

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ABBREVIATIONS AND ACRONYMS

BRICS	Brazil, Russia, India, China, South Africa
BRICs	Brazil, Russia, India, China
CPC	Communist Party of China
DHET	Department of Higher Education and Training
DNP	Draft National Plan for Higher Education in South Africa
DOE	Department of Education
DST	Department of Science and Technology
FET	Further Education and Training
FYP	Five Year Plan
GDP	Gross Domestic Product
HRD	Human Resource Development
HRDS-SA	Human Resource Development Strategy for South Africa (2010 -2030)
DBE	Department of Basic Education
HRST	Human Resources in Science and Technology
IBRD	International Bank for Reconstruction and Development
IBSA	India, Brazil, South Africa
IMF	International Monetary Fund
ISI	Import Substitution Industrialisation
MDG	Millennium Development Goals
MOE	Ministry of Education
MST	Mathematics, Science and Technology
MTSF	Medium Term Strategic Framework
NDB	New Development Bank
NDP	National Development Plan
NDS	New Developmental State
NGO	Non-Governmental Organisation
NPC	National Planning Commission
NQF	National Qualifications Framework
NSoI	National System of Innovation
OBE	Outcomes-Based Education
OECD	Organisation for Economic Cooperation and Development
OERD	Outline of Education Reform and Development

PIGS	Portugal, Italy, Greece, Spain
PSTD	Programme for Science and Technology Development
R&D	Research and Development
RMB	Renminbi (The national currency of China)
S&T	Science and Technology
SADC	Southern African Development Community
SANSA	South African National Space Agency
SCE	Senior Certificate Examination
SET	Science, Engineering, Technology
SOI	Systems of Innovation
StatsSA	Statistics South Africa
STEM	Science, Technology, Engineering, Mathematics
STI	Science, Technology, Innovation
STUPID	Spain, Turkey, Portugal, Italy, Dubai
TDP	Talent Development Plan
TSC	The State Council
WB	World Bank
WP-PSET	White Paper on Post-School Education and Training
YiSS	Youth into Science Strategy

CHAPTER 1

1.1 INTRODUCTION: BRICS – AN INTERNATIONAL SUPERMAN OR A GLOBAL HARVEY 'TWO -FACE'?

The handy acronym of BRICS - which was first coined in 2001 - sprouted at a time when a sturdy, viable and alternative investment location was sought after. Investors' faith in the economies which were once seen as stable was weaning, and countries were being clumped together under unfortunate labels such as PIGS[1] and STUPID[2] (Fourcade, 2013). BRICS provided a politically correct, seemingly strong and neutral group of countries for the world to begin taking seriously, and for the BRICS countries to take seriously themselves. Apart from providing a new investment portfolio, BRICS provides the platform for a new opportunity to infuse fresh ideas into the global political and economic arena (Martynov, 2011). This is as a result of the direct challenge that the group presented to current global governance structures, specifically with regards to reforming and improving the conditions under which emerging economies can access capital and develop independently of the west.

The BRICS mission is, as described by Martynov (2011), "a search for an alternative model of global development", away from the current dominant neoliberal paradigm of the West. Neoliberalism is often understood as the evil hegemonic leviathan that consumes nations and their potential for wide-spread prosperity as it thrives on relentless capitalism (Peet, 2009). The claim that BRICS blocks this norm puts the grouping under a favourable light. This stance puts BRICS in the position to be attractive to the international community, and create the perception that it can provide the alternative that will save the day.

The BRICS nations are in a favourable position in that they have traditionally strong states (Martynov, 2011), which supports their argument against the current hegemonic norm of neoliberalism which is also characterised by minimal state intervention (Peet, 2009). There is a strong sense that BRICS is in a position to shape a new developmental agenda (Martynov, 2011; Thakur, 2014), as development is a 'cornerstone of the BRICS initiative' (Mielniczuk, 2013); especially within a revived developmental state framework which incorporates the welfare and development of citizens (Williams, 2014).

There is also a strong opposing understanding of BRICS as being made up of countries that are two-

[1] PIGS is an acronym for Portugal, Italy, Greece and Spain.
[2] STUPID is an acronym for Spain, Turkey, Portugal, Italy and Dubai.

faced in that they are neoliberal states hiding behind a developmental state mask. This is particularly relevant to what is also known as IBSA; the cooperation grouping of India, Brazil, and South Africa. All three of these countries are accused of remaining under the firm grasp of the neoliberal Bretton Woods Institutions of the International Monetary Fund (IMF) and the World Bank (WB) (Peet, 2009).

Yet BRICS is currently in the process of creating a New Development Bank (NDB) that can be an alternative source of financing for developmental projects in emerging economies, with fewer conditionalities to the traditional western sources of development finance (Peter*, 2015)[3]. The NDB as well as the International Bank for Reconstruction and Development (IBRD), under the World Bank, emphasise development. Both have the objective of financing projects that will facilitate development (Yi, 2014). If financing development-promoting projects in developing countries is now an official pillar of BRICS, then it is worthwhile investigating what the current development strategies of the BRICS are. The ball is being hit back and forth in the international arena over whether BRICS is capable of providing an alternative to the IBRD and the IMF via the NDB, or whether such an institution will be a neoliberal replica of the IMF and IBRD internally with what will only be an 'alternative to development' mask (Chossudovsky, 2015).

The late 20th and 21st century have seen a variety of country blocs and south-south partnerships emerge, with many promising to be alternative solutions to western market and paradigm dominance (Alden & Vieira, 2005). These include amongst others, the Southern African Development Community (SADC) which spans from South Africa to the Democratic Republic of Congo. Some of the main objectives of SADC are to achieve development and economic growth, as well as alleviate poverty and improve the quality of life for SADC citizens (SADC, 2015). Another community is IBSA which is a trilateral dialogue forum in which the member states can create dialogue on promoting sustainable development and the improved well-being of their citizens and the developing world; with a focus on south-south cooperation to counter the historic marginalisation of the south and developing world (Alden & Vieira, 2005; SADC, 2015).

The main body that defines development goals in the developing world is the Organization for Economic Co-operation and Development (OECD). The OECD's mission is to 'promote policies that will improve the economic and social well-being of people around the world.' The OECD provides a platform for governments to share experiences, and to understand what drives the social, economic, and environmental situations within countries. In this role, the OECD forum is a leader in distilling development practices across the globe and has been promoting development as a main

[3] An * after the name indicates that a pseudonym for the interviewee was used

objective (OECD, 2015).

Considering how many blocs and groupings have previously emerged and are currently standing, the question emerges as to why and how BRICS would be different and/or valuable to investigate. However, BRICS is unique in that it unites nations from all corners of what is understood as the developing world, and seeks to be an alternative to the western dominant paradigm at the international level of high politics. Other forums originating in the developing world do not pursue goals at this supra-international level and often focus their efforts at a regional level. For this reason, BRICS is an intriguing new grouping to grapple with and to understand what prospects it may hold for truly carrying out its intended goal of creating a new multipolar world order.

NEOLIBERALISM AND THE DEVELOPMENTAL STATE

The 2008 global economic crisis rang alarm bells across the world that it might be time to reassess the validity of the free-market fundamentalist paradigm (Ahmad, 2011). As the current hegemonic paradigm, it is characterised by minimal state intervention, by a reliance on and trust in market-forces, and the equilibrating nature of markets (Peet, 2009). Under neoliberalism, developing countries are recommended to allow the markets to have free reign to solve issues that plague the global South, such as inequality, poverty, poor health care and a lack of education. The 2008 crisis spurred on a call for a more human-centric paradigm, to shift away from the current market-oriented global hegemonic paradigm (Ahmad, 2011).

As one of its primary focuses, BRICS seeks to create a multipolar world order, whereby the balance of powers between the global North and South are re-equilibrated to give more power to the latter (Peter*, 2015). Considering this, and the renewed interest in an alternative to neoliberal hegemony, it is worthwhile assessing the adoption of an alternative to this neoliberal, or free-market fundamentalist approach by a group of strategic global-south players: the BRICS. This alternative is that of the developmental state. The developmental state discourse addresses the nature of the role that the state should play in development - both economic and human; and the BRICS states are increasingly recognised as adopting diverse forms of the developmental state approach with an emphasis on promoting human development (Williams, 2014).

1.2 EMPIRICAL GAPS AND THE RESEARCH QUESTIONS

The BRICs[4] states began promoting the consolidation of the political group in 2006 on the side-lines of a United Nations General Assembly meeting in New York, as the Foreign Affairs ministers of the

[4] As South Africa only joined the BRICS forum in 2010 (Shubin, 2013), the use of BRICs denotes the grouping of Brazil, Russia, India and China only.

BRICs countries began discussions to formalise the concept of BRICs (Shubin, 2013). Although the official launch of BRICs is tied to the first BRICs summit in Yekarinburg, Russia in 2009 (Mielniczuk, 2013); 2006 is taken as the unofficial but substantive birth of the BRICs forum. This research report therefore views the life span of the BRICS forum as beginning in 2006 at the time of the meetings conducted at the foreign affairs ministerial level.

Discussions on BRICS continuously identify development as a key pillar of the BRICS community. However, as a collective body, BRICS has no official development policies that it promotes nor does the group intend on establishing such policies in the near future (Peter*, 2015). Therefore at this stage of infancy of the BRICS forum, it is only possible to research the individual BRICS countries with regards to their national development priorities, and explore the key focuses of development and the role of the state within the individual BRICS.

As the body of literature on BRICS currently stands, there is a lack of research, specifically comparative research, on the individual BRICS countries' approaches to development within the BRICS context. Most literature is on a per-country basis, is dated, and is no longer applicable to the current development discourse. There is a clear call for further analysis of individual countries' developmental state approaches. There is also a lack of research done on BRICS as a five member group rather than the four member BRICs.

Considering the above, this study is thus focused on the BRICS countries and not on BRICS as a collective, international forum. In order to feed into the body of literature on the BRICS countries approaches to development – specifically in the context of a developmental state approach –, the main purpose of this study is to flesh out the developmental strategies of the individual BRICS countries.

Considering the parameters described above, the primary research question for this report is:

How have the BRICS states engaged with the developmental state model since 2006?

In order to adequately address this main research question, the following two sub-questions are posited:

1 - Has the approach to development in BRICS countries shifted over the period 2006 to 2015?

2 - Are BRICS countries converging or diverging in their development strategies, if at all?

1.3 LITERATURE REVIEW

As development is a key issue that arises when considering BRICS, this literature review shall provide the framework through which a comparative analysis of the approach to development by

the BRICS countries shall be assessed. As stated, this research report views BRICS as a sum of its parts; as a collaboration of states that cannot exist without comprising of the specific states of Brazil, Russia, India, China and South Africa. Therefore, it is not the aim of this research to understand BRICS as an international institution.

As all of the BRICS nations have adopted a variation of the developmental state approach to development, this research report shall use the literature on developmental state theory as a foundation for its theoretical framework. A discussion of the progression of the debate on the developmental state shall be laid out, with the current understanding of the developmental state providing the lens through which this research shall be assessed.

The Transformation of the Developmental State

In the last couple of decades, each of the BRICS countries has passed through, or is currently promoting some form of a developmental state approach to development (Mielniczuk, 2013). China, India and Brazil are all seen to be actively promoting a variation of the developmental state model as a new model for development (Williams, 2014; Thakur, 2014), with South Africa ideologically embodying a developmental state model (NPC, 2011). Considering the research parameters, and the understanding that these countries are in fact pursuing some form of the developmental state model, it is useful and viable to study how each of the states engage with the developmental state model. This section of the literature review will take the reader through the progress of the developmental state model from the 20th century model characterised by the East Asian Tigers and through to the 21st century developmental state model characterised by the embracing of the capabilities approach.

The 20TH Century Developmental State

As presented by Ha-Joon Chang (2005), historically, some form of strong state intervention in controlling, nurturing and protecting industries occurred on the development path taken by now-developed countries. Minimising state intervention from the onset of the development path has not yet empirically proven to promote a sustainable take-off[5] in any country. It is historically evident that some form of the developmental state – characterised by increased state intervention in the economy of a country – has been deployed in the creation of economic growth and social transformation (Evans, 2014). As Latin America attempted to develop from the mid-1900s, states promoted import substitution industrialisation (ISI) and a strong rejection of the free-market

[5] Take-off is here referred to as the stage of economic take-off in the process of development, as described by Walt Whitman Rostow in The Stages of Economic Growth (1959).

notion. National markets were boosted by state subsidies and strong-protectionist policies to protect local markets and industries from the threats of global competition and the implications of openly engaging with the 'free-market' (Hirschman, 1968).

ISI compares with the theory of the developmental state which originates from the success of the East Asian Tigers (Hong Kong, Singapore, Taiwan, and South Korea) that followed a specific strategy to promoting development within their countries. At its birth, the developmental state followed a capitalist, economic-growth approach to development. The underlying assumptions were that economic growth, competitiveness and productivity were what constituted development and should be the priority focus of the developmental state. By assuming this stance on what constitutes development, states could ignore issues around welfare and social-equality goals. The role of the state was to create a platform for businesses and the state to interact closely, in order to promote economic development within key, mainly industrial sectors in the economy. Industrialisation was promoted, and supported by the state in targeted sectors of production. The objective was to increase investment in these key sectors through the use of incentives and control mechanisms that would disperse risk and limit the risk faced by the investor (Onis, 1991; Thompson, 1996; Williams, 2014).

There are two facets to the developmental state; one ideological and one structural. The ideological underpinning of the 20th century developmental state is one of developmentalism achieved specifically via state-driven economic growth. The developmental state's legitimacy is derived from its ability to maintain growth and achieve steady and high economic development, along with an industrialising structural change in the productive system. This ideology is promoted by the state to attempt to instill it in society as the accepted hegemony (Mkandawire, 2001).

The structural side emphasises a state's need to have the capacity to promote development as well as the autonomy to promote economic growth as is necessary to achieve the highest and most efficient result. This autonomy usually results in the exploitation of the labour force to promote developmental goals. However, the state must be accountable in order to prevent the abuse of state power. The structural side also requires a strong bureaucratic capacity and state legitimacy to be developed in order to build up an efficient and effective institutional framework (Mkandawire, 2001).

THE 21ST CENTURY DEVELOPMENTAL STATE

After the implementation of Amartya Sen's conception of the capabilities approach into the United Nation's official approach to development, the foundations of the developmental state shifted (Fukuda-Parr & Sakiko, 2011). The introduction of the capabilities approach can also be closely

linked with the notion of poverty reduction, as poverty alleviation has a direct impact on the welfare of humans and the ability to achieve human development (Sen, 2006). As Mkandawire (2010) notes, all states that have successfully achieved poverty alleviation have pursued a developmental approach. The developmental state hereon referred to as the 21st Century developmental state or the new developmental state (NDS) now includes the development of human capabilities in its growth objectives and strategies. Economic growth is no longer promoted at the expense of social welfare and social development. Discourse has shifted to understanding that investment in the human resources of a nation, via developing human capabilities is an important long-term investment for a state to make (Evans, 2014).

Investment in the 21st century developmental state does not focus on market forces and key industries to generate and attract private investment. If investments were continuously left to the free hand of the market and the private sector, then investment in human capabilities would most likely not occur as it is a risky investment that cannot be hedged against or measured in tangible assets (Evans, 2014). The state now recognises its role in promoting human resources development through investing in human capabilities development. The long term benefits include a more productive workforce, a healthier population, and a citizenry who are educated and skilled, and that can provide for themselves rather than relying on state resources for survival (Ardichvili, Zavyalova, & Minina, 2012).

A variety of innovative approaches to development are now included in the developmental state discussion. China has shifted its approach to development to promote social harmony, environmental sustainability and justice (Williams, 2014; James*, 2015). South Africa is attempting to redress deep social and economic inequalities through its adoption of the developmental state ideology (NPC, 2011). Brazil's development goals under President Lula were to promote social developmentalism, which would result in redistribution and a minimisation of inequalities. The driving force behind the developmental state is no longer economic growth alone, but incorporates unique national priorities (Williams, 2014).

Defining the New Developmental State

The definition of development varies with each development theory. Under institutionalism, development is defined by the improvement of formal institutional capacity to be increasingly impersonal, efficient and effective (North, Webb, Weingast, & Wallis, 2012). Under neoliberalism, development is defined by increased economic growth and capital accumulation, as measured by economic growth indicators (Evans, 2014; Peet, 2009).

What development is defined as in this research report is based on the NDS, and embraces

Amartya Sen's understanding of what constitutes human development. Development is therefore defined through two parts. The first part is human development, which is based on the provision of a foundation on which humans can have the positive freedom to choose how they live. This foundation includes the provision of services that will allow for an increased quality of life for those who live within a state. This understanding of development is heavily human-centred in that it aims to boost the basic framework within which humans exist, in order to promote the space for humans to choose to develop the capabilities they wish to, without being constrained by the lack of access to basic survival requirements. Under this category, human capabilities include improved education, health, life expectancy, income, and family foundations (Sen, 2006).

As the NDS shifts away from a purely industrial-growth led model, the notions of a knowledge economy and systems of innovation play an increasingly important role (OECD, 2007). States under the NDS actively promote innovation and a shift towards a knowledge economy. Skilled human resources are increasingly required, and states actively seek to develop larger quantities of quality, skilled workers that can be disseminated into and drive the developing knowledge economy.

The second part is linked to the institutional framework of the state. As Mkandawire (2001) and Evans (2014) note, an efficient bureaucracy and bureaucratic capacity are essential elements for the proper functioning of a developmental state. However, it is not assumed that a developmental state approach cannot be followed if, from the onset, a state does not fulfil these requirements. Development is therefore defined by an increase in bureaucratic capacity over time, as the state builds up its institutional framework and strength through the developmental state model. In this sense, development includes the increased ability of a state to tax its citizenry, to effectively use the macroeconomic tools at its disposal to regulate currency and boost trade, as well as the increased ability to create developmental policies that, over time, can be better implemented through the state's bureaucratic capacity (Mkandawire, 2001).

The NDS acknowledges the role of both formal and informal institutions in society, and the role that both types of institutions play in the promotion of a developmental state as well as in the successes that the developmental state can achieve. As Sen's concept of capabilities indicates, the informal institution of a family structure is as vital to human development as is providing the formal institutions in which human development is promoted - such as learning institutions and health care facilities.

Education as a Means of Measuring Human Development

Education is considered a vital input for the process of development. Education also has many direct and indirect effects on health, economic growth, institutional functioning and development,

trade, and labourer income (Gyimah-Brempong, 2011; Mkandawire, 2010). These effects are all closely linked with the notion of capabilities, as well as the NDS. Different levels of education also impact differently on various outcomes. Higher education is often seen as having a larger impact on long-term development, than pre-primary or primary school education (Gyimah-Brempong, 2011; Psacharopolous, 2006). Education is also claimed to have a positive impact on equity as well as economic growth in a given society (Psacharopolous, 2006).

The quality of education has also been proven to be more important than simply the promotion of the quantity of education (Gyimah-Brempong, 2011). There is an increased emphasis on scientific and technical skills (Gyimah-Brempong, 2011), whereby skills can be understood as 'high levels of professional and technical education' (Allais, 2015). It is suggested that the differences in economic growth in OECD countries since 1960 is 55% attributable to differences in average skills levels amongst the countries (Psacharopolous, 2006).

Education is also closely tied with labour outcomes (Hanushek, 1996). There is a persistent call for developing countries to recognise the importance of waged labour in promoting development and alleviating poverty (Mkandawire, 2010; Oya & Pons-Vignon, 2010; Allais, 2015). The promotion of education, both level and quality thereof, have shown to impact positively on labour market earnings (Hanushek, 1996). As Allais (2015, p. 242) notes, 'economic competitiveness is increasingly widely believed to rest on the skills of the labour force', and in many countries there is a skills shortage or gap that needs to be filled in order to boost competitiveness and promote development.

STEM Education

At the 2013 BRICS summit hosted in Durban, South Africa, the BRICS forum agreed to promote cooperation on Science, Technology and Innovation (STI) at the ministerial level, with the first ministerial level meeting on STI being held the following year. The paramount importance of STI for human development is stressed by the respective ministers within the BRICS forum. There is an understanding that the global environment is changing rapidly, especially with regards to technology. Based on this understanding and the importance of STI for human development, there shall be a distinct promotion of "people-centred and public-good driven science, technology and innovation, supporting equitable growth and sustainable development" through BRICS (BRICS, 2014, p. 2).

The emphasis on STI by BRICS, and the support by BRICS for the Millennium Development Goals (MDGs) (of which the second MDG is education) provides good incentive to analyse investment in and policy to promote education (Gyimah-Brempong, 2011), specifically STI-related education, in

the BRICS countries. STI-related education comes in the form of what is known as STEM – Science, Technology, Engineering and Mathematics. There is a global increase in the promotion of STEM education and training in recent years. This is increasingly evident with the emergence of Non-Governmental Organisations (NGOs) such as P-STEM Foundation in South Africa, and the STEM Education Coalition in the United States. There are also STEM educational programmes sprouting globally such as the Model Institutions of Excellence programme in North America. There is also an increased recognition by the private sector of the need and demand for STEM-educated workers[6]. This acknowledgement by the private sector, as well as regions such as the African Union, of the demand for STEM-educated workers eases the concern that Alice Amsden (2012) recognises that simply supplying educated labour does not mean that there will be a natural increase in demand for this increasingly educated labour.

Apart from this new found interest in STEM globally, there is also evidence that suggests that the performance in science and math related tests has a strong impact on economic growth in a country (Hanushek, 1996). It is increasingly recognised that STEM education plays an important role in the global market place of the 21st century (Coalition., 2015). This is especially applicable in the increasingly prevalent global knowledge economy where competitive advantages, growth and diversification of opportunities come from idea and knowledge generation (Evans, 2014; Seguino, 2014).

Systems of Innovation

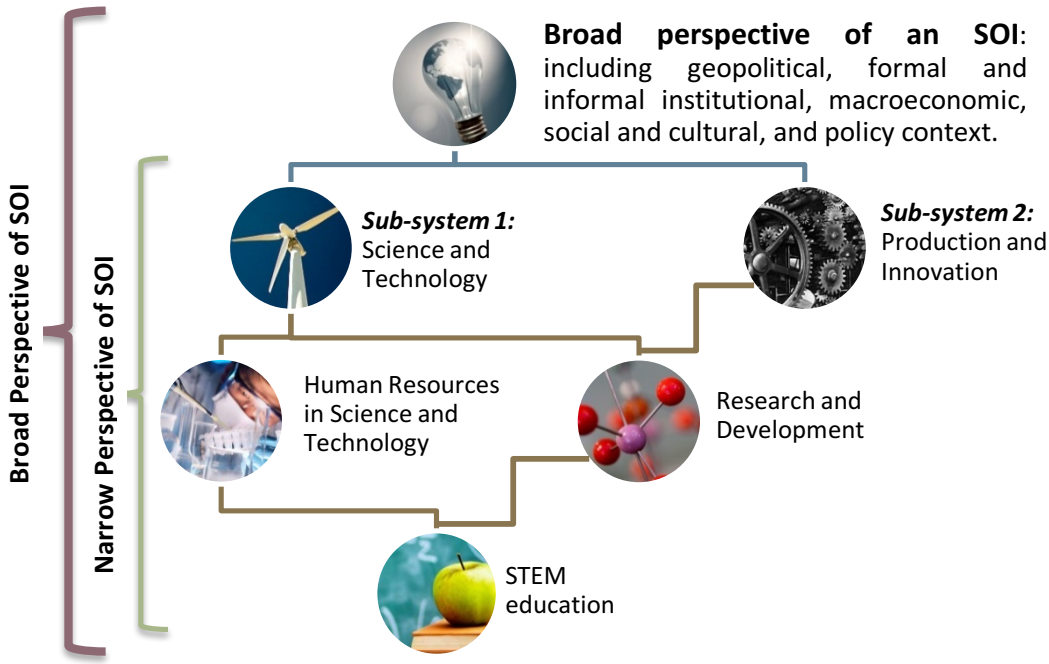
The concept of a system of innovation, developed in the 1970's (Cassiolato & Cuoto Soares, 2013), is a useful framework within which to understand STEM education. According to Pablo* (2015), a national system of innovation can be defined broadly as "networks of institutions through which knowledge is created and distributed", with knowledge being understood as something that goes beyond information alone, but is influenced and shaped by 'tacit elements' within a society's informal institutional framework (Cassiolato & Cuoto Soares, 2013, p. xxviii). More specifically, innovation capacity is derived from political, social, formal and informal institutional, and cultural factors, and within the context in which these factors operate.

[6] For example, in South Africa there are programmes driven by SASOL and DuPont to promote education in STEM to meet the demand of STEM-related jobs. The South African National Space Agency (SANSA) also explicitly notes the need for STEM related jobs. The African Union is also launching the PAUWES University which will focus on water and energy sciences in Africa.

The systems of innovation (SOI) approach can also be understood in a broad or narrow perspective. The broad perspective encompasses policies, financial systems, regulations and the sub-systems of 'science and technology' and 'production and innovation'. Under the broad perspective, an SOI can be understood to reflect all linkages between different factors that contribute to innovation, and the creation and dissemination of knowledge and ideas through the national and local networks of innovation. The two sub-systems, namely 'science and technology' and 'production and innovation' are collectively understood as the narrow perspective of the SOI framework. However, the narrow perspective is directly linked to the development of human resources in Science and Technology (HRST). HRST is in turn based on the promotion and development of STEM education, with the objective of feeding into the broader framework of a national SOI (Cassiolato & Couto Soares; 2013).

By assessing STEM education through the framework of a national system of innovation (NSoI), one addresses not only the quantitative and formal institutional measures in place to promote STEM education and thus HRST; such as policies, state investment in higher education and STEM education, and the number of institutions dedicated to understanding and implementing STEM education and the policies directed at its promotion. But one also incorporates the influence of informal institutions, such as habits, priorities and practices of the societal actors and social units such as the family, that are involved in the implicit promotion of a culture of innovation and the focus given to STEM education within a given society (Cassiolato & Cuoto Soares, 2013).

FIGURE 1: THE SYSTEM OF INNOVATION FRAMEWORK

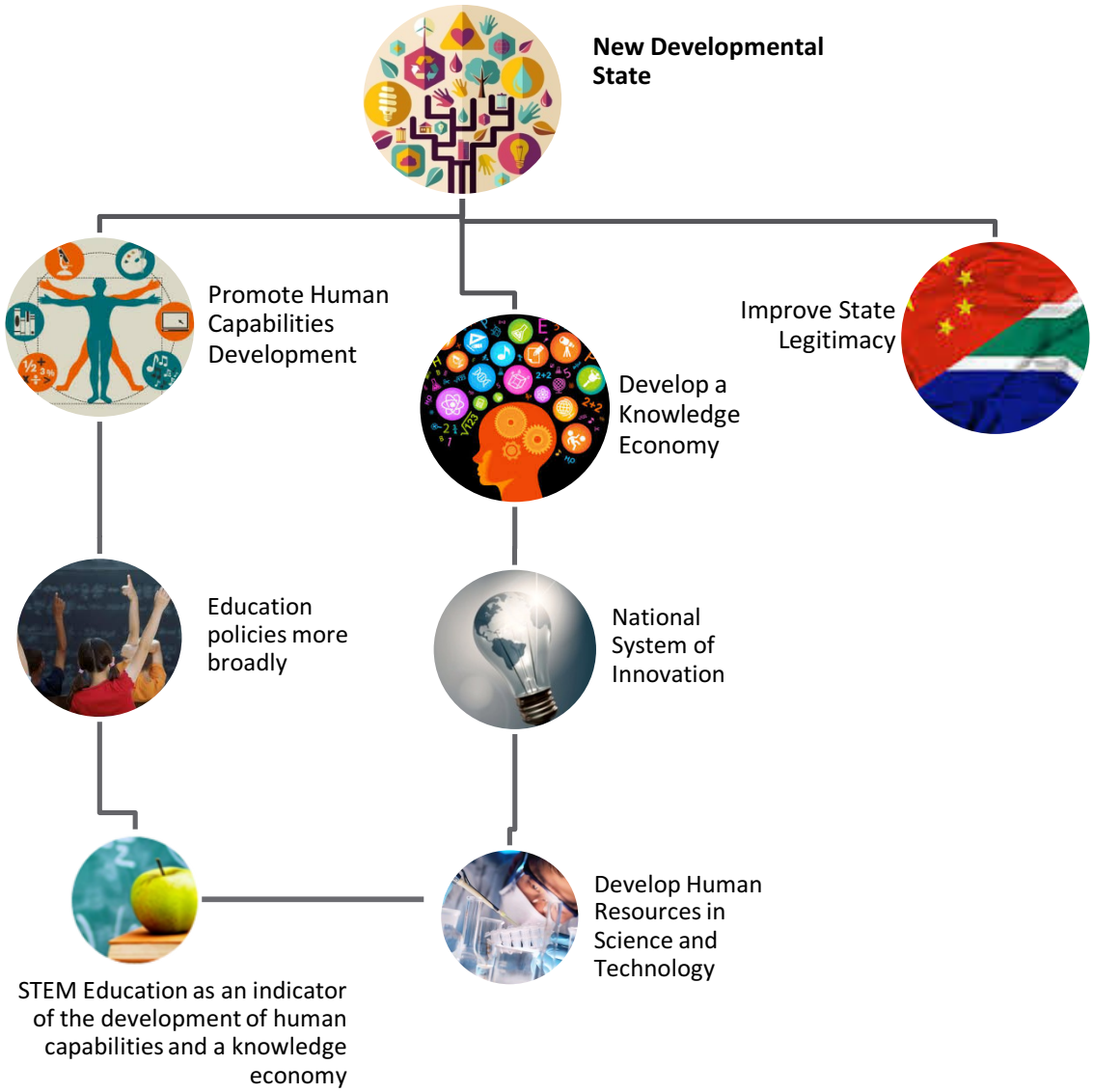


Source: Diagram adapted from Cassiolato & Cuoto Soares, 2013.

THE FRAMEWORK FOR ANALYSIS

The three core focuses of the NDS are 1) the promotion of human capabilities development, 2) the building up of a knowledge economy; and 3) improving state legitimacy. This research paper will be evaluating how the BRICS states engage with the developmental state model, specifically with regards to the first and second core focuses (promoting human capabilities and building up a knowledge economy). Figure 2 below illustrates the flow of how STEM education and education more broadly, and the building up of HRST through the NSoI, shall be used to evaluate how the BRICS states engage with the NDS through their policies and strategies on building up human capabilities and a knowledge economy.

FIGURE 2: THE NEW DEVELOPMENTAL STATE AS A FRAMEWORK FOR ANALYSIS



Source: Diagram compiled by author

Conclusion

The NDS framework is a complex concept, and is a very recent concept in itself. However, it is a concept worth exploring as it embraces many features of the new trends in development and growth, such as the capabilities approach and the notion of an ever-growing knowledge economy, whilst still embracing the viability of enhancing state capacity and using the state to promote development. This paper evaluates the strategies and policies in the BRICS countries that are designed to promote human development through STEM education and SOI; and identify patterns of convergence or divergence on these strategies across the BRICS states. The researcher believes that these are useful and adequate tools to use in understanding how BRICS states engage with the NDS model, considering the impact that these variables have on human capability enhancement – i.e.: the improvement of the human resources of a nation; as well as how the selected variables feed into the building up of a knowledge economy.

1.4 Research Methodology and Methods

This research report takes the view that the world is made up of social actors and their actions. For this reason a realist ontological approach is not applicable in understanding how BRICS states engage in development since the inception of BRICS; as this approach assumes a detachment between the observer and the observed (Blaikie, 1993). To satisfy the above-mentioned worldview, an ontology that assumes that social realities are produced by actors who operate in an "intersubjective world of cultural objects, meanings and social institutions" (Blaikie, 1993, p. 203), shall be used. This ontology shall be referred to as the pragmatic perspective.

The Comparative Method

This research report employs a comparative analysis of the two BRICS states in order to understand how the states engage with a human-centered developmental state model since the inception of BRICS. This research is therefore a discovery of relationships, specifically of convergence or divergence in development strategies between the BRICS states. The comparative method is not a method of measurement, but is a method of discovering empirical relationships (Lijphart, 1971). The comparative method forms the overarching method used throughout this research report.

Maximising comparability within the comparative method framework is best done by increasing the number of cases to be analysed, or by analysing the selected sample cases over a period of time (Lijphart, 1971). It is for this reason that the BRICS nations' engagement in development shall be assessed since the unofficial inception of BRICS; in order to provide a valid and controlled assessment of the converging or diverging patterns of development over time, where the time

frame is delimited by the current lifespan of the BRICS forum from 2006 to 2015.

General Research Parameters

Sample Countries

The population of BRICS is classified by the individual states that make up the forum. The population is therefore the 5 state group made up of Brazil, Russia, India, China and South Africa. Due to time, resource and language constraints, only two of these countries are used as cases of analysis in this research report. The reason for selecting two states is to allow for comparability, as the comparative method is characterised by a small sample size with many parameters (Lijphart, 1971).

The countries selected are South Africa and China. The reason for selecting South Africa is threefold. First, language was not a potential barrier as policies are in English and interviewees spoke English. Secondly, the author resides in South Africa which made access to interviewees less difficult. Lastly, South Africa is considered the weakest link in the BRICS forum due to its relatively small size economically, in terms of land mass, population, and global influence and power compared to the other BRICs (Shubin, 2013).

China on the other hand is often portrayed as the most dominant and strongest out of the BRICS (Shubin, 2013). For this reason, and China's unavoidable position in the global economy and in the developing world, China is selected as the second sample country. As the largest economy in the developing world, China presents a real force and power in the developing world. By selecting China and South Africa, the two perceived outliers of the BRICS group are used as the sample cases for this study.

Research Indicators

As discussed in the literature review, education and the NSoI are useful concepts to think about when discussing development, and the NDS. For the purposes of this research, STEM education as an element of broader education strategies, and the national system of innovation as an element of the knowledge economy have been used as the 'indicators' for measuring state prioritisation of human development objectives in South Africa and China. It is through these two indicators, STEM education and the NSoI, that this research was conducted.

STEM Education

The reason for selecting STEM education is to cover the first half of the NDS model, which is focused on improving human development. It is through the analysis and comparison of STEM

education in the sample countries that this research represents the 'development of capabilities' aspect of the NDS. According to Amartya Sen (2006), education is a fundamental tool to improving human development and capabilities. Focusing on STEM education, as well as the broader national system of innovation also permits the element of the knowledge economy of the NDS to be included in the analysis of the developmental state, according to the definition applied in this report. STEM education analysis therefore allows for - and is used as - the measurement of education, skills building, and government investment and emphasis on building up its human resource capacity and capability to compete in the global knowledge economy.

Research Techniques

This report utilised three research techniques. The techniques employed were policy analysis, expert interviews and documentary analysis. All policies, documents, and experts interviewed were selected on their ability to provide information on one of four different themes: 1) the developmental ideology of each sample country, 2) the sample countries' national systems of innovation and innovation objectives, 3) higher education and specifically STEM education, and 4) the sample countries' National Systems of Innovation.

Policy Analysis

Policy analysis was used as the primary research technique as policies are the tools through which states flesh out their development agendas, and on which they build developmental strategies. For this reason, policy analysis was essential to understanding how BRICS states engage in development, as it is through policies that the official approach to development, and specific developmental strategies, by a state can be found (Bechhofer & Paterson, 2000). Policy analysis is a useful tool to identify convergence or divergence of how states engage in development over time (Knill, 2005). The approach to policy convergence that was applied in this research paper is that convergence occurs "if there is a decrease in variation of policies among the countries under consideration" over time (Knill, 2005, p. 769). Therefore, the reason for using policy analysis as a method in this research was not to evaluate policy (Bechhofer & Paterson, 2000); but to identify convergence or divergence patterns, as well as understand how individual states engage in development through their official policy agendas.

Documentary Analysis

Documentary analysis, defined as the systematic analysis of electronic or printed documentary material (Bowen, 2009), was used as a supplementary research method in this research. Documentary analysis provides a useful channel through which a longitudinal comparative study

could be conducted, as the types of documents used are regularly created and can therefore provide a wide range of data over the 10 year period of 2006 - 2015 on which to draw information (Bowen, 2009). The first documentary tool that was used was speeches. Speeches were selected on the basis of their applicability to the four above-mentioned themes, as well as with regards to which state department they were given by. Speeches by the ministries of education, science and technology, and Presidencies were given preference. Speeches were only selected if they were given during the period of 2006 to 2015. The second documentary tool used was numerical data relating to STEM education, and education more broadly in both countries.

The reason for incorporating documentary analysis was to establish the official development agenda and priorities of the selected countries, as exposed to the public. The use of speeches and numerical data enabled the triangulation of the information extracted from policy documents, and expert interviews (Bechhofer & Paterson, 2000; Bowen, 2009); as well as provide further insight into the priorities of development in the two BRICS sample countries.

Expert Interviews

In order to accurately embody the pragmatic perspective, this research assumed that development is not engaged in solely through policy, but is adopted and engaged with by the relevant social actors (Friedrichs & Kratochwil, 2009). For this reason, expert interviews proved to be a useful supplementary research technique as perspectives on certain policies and strategies could be extracted for interviewees – which is information that was not available through the other research techniques of policy analysis and documentary analysis. The relevant experts were also able to provide additional insight to the process of development in the respective states, as well as how national development strategies are linked to BRICS.

The types of interviews conducted were semi-structured, in-depth interviews. The reason for using semi-structured interviews and not structured interviews was to gain the widest range of information relating to the research question. According to Bechhofer & Paterson (2000), the finer details of a situation may emerge under a semi-structured interview that would not emerge under a structured interview. The purpose of the expert interviews was to reach these subtle pieces of information that are only accessible through expert interviews.

Non-probability sampling was employed as the specific cases of China and South Africa were analysed to understand the phenomena of how BRICS states engage in development, and specifically through the lens of the selected indicators: National Systems of Innovation and STEM-education. A mixed-technique of sampling was used. The mix included purposive/judgement and snowball sampling techniques (Marshall, 1996). The majority of experts were selected purposively.

As interviews were not the sole method used in this research, it was not possible to conduct more than four interviews due to time and resource constraints.

1.5 Chapter Layout

In order to address the main research question, and two sub-questions of this research paper, this research paper is divided into a further three chapters. The chapters are laid out as follows:

Chapter two presents the case study of South Africa. Chapter three discusses the case study of China. Chapter two and three are laid out by first providing a brief history of the country in question, with specific regard to the recent economic and political climate of each country. The chapters then proceed with describing any developmental policies that the respective country has adopted, including how they each envision development and the role of the state therein. This section includes a short discussion of the broad understanding of the role of human resource development in national development, for each nation. Chapters two and three then provide a general overview of the education systems in South Africa and China, respectively. Thereafter, an in-depth discussion of key education policies around STEM education and the NSoI, education more broadly, and human capability development are fleshed out from 2006 – 2015, including a short overview of key policies adopted prior to 2006. In conclusion, each chapter provides a trend analysis of the 10 year period spanning 2006 to 2015, in the respective country.

Chapter 4 is dedicated to answering the main research question, "How have the BRICS states engaged with the developmental state model since 2006?", and the two sub questions, "1 - has the approach to development in the BRICS countries shifted over the period 2006 to 2015?" and "2 - are BRICS countries converging or diverging in their development strategies, if at all?" The chapter begins by identifying any patterns of convergence or divergence in the development strategies of South Africa and China. This analysis is based on the trends identified at the end of Chapters 2 and 3. Secondly, the chapter discusses any changes in the approach to development in the two countries. The results of these two questions are then used to aid in answering the primary research question of how the BRICS states have engaged with the developmental state model since 2006.

CHAPTER 2: PROMOTING HUMAN RESOURCE DEVELOPMENT IN SOUTH AFRICA

2.1 CHAPTER INTRODUCTION

This chapter explores South Africa's policies and strategies that define the country's engagement with human resource development, specifically through policies around STEM education and the country's NSoI. The country has a clearly defined understanding of the role of the state in development, and more specifically around what human development means and what role the state should play in human development. In order to understand how South Africa has engaged with the developmental state model, as defined in this research report, this chapter shall lay out the human resource development policies and strategies that have been adopted in the country between 2006 and 2015. Prior to fleshing out the policies and strategies around STEM education and the NSoI, a background to South Africa's recent history is laid out. Secondly, an overview of the understanding of, and policies around a developmental state and the promotion of human resource development as an element of the developmental state are given. This chapter concludes with an analysis of any trends that the country's human resource development (HRD) policies and strategies have taken over the period of 2006 – 2015.

2.2 AN INTRODUCTION TO SOUTH AFRICA

South Africa is an ex-colonial country with a long history of deep social divisions; specifically along racial lines with black South Africans being the most affected by oppression, exploitation and legalised racism under apartheid. Despite the overhaul of the apartheid government and the introduction of a democratic South Africa in 1994, the majority of black South Africans continue to live under poor living conditions. Service delivery remains below standard for many South Africans, and many continue to be served by low quality public institutions – including educational institutions (DHET, 2013).

Noticeable features of current day South Africa are the disparities in living conditions, weak economic opportunities, and poor service delivery across the nine provinces. The divide between rural and urban South Africa remains noticeable, and continues to divide the population with regards to living standards, with those living under worse conditions living in the rural areas and underdeveloped provinces of the country. Due to the Bantu education system imposed on the black population under apartheid, the country remains burdened with a large group of unskilled, working-

age citizens. This has impacted, and continues to impact, the mismatch of supply and demand for skills in a developing South Africa (Murtin, 2013).

Partly as a result of the mismatch of the supply and demand for skills in the labour market, the level of unemployment has been increasing in South Africa over the past years with the unemployment level sitting at 25.5% in the third quarter of 2015, when using the narrow definition of unemployment (StatsSA, 2015). Since the democratic government took over in 1994, the need to improve human resource development (HRD) has been identified as a strategic priority (Presidency, 2010).

2.3 Building a Developmental State in South Africa

South Africa's democratic government has taken cognisance of the issues facing post-apartheid South Africa. The main issues facing South Africa include growing unemployment, poverty, continued racial and class divisions in society, inequality, poor service delivery, and an underperforming economy. In order to address these issues; specifically the twin challenges of poverty and inequality (NPC, 2011); the government has formulated a variety of policy documents that have a key focus on building up a developmental state. The most notable of these documents is the National Development Plan (NDP), which dedicates an entire chapter (Chapter 13: Building a Capable and Developmental State) on the state's intentions to build up a developmental state. In the document, it is noted that building up state capacity is the most vital step to achieving a developmental state. This goes along with the ability to not only form policies and regulations, but to be an active state that implements them as well (NPC, 2011).

However, despite certain achievements made by the government; including the expansion of the provision of electricity to underprivileged areas (Peter*, 2015), and a successful restructuring of public finances and the creation of an effective taxation system (NPC, 2011); there are a number of challenges still limiting the progression towards a developmental state. Amongst the most salient challenges is the 'tendency to jump from one quick fix or policy fad to the next' (NPC, 2011, p. 408), with many initiatives being ad hoc and not taking into account the cumulative effect of the policies being adopted. This has resulted in a lack of responsibilities and accountability within and between the levels of government – local, provincial and national – and difficulties in managing the system as a coherent body (NPC, 2011).

In July 2009 the Minister of Planning in the Presidency published a policy framework entitled "Together Doing More: Medium Term Strategic Framework: A Framework to Guide Government's Programme in the Electoral Mandate Period (2009 – 2014)". The Framework identified 10 strategic

priorities for the period of 2009 – 2014. Strategic priority 10 states: *Build a developmental state including improvement of public services and strengthening democratic institutions.* This strategic priority focuses on building an "effective and accountable state as well as fostering active citizenship" (Presidency, 2009, p. 40) through improving the capacity of the state; improving the delivery and quality of public services; entrenching a culture of practice of efficient, transparent, honest, and compassionate public service; and building a partnership with society and strengthening democratic institutions (Presidency, 2009, pp. 40 -43).

Apart from the clear focus on improving service delivery and government coordination, the role of a developmental South African state is also used as the framework through which social redress can be tackled. A cross-cutting theme in South Africa's developmental goals is to achieve transformation of society, specifically with regards to the 'elimination of racism, sexism and other forms of discrimination'. Additionally, the state emphasises the goal of entrenching 'democratic norms and a culture of tolerance and human dignity' throughout the nation (DHET, 2013, p. 10).

Development through Building up Human Capabilities

Early post-apartheid South Africa placed the focus of development on capital investment in infrastructure and machinery; and pushed for export-led growth strategies. The flow of development was considered to be economic development first, with the resulting outcome of human development through improved education, improved health care, and higher incomes. This mentality has shifted to focus on direct investments in building up human capital in the country (Presidency, 2010).

The country defines human resource development as: "formal and explicit activities that will enhance the ability of all individuals to reach their full potential. By enhancing the skills, knowledge and abilities of individuals, HRD serves to improve the productivity of people in their areas of work – whether these are in formal or informal settings. Increased productivity and improvements to the skills base in a country supports economic development, as well as social development" (Presidency, 2010, p. 9).

The South African state defines one of its most critical roles as being the ability to enable people to develop their capabilities. The 2001 Human Resources Development Strategy indicated that in order to achieve a rising quality for all in South Africa, it would be necessary to maximise the ability of the people of South Africa to build up knowledge and skills (Presidency, 2010). A key feature of South Africa's understanding of the developmental state, and human capability development, is that

democracy is vital to achieve the sort of developmental state that South Africa is aiming for; one that tackles poverty and inequality at their roots (NPC, 2011).

The goals around socio-economic development in South Africa are often linked with the building up of the capabilities of the country; specifically with regards to human capabilities which promotes the role of education, health, and income in human development. According to the OECD (2008; p 241) "existing policy frameworks and reports show that, at national level, there is widespread knowledge and understanding in South Africa that human resource development strategies and policies are key tools for successfully achieving socio-economic goals". However, there remains a gap between linking human resource development to broader economic and developmental goals.

The Medium Term Strategic Framework (MTSF) (Presidency, 2009), a document which attempts to address the gap identified above, holds the central objective of reducing inequality, diversifying and expanding the economic base, providing universal access to electricity, and halving poverty and unemployment by 2014, compared to 2004 standards. The goal of halving unemployment has not been achieved, as the unemployment rate in 2004 stood at 25.15% and in 2014 it stood at 25.1% (IMF, 2015). More optimistically however, those living below the lower-bound poverty line of 443 Rand per month in 2011 prices (as adopted by the NDP), was sitting at 42.2% in 2006 and had decreased to 32.3% by 2011 (Lehohla, 2014).

As can be seen in the NDP and the Medium term Strategic Framework, the building up of a developmental state and the strengthening of the human resource base are key priorities for South Africa. There is also a clear understanding that specific skills are needed to be built up in South Africa, as the country tries to address the skills mismatch being experienced in the labour market.

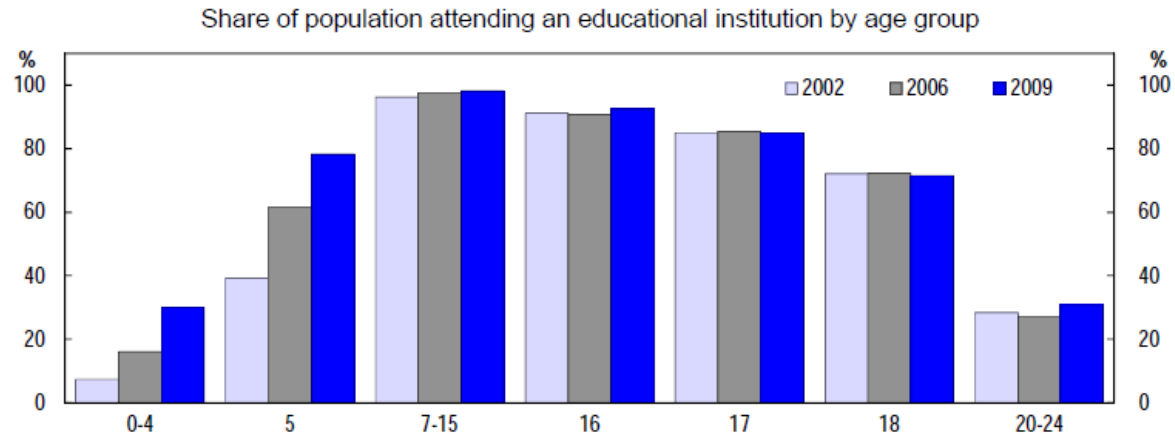
2.4 An Overview of the Education System in South Africa

Since the end of apartheid, the South African government has made progress in expanding the access to education and thus improving the quantity of learners who achieve some level of education. However, the quality of education received by many black learners is very low, especially in disadvantaged areas where learning materials, qualified educators, and infrastructure are lacking (Murtin, 2013; DHET, 2013). The state has been actively trying to democratise the education system and has achieved large scale expansion

> *"The single most important investment a country can make is in its people… knowledge production alongside innovation are central to building the capabilities of individuals and society as a whole." (* (NPC, 2011, p. 296)

of enrolments in schools, universities and colleges – institutions which were previously reserved for the privileged (white) minority under apartheid (DHET, 2013). Graph 1 below shows the slight upward trend in attendance rates in educational institutions over the years 2002 to 2009, spanning the age groups between 0 and 24 years old.

GRAPH 1: ATTENDANCE RATES AT EDUCATIONAL INSTITUTIONS IN SOUTH AFRICA: 2002 TO 2009



Source: "Education for All, Department of Basic Education, 2010a" as cited in Murtin (2013; pg. 7)

Education is compulsory from Grade 1 (which is started at 7 years of age) up until Grade 9 (which is usually achieved by the age of 15) in the country, and South Africa has achieved nearly universal enrolment from grades 1 to 9, as indicated by the graph above. For grades 10 to 12, of which grade 12 is the final year of the basic education system – commonly referred to as matric, learners can choose whether to continue their education in the basic education system or take a vocational training path by enrolling in a Further Education and Training (FET) college (Murtin, 2013).

Despite continuous attempts to reform the education sector in the country, there continues to be a large disparity between previously disadvantaged learners and previously advantaged learners. In 2009, the matric pass rate for white learners was 99% compared to the 57% amongst black learners (Murtin, 2013, p. 7). Racially based differences in the education system continue to be a pertinent issue in the country that requires redress; at both basic education and higher education and training levels. Below standard pass rates, high repetition rates, and dismal mathematics and reading proficiency of South African pupils are all concerns facing the government, schooling sector, and education departments.

The national curriculum has undergone a number of reforms in attempts to redress the disparities in the education system (Murtin, 2013). The curriculum was reformed in 1997 with the launch of Curriculum 2005; which aimed at addressing the racial divisions of the education system and

fostering a culture of human rights, multilingualism, multi-culturalism, nation-building, and reconciliation (OECD, 2008). However, Curriculum 2005 was criticised for being too complex and resulted in a second reform being phased in, in 2008. The new curriculum has a focus on learner-centred education, aiming at developing "critical thought and democratic practice with an appreciation of the importance of content and support for educators" (OECD, 2008, p. 81). A critical focus of this reform was to dedicate more time to learning basic skills at primary school level, including mathematics and language (Murtin, 2013).

In 1995, an overhaul of the national qualifications framework (NQF) was also adopted. The NQF was established as a framework to encompass the education and training system, by dividing the system up into levels of education attainment (OECD, 2008). The NQF was adapted to have a focus on outcome-based education (OBE). The desired outcomes that were to be achieved were defined as students who are able to solve problems through using creative and critical thinking; students who can work effectively as members of a team or community; students who are able to organise and manage themselves and their activities responsibly and effectively; students who can collect, analyse, organise and critically evaluate information; students who can communicate effectively through visual, mathematical and language skills; students who can use science and technology effectively and critically whilst showing a responsibility towards the environment and others; and students who can demonstrate an understanding of the world as a set of interrelated systems (OECD, 2008).

2.5 Human Resource Development Policy in South Africa: 2006 – 2015

A Background to Key Education Policies prior to 2006

Prior to 2006, two essential policy documents were released on higher education in South Africa. The first being the "White Paper 3: A Programme for the Transformation of Higher Education", released in July 1997. The second document was the "Draft National Plan for Higher Education in South Africa", issued in 2001. The White Paper 3 stipulates that higher education plays three crucial roles in a knowledge-driven world. These goals were defined as being: 1) human resource development; 2) high levels skills training, specifically with regards to professionals and 'knowledge workers'; and 3) the production, acquisition and application of new knowledge (DOE, White Paper 3: A Programme for the Transformation of Higher Education, 1997, p. 10). White Paper 3 laid the foundation for understanding the link between higher education and a knowledge economy, as well as the important role of building up skilled human resources that can contribute to the changing economy (OECD, 2008).

The Draft National Plan for Higher Education (DNP) emphasises the importance of increasing the number of skilled workers in South Africa, for social and economic development, considering the expansion of a knowledge-driven world. The first strategic objective of the document was to produce graduates with the necessary skills to meet the human resource needs of the country. The DNP indicated that an endemic shortage of certain skills was being faced in the country. The skills that were deemed to be in short supply fell in the fields of science, economics, information technology, engineering, technology, and accountancy.

The shortage of skills was considered in the context of a higher education system that did not produce enough graduates and was experiencing a fall in the retention rates of students; and of a schooling system that was experiencing a decline in student outputs, specifically a low number of students matriculating with higher-grade passes in mathematics. Four outcomes relevant to this research were established in the DNP. The outcomes were as follows: 1) Increase participation rates at higher education institutions; 2) increase graduate outputs, specifically with regards to the number of students graduating annually; 3) Change the ratio of enrolments by field of study, with the specific goal of increasing the ratio of science, engineering and technology enrolments from 25% to 30%; and 4) enhancing the cognitive skills of graduates to allow them to be citizens who participate in a democratic society, and to be professionals who can contribute to the economy.

Apart from the above-mentioned policies on higher education, the government of South Africa recognised the need to improve school-level mathematics and science grades, in order to allow for an increased number of university enrolments and graduates in the science, engineering and technology (SET) fields. In 2002, a strategy was adopted to promote mathematics, science, and technology at school level. The strategy was to establish a number of targeted schools, mainly in rural and underprivileged areas, that would become centres of excellence in mathematics, science and technology (MST). These schools were referred to as Dinaledi (star) schools. The objective of the Dinaledi schools was to double the number of mathematics and science matric graduates to 50 000, by 2008 (OECD, 2008).

Education Policies in South Africa from 2006 – 2015

Since 2006, six key policy documents related to STEM education, and education more broadly, have been published by ministries of the South African government. The timeline of the release of these documents is as follows:

This section will be divided by year and policy document, and relevant information from speeches, interviews, and other non-ministerial policy documents shall be compiled to create a progressive structure of education policy in South Africa from 2006 to 2015. Information pertaining to the NSoI and STEM education more specifically shall be laid out in each sub section below.

Education Policy in South Africa: 2006 – 2007

During the period 2006 – 2007, the second post-apartheid President of South Africa, Thabo Mbeki (who was in power from 1999 – 2008), was driving his brain-child, the African Agenda, in the Presidency. A central pillar of South Africa's diplomatic relations, and national priorities revolved around the building up of South Africa's position on the African continent whilst promoting an integrated and harmonised African Agenda. This sentiment was present even in the understanding of a knowledge economy, as it became intertwined with all ministries of the South African government. According to the Department of Science and Technology (DST), "broadening and deepening Africa's agenda for sustainable growth and development through knowledge and innovation should constitute one of [South Africa's] goals" (Mangena, 2006). The creation of a knowledge-driven economy became synonymous with the country's developmental objectives, as "the government's broad developmental mandate can ultimately be achieved only if South Africa takes further steps on the road to becoming a knowledge-based economy, in which science and technology, information, and learning move to the centre of economic activity" (DST, 2007, p. 2).

> *"Science and technology is a sine qua non for modernisation"*
> (Motlanthe, 2013)

By 2006, South Africa had a holistic understanding of its NSoI, rather than focusing policy only on science and technology research. A key focus area of the country's NSoI was research and development (R&D). R&D was seen as the framework in which human capacity in science and technology would be built up, innovation by both private enterprises and public research institutions, and policy making would take place. The focus of the NSoI under apartheid was based on mining technologies and medical research. However, by 2007 the focus had shifted to areas such as palaeontology, indigenous knowledge, and astronomy. The state also emphasised the desire to use the NSoI as a tool to explore new techniques to aid with poverty alleviation in the country. Innovation programmes became focused around biotechnology, manufacturing technology, information technology, and technology for poverty reduction (OECD, 2007).

THE YOUTH INTO SCIENCE STRATEGY

In 2006 the DST began developing a programme called "Youth into Science Strategy" (YiSS), which was formally implemented in 2007. The objective of YiSS was to nurture young talent in STEM fields, and to enhance participation in, and awareness of, STEM-related careers. YiSS outlined programmes aimed at the senior education level (Grade 10 – 12); post-school level; and to promote public awareness of STEM. The public awareness programme implemented was the national science week whereby STEM is promoted for a week annually, nation-wide, in science centres, to promote awareness and interest in STEM amongst communities (Arends, F; et al; 2014).

> *"YiSS aims to increase the quality and quantity of SET graduates from the schooling system by improving science and technology awareness and literacy, and recruit more school-going youth and undergraduates to pursue careers in STEM" (Arends, F; et al; 2014; p.1)*

The senior education programme that was implemented in 2006 was the Talent Development Programme. The Talent Development Programme was adopted in selected Dinaledi schools. The programme took top performing grade 10, 11, and 12 students and provided them access to additional mentoring, challenging academic work, and assistance to prepare for university life (Arends, F; et al; 2014).

The Post-school programmes that were adopted and that aimed at helping almost-graduates and graduated students find employment and gain experience in STEM fields were: (i) the National Youth Service: Unemployed Science Graduates; and (ii) the Engineering Experiential Programme. The Unemployed Science Graduates Programme aimed to create employment opportunities for STEM

graduates who are unemployed, in the science centres that are used for the national science weeks but that are open to the public throughout the year. The first phase of this programme was implemented between 2007 and 2011. The Engineering Experiential Programme sought to create employment and experience opportunities for engineering students from Universities of Technology; as these students often failed to secure job placements in the industry due to a lack of work experience (Arends, F; et al; 2014).

Innovation Towards a Knowledge-based Economy: Ten Year Plan for South Africa

In 2008 the Department of Science and Technology of South Africa released a publication entitled: "Innovation Towards a Knowledge-based Economy: Ten Year Plan for South Africa: 2008 – 2018". This document lays out the challenges the country faces that are limiting it from becoming a knowledge-based economy. The primary objective of this document is to lay the foundation for the vision to create a society that, by 2018, "uses its knowledge systems and human capital to solve problems in [the] country and on [the African] continent, while exploiting economic opportunity in a sustainable way" (DST, 2007, p. 5). The strategic role of the NSoI in building up HRST is emphasised in this document, with the report indicating that "the NSoI must become more focused on long range objectives, including urgently confronting our inadequate production (in both a qualitative and quantitative sense) of knowledge workers capable of building a globally competitive economy" (DST, 2007, p. iv).

The report identified four elements that will drive the development of a knowledge-based economy:

- Human capital development
- Knowledge generation and exploitation (R&D)
- Knowledge infrastructure
- Enablers to address the "innovation chasm" between research results and socioeconomic outcomes.

The report places the role of human capital development through education, and knowledge generation, at the core of building up a knowledge economy. Increasing the number of PhD graduates in the country was identified as a key priority to boosting human capital development. In 2005, only 561 students graduated with PhDs in the SET fields. The target set in the report is to increase this graduation rate fivefold by 2018, to 3000 SET PhD graduates annually. Apart from simply increasing the number of PhD graduates, the Ten Year Innovation Plan indicates that increased attention should be paid to honing specialised skills at the interface between engineering,

technology and economics. The plan recommends honing these specialist skills through revised curricula for post-graduate students that include courses on innovation and technology management, product development, technology incubation, project management, and business management (DST, 2007, p. 30).

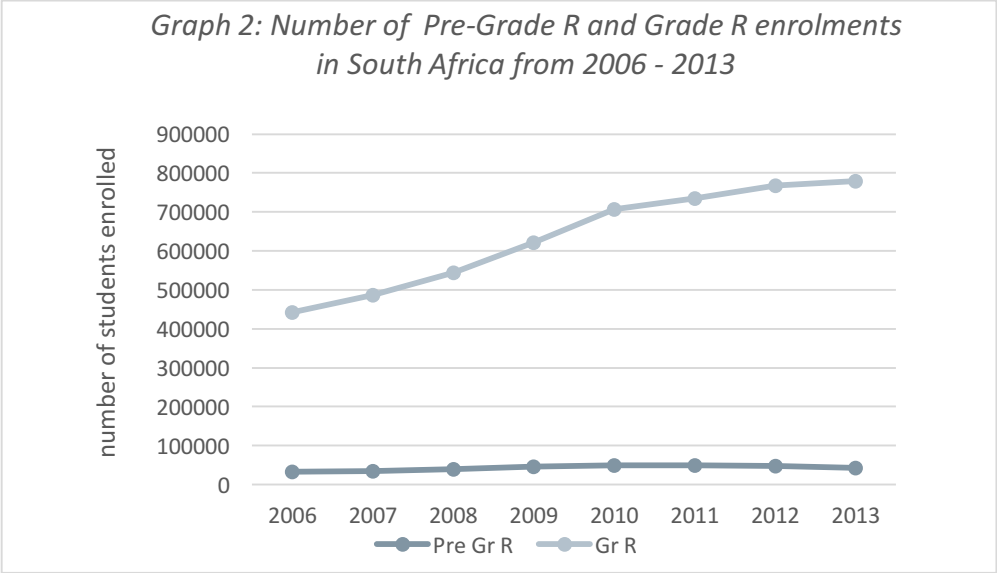
Education Policy in South Africa: 2008 - 2009

The Medium Term Strategic Framework & The 'Foundation For Learning' Strategy

In 2009, the 4th democratic elections of South Africa were held, and this ushered in a new electoral mandate. The Medium Term Strategic Framework was released as a framework to guide government's programme in the then forthcoming electoral mandate for the period of 2009 to 2014. The MTSF contained a Strategic Priority revolving around human resource development. Strategic Priority 4: *Strengthening the skills and human resource base*, is based on the building up of 'human capital and capabilities in order to improve the quality of the country's human resource and skills base' (Presidency, 2009, p. 22).

Strategic Priority 4 identified a number of elements to guide the progression towards the end goal of strengthening the skills and human resource base. The first element was to create a culture of achievement amongst learners, and to improve learner outcomes. This included better utilisation of resources available to improve school quality, especially in the public education system where poor utilisation of resources was a persistent issue.

The second element was to improve access to, participation in, and quality of early childhood development services; considering the historical disparities in access to, and quality of education received by the majority of learners in the country. This element is consistent with the government's understanding of the capabilities approach to human development, as quality early childhood development is deemed essential to the promotion of human capability development later in life. Graph 2 depicts the changes in early childhood education (pre-Grade R, and Grade R) in South Africa, from 2006 – 2013. Grade R (for children aged 4, turning 5 (OECD, 2008, p. 47)) enrolment increased dramatically over the 8 year period, increasing from 441587 students enrolled in 2006 to 779370 students enrolled for Grade R in 2013. However, Pre-Grade R enrolments only increased by 5019 students, nation-wide, over the same period.



Graph 2 Source: Compiled by the author from annually released statistical publications, "Education Statistics in South Africa"; published by Statistics South Africa.

In March 2008, another strategy to address poor learner outcomes in later years of the schooling system was launched by the Minister of Education. The three year strategy, named the 'Foundation for Learning' strategy aimed at ensuring quality education for the foundation phases of schooling which encompasses Grade R to Grade 3.The focus area of the strategy was to improve the foundation laid in mathematics and language skills for young learners. The strategy called for parents, students and educators to play a role in the development of this foundation whilst acknowledging the importance of a strong foundation in mathematics and languages, as well as the challenges that learners face in building up this foundation (OECD, 2008).

The third element of the MTSF's Priority Strategy 4 was to expand access to secondary education, whilst also increasing the capacity of schools to allow for increased enrolments at secondary education level. The government began supporting the initiative to make the first 12 years, and not only 9 years, of education compulsory.

The final two elements relevant to this research are element eight, which is defined as broadening access to post-secondary education and improve higher education throughput rate by 20% by 2014; and element nine. Element nine revolved around increasing the number of skilled personnel in priority areas such as design, engineering and artisanship. A strong recognition for the shortage of skills facing the labour market in South Africa is expressed in elements eight and nine; with strategies to solve the issue of skills shortages including the establishment of new and appropriate higher education institutions, and an increase in the number of students studying at post-graduate

level and conducting basic and applied research. Furthermore, element eight indicates that efforts would be made to 'work with the private sector in order to contribute to innovation across society' (Presidency, 2009, p. 27).

Education Policy in South Africa: 2010

The Human Resource Development Strategy for South Africa

By 2010 the Government of South Africa believed it necessary to publish a revised Human Resources Development Strategy for South Africa to replace the 2001 HRD strategy with an updated version that addressed the shortcomings of the 2001 strategy. The HRDS-SA (2010; p. 19 - 20) outlined 15 strategic goals, and eight commitments to contribute to three central objectives of development in South Africa. The central objectives are described as:

1. To urgently and substantively reduce the scourges of poverty and unemployment in South Africa
2. To promote justice and social cohesion through improved equity in the provision and outcomes of education and skills development programmes; and
3. To substantively improve national economic growth and development through improved competitiveness of the South African economy.

The eight commitments stipulated in the HRDS-SA were designed to address the above objectives. Commitment one, three and eight discuss the role of education and the building up of specific and required skills. Commitment one seeks to overcome the shortage of human capital with required skills in design, engineering and artisanship. The commitment seeks to accelerate training, and increase the number of personnel with the above-mentioned required skills.

Commitment three seeks to improve universal access to quality basic education, which covers grades R – 12. This objective places a strong focus on improving access to quality education specifically for the poor, and with the end goal of equipping learners with the capacity for good citizenship.

Commitment six seeks to "improve the technological and innovation capability and outcomes within the public and private sectors to enhance [the country's] competitiveness in the global economy and to meet [South Africa's] human development priorities" (Presidency, 2010, p. 23). In order to meet this commitment, the strategy indicates that the number of skilled personnel in the SET fields should be increased, and that the country's performance in teaching, research and innovation in the SET fields should be improved.

Education Policy in South Africa: 2011 - 2012

The Adopted Dinaledi Schools Project

In 2011, the YiSS was expanded to incorporate a new initiative: the Department of Science and Technology's 'Adopted Dinaledi Schools Project'. The project was a 3 year initiative that ran between 2011 and 2013. 18 Dinaledi schools were selected and were to receive supplementary tuition in mathematics and physical sciences for students in Grades 10, 11, and 12. Additionally, supplementary training in these subjects was to be provided to teachers, and additional teaching resources were to be provided to these schools (Arends, F; et al; 2014).

The National Development Plan

The NDP chapter on education, "Chapter 9: improving education, training and innovation" reflected a similar recommendation to what the Adopted Dinaledi Schools Project aimed to achieve. The NDP indicated that increased consideration should be given to expanding the Dinaledi Schools initiative to increase access to maths and science in underprivileged schools. This in order to meet the 2030 goals of 1) improving numeracy and literacy, and science and mathematics outcomes of learners; thus enabling a higher number of learners to be eligible for studying STEM related degrees at university; and 2) increasing the number of students who matriculate with university exemption, and passes in mathematics and physical sciences, to 450 000 learners annually (NPC, 2011, p. 305).

However, apart from setting the target of increasing learners studying in the STEM fields, the NDP places a heavy focus on the urgent need to improve the quality of education in the country. HEIs need to be invested in, so as to meet the demands of increasing learners entering the higher education system. HEIs are seen as critical for developing a knowledge economy and the critical skills required to build up a knowledge economy which are identified as being, amongst others, engineering, actuarial science, medicine, financial management, and chartered accountancy. The NDP also indicates that there is a shortage of academic staff in the fields of engineering and natural sciences.

> *"South Africa needs to dev and strengthen collaborat with other education syster the English-speaking world the BRIC countries"* (NPC, 2 p. 305)

Apart from increasing academic staff at the post-school education level, the NDP seeks to see an increase in the number of post-graduate students and the number of researchers. The goal set is to have 5000 doctoral graduates annually by 2030, with the majority of these being in STEM fields. The NDP also recommends that international exchanges be pursued and encouraged, to promote research and innovation capacity.

Throughout the policy documents discussed in this research report, increased emphasis is placed on South Africa integrating into the global economy. The NDP places emphasis on the need for South African learners to be able to be admitted into education systems in other countries. The desire to absorb learners into the South African education system from the SADC and the African continent more broadly (Presidency, 2010), as well as international students, is also becoming more prevalent.

The NDP claims that universities are increasing their role in the knowledge economy, as R&D is increasingly produced by universities and respectively less so by the private sector. Increasing PhD graduates is indicated as being vital for the increased ability to produce research in the country. However, the NDP calls for all stakeholders in the NSoI to play a part in R&D and improving South Africa' global competitiveness. The NSoI is placed in a key position for improving South Africa's global competitiveness, as "continued advances in technological innovation and the production of new knowledge are critical to growth and development" (NPC, 2011, p. 326). To aid in the boosting of the NSoI, the NDP (2011; p. 327) recommends the following:

1. Nurture and coordinate research capacity in higher education and link this to post graduate studies. Improve coordination and support for partnerships between universities and other research and innovation sites.
2. Develop a common policy framework on the critical role of science and technology, the role of higher education in shaping society, and the future of the country and its growth path.
3. Relax immigration requirements for highly skilled science and mathematics teachers, technicians, and researchers.
4. Revitalise science and mathematics by increasing the number of school leavers eligible to study science and mathematics-based subjects at university.
5. Develop a few world-class centres and programmes within both the national system of innovation and the higher education sector over the next 18 years (2012 – 2030).

Education Policy in South Africa: 2013-2015

White Paper for Post-school Education and Training: Building an Expanded, Effective and Integrated Post-School System

The White Paper for Post-School Education and Training (WP-PSET) sets out the vision for the post-school education system that will hopefully be achieved by 2030. The WP-PSET supplements previous policy documents, including the NDP, that have set goals to meet

> *"This White Paper sets out policies to guide the DHET and the institutions for which it is responsible in order to contribute to building a developmental state with a vibrant democracy and a flourishing economy." (DHET; 2013; p.4)*

priorities and strategies that are set out to improve education, employment, and national economic development (DHET, 2013).

The primary policy objectives envisioned in the WP-PSET (2013; p. 4) are:

1. A post-school system that can assist in building a fair, equitable, non-racial, non-sexist and democratic South Africa
2. A single, coordinated post-school education and training system
3. Expanded access, improved quality and increased diversity of provision
4. A stronger and more cooperative relationship between education and training institutions and the workplace
5. A post-school education and training system that is responsive to the needs of individual citizens and of employers in both public and private sectors, as well as broader societal and developmental objectives

The WP-PSET identifies three policy drivers that will be essential to achieving the above 5 goals. These drivers are 1) improved planning, so as to better coordinate with other policy initiatives and other governmental departments – specifically the DST; 2) increasing funding to boost access to education by limiting the impact of post-school education fees on the poor and to provide funding for the management and maintenance of institutions, and the building of new education institutions, as well as increasing investment in research; and lastly 3) quality assurance as the quality of education received by many learners was still deemed below standard at the time of the publishing of the White Paper.

Whilst acknowledging the central role that universities play in the generation of knowledge, primarily through research, the WP-PSET indicates that the current level of knowledge generation is insufficient to meet the country's developmental needs. The White Paper urges for policy to be focused on growing innovation and research, improving the quality of research, building up the national system of innovation, and to promote collaboration between universities and other stakeholders in the R&D process.

Investigation into the Implementation of Maths, Science and Technology

The Department of Basic Education (DBE) commissioned a task team to investigate the implementation of maths, science, and technology strategies in the nine provinces of South Africa, and nationally. The last strategy published on MST was published in 2001, and it was the implementation of this 2001 national strategy for MST that the task team focused on investigating. The implementation report is the outcome of this investigation. It identified similarities, strengths,

and weaknesses amongst the nine provincial MST strategies; as well as proposed certain recommendations to improve the MST strategy in South Africa. As a result of this report and investigation - and the recommendations made therein -, the DBE has put in place a plan to develop a national MST strategy to guide government's implementation and improvement of MST until 2019 in South Africa (www.gov.za, 2014). At the time of writing this research report, the new national MST strategy was not yet complete or available.

Some of the key recommendations made in the implementation report are detailed below:

1. It was found that HEIs are not supplying sufficiently qualified or trained MST teachers into the schooling system. To address this concern, the report recommended that the Department of Basic Education set and monitor quality benchmarks for HEIs to adhere to; as well as get actively involved in the creation and monitoring of a curriculum for training new MST teachers that can be adopted in HEIs.
2. Government departments should better coordinate amongst themselves, to compliment initiatives being undertaken by the different departments. The DBE and DST are recommended to work closely together, as the Youth into Science Strategies of the DST could be better utilised by the DBE; specifically the resources available through the science centres.
3. Re-evaluate the Dinaledi Schools initiative, as the schools have consistently contributed to improved MST achievement in the country; but some schools are non-performers and the programme requires differentiated levels of support that should be provided for. The implementation report recommends increasing the number of non-fee paying Dinaledi Schools, and considers the Dinaledi initiative to still be valuable.
4. A talent search strategy should be created, as many provincial education departments pay attention to the non-performing schools at the expense of schools with talented learners in MST. The implementation report recommends the establishment of "at least one dedicated Mathematics and Science Academy or a special Mathematics, Science and Technology School" in each province (DHET, 2013, p. 48).
5. There is a sentiment that the subject of technology is not being given enough attention or being done justice under the current curriculum. Technology is currently merged with the subject Natural Science; and the implications of this combination should be investigated. Teachers should receive improved training in the subject of Technology, and a wider variety of technical subjects should be offered at the further education and training level.

2.6 Trends in Human Resource Development in South Africa

South Africa's understanding of the developmental state, the country's unique priorities, and how the country understands the role of the state in development are incorporated in the majority of policy documents and high-level state representative's speeches. Policy documents and speeches consistently include the importance of building up a developmental state, enhancing the NSoI, developing a knowledge economy, promoting human resource and human capability development, and the role of STI in development. The consistent inclusion of these concepts and priorities is present over the period of 2006 to 2015. However, the approach to achieving these objectives has shifted over the years in question. The below section provides an analysis of these shifts and trends in South Africa's approach to development from 2006 – 2015. The analysis in this section shall be used as the basis for comparison with China, in answering the sub-questions of this research report in Chapter 4.

The following areas related to human resource development have shown changing trends over the decade of 2006 to 2015:

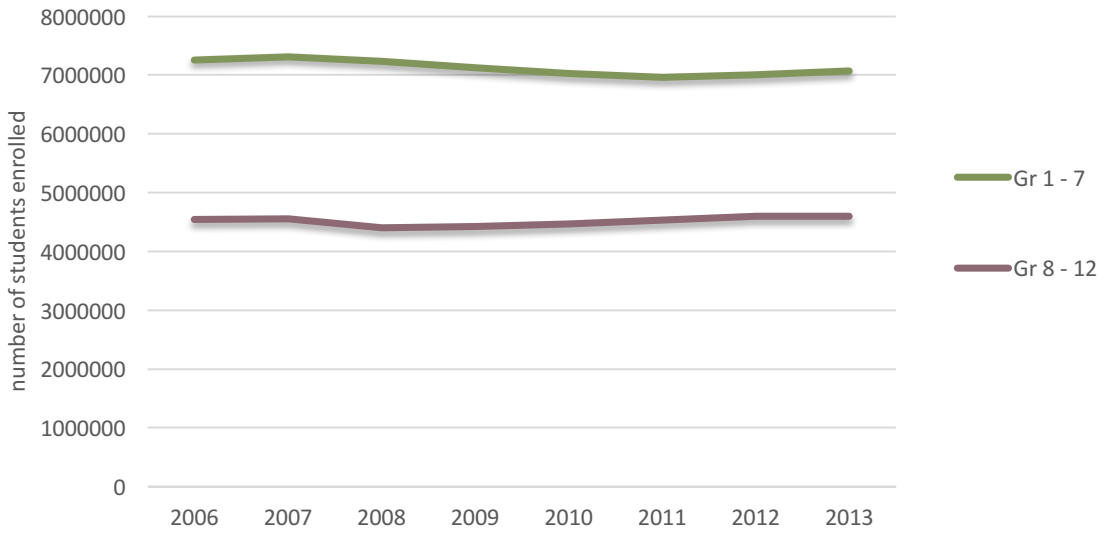
1. The education system
2. The Dinaledi Schools initiative and centres dedicated to STEM development
3. Strategies to promote human development in mathematics and science
4. The industries in which innovation is promoted, and the emphasis placed on certain aspects of the NSoI

The Education System

Prior to 2006, focus was placed on expanding access to education in order to redress the structural inequalities of the past. Government aimed at creating universal access to education up until grade 9, and drastically expanded the schooling system to meet this target. However, the quality of education did not keep up with this expanding school sector and could not meet the demand of the increased number of learners in the country. A clear shift in the prioritisation of quality rather than quantity of education is witnessed in the years 2006 to 2015. Policies prior to 2009 indicate that the quality of education is poor and needs to be lifted; however the main priority remained increasing access to education and transforming the education system to allow more disadvantaged learners to enter the system. In the later years (2009 – 2015) increased urgency is placed on the need to improve the quality of education, and drastically. Increased attention is paid to the need to radically improve the outcomes of learners in the subjects of mathematics, science, and English.

Although there was an increased urgency to improve quality of education, the primary goal of increasing access to education remained central to South Africa's policies and education goals. Despite consistent increases in the national budget allocated to funding the education system to achieve the goal of increasing access to education, the total number of students accessing education over the years 2006 – 2013 barely fluctuated, as indicated by Graph 3 below.

Graph 3: Number of Students Enrolled in Primary and Secondary School in South Africa from 2006 to 2013



Source: Compiled by the author from annually released statistical publications, "Education Statistics in South Africa"; published by Statistics South Africa.

In order to address the poor quality of the education system, the national curriculum underwent two major changes. The first change was prior to 2006 in which the curriculum focused more on trying to stimulate the transformation of the education system as well as the mentality of learners through promoting human rights, nation building, multi-culturalism and multilingualism. The new curriculum changed focus, and altered the education system from 2008 onwards to be more learner-centred and develop students capable of critical thought and who embraced democratic principles. Additionally, the 2008 curriculum reform placed increased emphasis on building solid foundations in mathematics and language during earlier years of education.

As part of the 2008 curriculum reform, pass rates were adjusted, and an increase in the number of students who matriculated was seen. Table 1 below indicates the percentage of matriculants who passed matric, and indicates the percentage of students who matriculated without endorsement to enter into higher education, and those who qualified to enter into either a bachelor programme, a diploma programme, or a higher certificate programme. In 2006, the number of students who passed with university exemption stood at 16.3%, and had risen to 30.6% by 2013.

TABLE 1: PERCENTAGE OF MATRIC STUDENTS WHO PASSED THE SENIOR CERTIFICATE EXAMINATION, ACCORDING TO TYPE OF POST-SCHOOL EDUCATION EXEMPTION RECEIVED: 2006 – 2013

	% of candidates who passed Senior Certificate Examination (SCE)				
Year	without endorsement	Who qualified to enter bachelor programme	Who qualified to enter diploma programme	Who qualified to enter higher certificate programme	Overall pass rate (%)
2006	50.3	16.3	N/A	N/A	66.6
2007	50.1	15.1	N/A	N/A	65.2
2008	1	19.1	23	19.1	62.2
2009	0.2	19.9	23.7	16.9	60.6
2010	0.1	23.5	27.2	17	67.8
2011	0.1	24.3	28.5	17.2	70.1
2012	0.1	26.6	29.9	17.3	73.9
2013	0	30.6	30.8	16.8	78.2

Source: Compiled by the author from annually released statistical publications, "Education Statistics in South Africa"; published by Statistics South Africa.

Throughout the 10 year period, emphasis is given to increasing the number of learners studying mathematics and science at school level, and STEM-related degrees at higher education level. What did shift with regards to this emphasis is the urgency placed on increasing the number of learners, the output of graduates, and the quality of education in these subjects. A target was set to increase matriculants who achieved university exemption and passed mathematics and science to 9% of all matriculants, by 2018, compared to 3.4% in 2002 (DST, 2007, p. 9).

Table 2 below represents the changes in the number and percentage of matriculating students who passed mathematics and science between the years of 2008 and 2013.The percentage of candidates who passed mathematics and science increased over the period. However, the total number of students writing physical sciences in their SCE decreased by 32917 students over the 6 year period. Despite the drop in the number of students writing physical sciences, the aggregate number of students who passed physical sciences increased over the period from 62 365 in 2008 to 78 731 in 2013.

TABLE 2: NUMBER OF CANDIDATES WHO WROTE, AND PERCENTAGE OF CANDIDATES WHO PASSED, MATHEMATICS AND PHYSICAL SCIENCES IN THE NATIONAL SENIOR CERTIFICATE IN SOUTH AFRICA: 2008 – 2013

Year	Mathematics		Physical Sciences	
	Total candidates who wrote (mathematics but not including math literacy)	**% total candidates who passed** (pass includes only those who passed with 40% and above*)	**Total candidates who wrote**	**% total candidates who passed** (pass includes only those who passed with 40% and above*)
2008	300,008	30	217,300	28.7
2009	290,407	29.4	220,882	20.6
2010	263,034	30.9	205,364	29.7
2011	224,635	30.1	180,585	33.8
2012	225,874	35.7	179,201	39.1
2013	324,097	40.5	184,383	42.7

Source: Compiled by the author from annually released statistical publications, "Education Statistics in South Africa"; published by Statistics South Africa.

** Note: The pass rate of 40% was used as a proxy for students who would likely achieve university, or university of technology exemption, as the data on how many students who achieved university exemption with mathematics and science passes was not publicly available at the time of compiling this research report.*

THE DINALEDI SCHOOLS INITIATIVE AND CENTRES DEDICATED TO STEM DEVELOPMENT

Apart from the shift in emphasis placed on mathematics and science at school level, increased focus was given to practical strategies that could promote STEM education from early childhood and throughout the education system. The first practical initiative taken was the Dinaledi Schools project in 2002. The Dinaledi project began as a project to improve maths and science outputs and learning in selected schools across the country. In 2006, the YiSS expanded the Dinaledi programme to not only improve maths and science at school level, but to prepare selected talented students from Dinaledi schools and prepare them for university life and better enable them to enter into STEM fields at university. In 2011, the Adopted Dinaledi Schools Project was implemented and took the Dinaledi programme a step further to improving training to teachers, improve the resources available to selected Dinaledi schools, and to provide supplementary tuition to grade 10 to 12 students. By 2013, the Dinaledi project was identified as valuable but needing to improve and adapt the support structures that are provided by the schools. The project was recommended to be streamlined by removing non-performing schools, as well as to increase the number of non-fee paying schools. The Dinaledi initiative increasingly appears as an essential mechanism to improve mathematics and science at school level; and in 2006 it became a project that was also laying the platform for further education in STEM. In 2013, the DHET expanded the concept of schools dedicated to mathematics and science education from not only the Dinaledi Schools, but to proposing dedicated MST academies that can be set up across the country to specialise in honing the talents of students who show potential in MST.

Apart from the Dinaledi Schools and the increased focus on establishing schools dedicated to MST; increasing attention is paid to the importance that science centres play in the country, with the number of science centres growing each year. The science centres were initially seen as places for communities to engage with STEM, and for learners to become enthused by the prospect of a future in STEM fields. Promotion of these initiatives are as a result of the government's increasing understanding that achievements at school level in mathematics and science are important as HEIs use performance-based entry requirements which are often linked to performance in mathematics and science (Pandor, 2011).

STRATEGIES TO PROMOTE HUMAN DEVELOPMENT THROUGH STEM EDUCATION

The various strategies and policies that the government has devised from 2006 to 2015, in its attempt to promote human development through STEM education, can be summarised as follows:

2006 - 2015	2006 - Youth into Science Strategy with the objective of nurturing young talent in STEM fields
	2006 - Talent Development Programme aimed at equipping talented MST learners for university life as STEM students
	2008 - Hone specialised skills at the interface between engineering, technology, and economics at HEIs
	2008 - Foundation for Learning Strategy to improve foundation phase mathematics and language skills in grade R to Grade 3 learners
	2009 - Create a culture of achievement amongst learners and improve learner outcomes
	2009 - Improve access to and quality of early childhood education
	2011 - Improve numeracy, literacy, and outcomes in science and mathematics amongst school learners.
	2011 - Adopted Dinaledi Schools Project in which supplementary tuition in MST was to be given at selected Dinaledi Schools
	2011 - Develop a few world-class centres and programmes that will focus on innovation in STEM fields
	2013 - Increase the attention at school level that is paid to technology as a subject
	2013 - create MST academies across the country that specialise in MST education at school level

The main trend that can be identified in the above timeline is that from 2006 – 2008, the focus was on intermediate, senior and FET phases of schooling, and sought to improve HRST through directly addressing education in MST at these phases. From 2008 – 2011, this shifted to focusing on early childhood development and the important role that a quality foundation phase plays in the building

up of human resources, as well as mathematics and science ability later in life. From 2011 to 2015, the focus shift again to being on physical centres and training programmes that could be established to increase education in STEM subjects, and boost innovation.

Industry Focus and the NSoI

Apart from the long-term investments being made in improving education in STEM, the government has focused on shorter term strategies to build up the NSoI and carve out a niche location in the global knowledge economy for the country. In 2007, the core areas for investment, in building up the knowledge economy, were identified as palaeontology, astronomy, indigenous knowledge, biotechnology, manufacturing technology, information technology, and innovation and technology for poverty alleviation. By 2010, the government had narrowed down the priority sectors for investment and innovation to the following 5 key areas: space science and technology, renewable energy, global climate change, pharmaceutical research and bio-economy research, and the exploration of human and social dynamics (Pandor, 2010). Innovation and R&D in mining technology, manufacturing technology, and raw material and natural resource production remained priority focuses throughout the period of 2006 – 2015, with Minister Naledi Pandor indicating that these 3 areas remain concentrated on, in the project of building up South Africa's NSoI and knowledge economy (Pandor, 2014).

South Africa's government has shown a consistent understanding of the need to boost HRST in order to boost innovation and achieve growth in the identified priority sectors. Policy documents indicate that a high weighting is given to increasing the number of PhD graduates in STEM fields, increasing the number of enrolments in STEM degrees at HEIs, improving R&D capacity and capability, and increasing the number of researchers; in order to boost the NSoI and move South Africa towards a knowledge economy. In 2001, a target was set to increase university enrolments in SET degrees from 25% to 30% before 2011 (DOE, Draft National Plan for Higher Education in South Africa, 2001). Yet, over the period of 2006 - 2013, the percentage of students who enrolled for SET degrees barely increased with the percentage only increasing from 28.5% to 28.8% over the 8 year period[7]; not meeting the 2011 target of 30% SET enrolments at HEIs.

Again, the trend in policies around building up the NSoI revolves around a change in the emphasis placed on certain aspects of the NSoI. Developing R&D, in terms of both output and quality of research, was the primary focus in the first half of the 10 years in question. However, the focus increasingly shifted to be on increasing the number of PhD graduates, and researchers in STEM

[7] See graph 6 on page 74 for a complete analysis of the trend in SET enrolments at university level, in both South Africa and China, from 2006 to 2013.

fields. The shift was therefore from improving R&D output to increasing human resource inputs; and all sectors involved in the NSoI – both public and private – are called on to invest in building up HRST. Policies recommend creating more internship opportunities for STEM graduates, amended curricula to better prepare STEM graduates for the labour market, and for increased investment to be placed in the commercialisation of the outcomes of research (especially research conducted at universities).

2.7 CONCLUSION

The South African government has acknowledged the need to better coordinate policies as there is a tendency to create new policies on an ad hoc basis without identifying the knock-on effects of accumulating policies and strategies. However, there are certain factors that remain consistent throughout the country's policies in the years 2006 to 2015. These factors include the following: 1) the emphasis placed on transforming institutional structures to amend the wrongs done under apartheid; 2) viewing South Africa as not only an autonomous country, but as a building block of a larger unit – the African continent, and further still, of the global South; 3) the need to improve both quality and access to education; 4) the need to build up human resources and human capabilities; 5) the desire to turn South Africa into an innovation driven country that's economy is based on knowledge production; and 6) the need for the state, education institutions (specifically HEIs), and the private sector to coordinate efforts to achieve the identified national goals that will allow the country to develop.

From the information and analysis presented in this chapter it is evident that South Africa is actively engaging with the NDS model in, and through, its policies. The country is consistently pushing towards increasing innovation, R&D, commercialisation of research, the building up of HRST, and all with the end goal of developing a knowledge economy. South Africa also consistently acknowledges the need to build up human resources, through building up human capabilities. The country has reflected a clear cognisance of the need to not only focus on senior and FET phases of education; but to build up a culture of mathematics and science from early childhood development. The country appears to have embraced the notion of human capability development, and does reflect an understanding that investment in human resources is essential for the nation to develop and achieve its goals of becoming a developmental state and create a knowledge economy.

CHAPTER 3: PROMOTING HUMAN RESOURCE DEVELOPMENT IN CHINA

3.1 CHAPTER INTRODUCTION

This chapter explores China's policies and strategies that define the country's engagement with human resource development, specifically through policies around STEM education and the country's NSoI. The country has a clearly defined understanding of the role of the state in development, especially as a communist state in a globalised economy. In order to understand how China has engaged with the developmental state model, as defined in this research report, this chapter lays out the human resource development policies and strategies that have been adopted in the country between 2006 and 2015. Prior to fleshing out the policies and strategies around STEM education and the NSoI, a background to China's recent history is provided. Secondly, an overview of the understanding of, and policies around development and the promotion of human resource development is given. This chapter concludes with an analysis of any trends that the country's HRD policies and strategies have taken over the period of 2006 – 2015.

3.2 AN INTRODUCTION TO CHINA

China has embarked on a transformation of its economy from 1978 until today. 1978 marked the reform of China's economy as it was the year that Deng Xiaoping's reform philosophy was accepted and adopted in the country. Deng Xiaoping promoted the philosophy of modernising China through professionalism, meritocracy, and the enhancement of scientific and educational work. The country had previously devised a concept called the 'four modernisations' in which modernising agriculture, industry, national defence, and science and technology (S&T) was promoted. The four modernisations were further emphasised from 1978 onwards. Since 1978, the country has consistently strived to develop 'socialism with Chinese characteristics' (Tisdell, 2009).

For over 3 decades, China's economy has thrived on the country's population dividend as the economy has experienced a rise in the number of working age citizens entering the labour force. This has resulted in China becoming "the factory of the world" (James*, 2015), as it built its initial development path through utilising and benefiting from its most abundant resource: cheap and mobile labour. However, due to China' one-child policy, the population is aging rapidly and China has identified that it can no longer base economic growth on manual labour. The country recognises the need to shift to a more long-term growth strategy, which is based on innovation and a knowledge economy, away from the historically manufacturing-economy model (Huiyao, 2009).

During the 1990s, China began actively opening up trade to the rest of the world – after having been relatively isolated from the global economy (Criscuolo & Martin, 2004). Despite double digit economic growth and unprecedented social achievements made in the country; there remains a stark divide between urban and rural development in China. The divide, and growing inequality, is between strong economic growth and development in the west (which is predominantly urbanised), and persistent under-development in the east (which is predominantly rural). These differences also overlap with cultural, social, historical and ethnic dimensions (Gallaghar, Hasan, et al., 2009).

Additionally, the primary aspect of Deng Xiaoping's theory; which promoted targeted economic growth in specific regions first - with a focus on egalitarianism and wealth redistribution later; added to the economic disparities amongst regions. Despite double-digit economic growth under Deng Xiaoping's approach; China moved away from this theory and began promoting a 'common prosperity' mentality from 2005 onwards. This shift marked the start of a more holistic approach to development, whereby more people and more regions could benefit and take part in economic development (Fan, 2006).

This shift in mentality can be identified by the change in focus from China's 10th to 11th five year plan (FYP)[8]. The 10th FYP focused on 'economic development and economic restructuring' (Criscuolo & Martin, 2004, p. 60); whereas the 11th FYP adopted the "strategic concepts of the 'Scientific Approach to Development' and 'Constructing a Harmonious Socialist Society', [reflecting] a keener attention to the issues of humanity, society and the environment, as well as the economy" (Rui & Zhiyong, 2006).

3.3 Building a Developmental State in China

By 2005, the Chinese government had begun to acknowledge that economic growth did not naturally result in economic development. Critics emphasised how environmental degradation and income inequality were rapidly rising. The country began taking cognisance of these two fundamental issues. The above mentioned strategic concepts of the 11th FYP (2006 – 2010) incorporated long term sustainability and improved redistribution of the fruits of national economic growth across regions (Fan, 2006).

The 11th FYP saw its foundation in three key pillars: Marxism-Leninism aiding in the building up a socialist society with Chinese characteristics, Deng Xiaoping theory, and the Three Represents

[8] Since 1953 (China.org.cn), China has outlined its developmental objectives and strategies in five year increments, through the national tool of five year plans (James*, 2015). The 10th five year plan spanned the years of 2001- 2005. The 11th five year plan spanned the years from 2006 – 2010 (Criscuolo & Martin, 2004).

theory. The Three Represents theory reflects the three core ideals that the ruling Communist Party of China (CPC) represents: 1) the development trends of advanced productive forces, 2) the fundamental interests of the majority of Chinese citizens, and 3) orientations of an advanced culture (Fan, 2006, p. 716).

"It is imperative to regard ti cultivation of [China's] peopl a fundamental mission" (MC 2010, p. 6)

Apart from the above three mentioned key pillars, the primary guidelines for China's development are summarised as 1) rejuvenating the economy and economic growth through science and innovation; 2) strengthening education and the nation, with skilled personnel; 3) enabling development through prioritising the role of science and technology in transforming economic development; 4) establishing a NSoI with Chinese characteristics; and 5) turning China into a moderately prosperous society by 2020 through becoming an innovation driven country (CPC, 2012, p. 3). The role of the Chinese government is considered as being crucial in adhering to these guidelines to achieve the national objectives as laid out in the FYPs and other policy documents. The role the state plays in national development is strongly emphasised, with the state's role being reflected in social welfare, economic growth and development, education, and social development. Additionally, environmental sustainability in development started to be stressed from 2006 onwards (James*, 2015).

Development through Building up Human Capabilities

China is facing a unique human resources issue as the country boasts a labour force of over one billion people, and a rapidly increasing number of workers with higher education – which is set to reach 195 million by 2020. The issue that China is facing revolves around providing employment for the ever growing number of college graduates. Historically, China has relied on a large number of workers performing unskilled and semi-skilled labour, specifically in the manufacturing sector. However, the increasing numbers of college graduates means that a divergence is begin generated between the skills supplied by the labour force and the skills required by the 'factory of the world' economic model. As a result, China is actively trying to move away from a primarily manufacturing economic model (which is unsustainable in the long run) towards an innovation driven and knowledge economy model of development (Huiyao, 2009).

In support of the move towards an innovation based economy, China adopted a national talent development plan in 2010, which is the country's first comprehensive plan to develop the nation's human resources. The National Medium- and Long-term Talent Development Plan (2010 – 2020) (TDP) is a 'blue print to create a highly skilled national work force within the next 10 years' (Huiyao,

2009, p. 1), with the end goal of creating a work force that is talent-rich, rather than being labour intensive. The government has set a target that state expenditure on human resource development will be 15% of GDP by 2020. The adoption of the national talent plan, and the planned increase in state expenditure on human resources, reiterates the country's dedication to developing its human resources, as well as emphasise its understanding of the importance of human resources in the building up of a knowledge economy (Huiyao, 2009).

The Chinese government consistently affirms the importance of education in developing human resources. This includes improving the quality of education, access to education across the different regions, and the development of an adapted education system that promotes the Chinese ideals of socialism, modernisation, and innovation. These points are stressed with regards to turning China's education system into one of the world's best; rather than simply one of the world's largest (MOE, 2010).

China's national policy is to understand basic education as a fundamental human right. It is understood that citizens should not be inherently discriminated against because they are located in rural areas. Access to basic education should be equitable across regions (James*, 2015). Human resource development in China is considered to be the outcome of the fundamental right to education, access to, and quality of education; and is closely linked with the building up of good citizens who promote and live by socialist ideals. China understands HRD to be an essential element of building up the country's economy, as well as "making China a prosperous, strong, democratic, culturally advanced and harmonious modern socialist country" (MOE, 2010, p. 5).

3.4 An Overview of the Education System in China

Prior to 1949, the Chinese system was embedded in a semi-feudal society, resulting in over 80% of the Chinese population being illiterate. In 1949 a socialist education system was adopted which promoted universal basic education in the country. Since the late 1970's, the education system has been founded on the principals of promoting character-building, respect, valuing education (MOE, 2005), and a strong culture of mathematics and science education – as a strong foundation in these two subjects is considered beneficial for all other subjects (James*, 2015). The role of education in society and the economy is well-defined with the principle goals of education being to 'service the socialist modernization drive and the people … [and] cultivate socialist builders and successors that are fully developed morally, intellectually, physically and in aesthetic appreciation" (MOE, 2005, p. 6). The education system is also responsible for teaching 'patriotism, collectivism, and traditional

Chinese virtues' (MOE, 2005, p. 15). The education system in the country is currently structured as represented in Table 3 below:

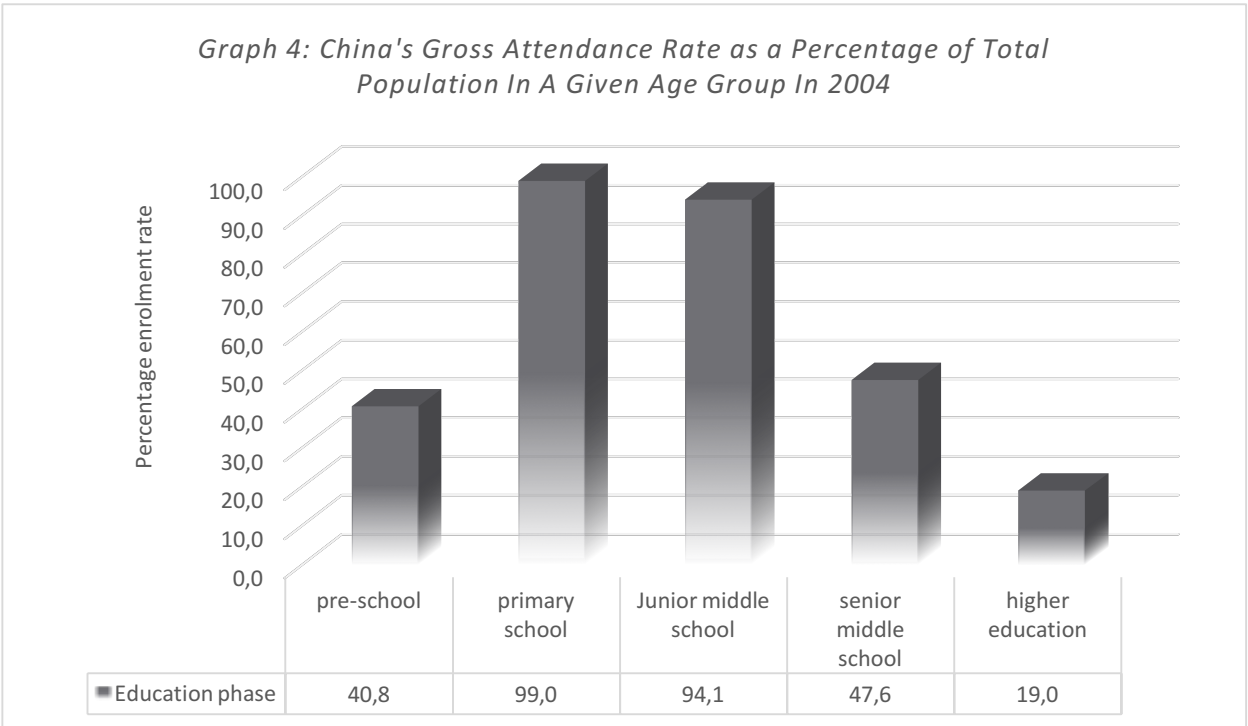
TABLE 3: THE STRUCTURE OF THE EDUCATION SYSTEM IN CHINA

Age	Academic Year	Traditional Schooling Phase	Vocational Training Phase	
3 - 5		Preschool		
6 - 11	1 – 6	Elementary		Nine-year compulsory education
12 - 14	7 – 9	Junior Secondary	Junior Secondary Vocational	
15 - 17	10 – 12	Senior Secondary	Secondary Vocational	Continuing education and training
18 - 21	13 – 16	Undergraduate	Post-Secondary Vocational	
22 - 24	17 – 19	Masters		
25 - 27	20 – 22	Doctoral		

Source: Adapted from Figure 1 in 'Education in China' (MOE, 2005, p. 7)

China adopted a policy of universal access to basic education, up to 9 years of schooling. By 2000 the country had nearly achieved this goal. By 2004, the percentage of each age group attending schooling was as reflected in the graph 4 below:

Graph 4: China's Gross Attendance Rate as a Percentage of Total Population In A Given Age Group In 2004



Source: Adapted from data provided in (MOE, Education in China, 2005)

China's 11th 5 year plan aimed to develop preschool education and special education; as well as increase enrolment in senior middle school to 80% by 2010 (Gallaghar, Hasan, & et-al., 2009). Certain metropolitan areas have also implemented a compulsory 12 year education policy. These areas include Shanghai and Beijing (James*, 2015). Despite high levels of educational attainment in key economic areas in the country, those living in rural regions still suffer from poorer quality education and poorer access to education.

3.5 Human Resource Development Policy in China: 2006 – 2015

A Background to Key Human Resource Development Policies Prior to 2006

Prior to 2006, China had adopted two strategic policies to improve education, boost higher education in the country, and build the country's higher education sector into a competitive industry in the global economy. These two policies were the 211 project and the 985 project. The 211 project was announced in 1993, and officially implemented in 1995. The project injected funds into over one hundred identified universities and HEIs across China. The project injected over RMB 30 Billion into the identified institutions in order to build up faculties, improve curricula, and build institutions capable of delivering high levels skills training needed for the country's future economic development. Capacity building focused on improving and expanding the subjects of engineering, technological sciences, physical sciences, and biological sciences (Gallaghar, Hasan, & et-al., 2009).

The 211 project was later considered overly ambitious (James*, 2015). As a result, the 985 project was adopted in 1999 to focus investments on 36 of the identified universities from the 211 project. Out of these 36 universities, nine universities were identified as universities that should be built up into world-class, internationally competitive universities. The objective was to turn these nine universities into hubs for international research collaboration which attracted internationally renowned professors from across the globe, and promoted international and national staff and student exchanges (Gallaghar, Hasan, & et-al., 2009).

In 1999, China also set certain targets for education that were to be achieved by 2010. Included in the targets set was increasing the enrolment rate at universities to 15% (of the 18 – 22 year old age cohort) by 2010 (Gallaghar, Hasan, & et-al., 2009).

Education Policies in China from 2006 – 2015

After the 211 and 985 projects, and from 2006 onwards, six key policy documents were released by the Chinese government and its relevant ministries. The timeline for the release of these documents is as follows:

This section will be divided by year and policy document, with relevant information from other documentary sources and interviews being used to supplement the information about education policies in China from 2006 – 2015. A progressive structure, from 2006, up to 2015, shall be compiled, with information about the NSoI and STEM education in the country being laid out under each year's sub-section.

Education Policy in China: 2006- 2009

With the adoption of the 11th FYP, China made explicit the goals of minimising the growing inequalities between urban and rural areas. A consciousness of environmental sustainability is evident, and rural development is promoted. Additionally, improved service delivery was placed as a priority for the government. The plan revolves around 'putting people first', and building a harmonious society (Kai, 2006).

With a highly centralised state, whose role in society includes playing a strategic part in every aspect of society and development (James*, 2015); the country shifted towards increasing the independence of the private sector under the 11th five year plan (FYP). The plan identified the need to strengthen the capacity of enterprises, allowing them to increase innovation independently, and become more competitive globally. The objective of opening up the economy further was identified,

and the promotion of a market economy system was stipulated (Kai, 2006). According to Kai (2006), "Breakthroughs will be made in the reform and institutional building of areas such as administrative governance, state-owned enterprises, taxation, finance, science and technology, education, culture, and public health."

EDUCATION IN THE 11TH FIVE-YEAR PLAN

The 11th FYP identified a number of policies regarding human resource development, education, and the NSoI that were to be adopted during the 2006 – 2010 period. The first policy is to gear education towards building ethically aware citizens in order to achieve the goal of building a harmonious society. Secondly China aimed to "promote development by relying on the people-centred approach, take the improvement of the living standard as the starting point as well as the ultimate goal of [the government's] work, and transform the development pattern from excessively emphasizing the accumulation of material wealth to focusing more on the overall development of the people as well as the balanced economic and social development" (Kai, 2006). Focus is placed on poverty reduction, addressing unemployment, improving income redistribution, strengthening state capacity to meet the needs of those living specifically in rural areas, promoting democracy, and promoting development through a holistic approach that entails 'political, material, cultural, and ethical progress'. An overall enrichment of the lives of citizens is envisioned in the 11th five year plan, whereby culture, the economy, politics and 'spiritual drives' work in unison to achieve modernisation and development (Kai, 2006).

The 11th FYP also pays attention to the enhancement of innovation and the building up of a knowledge economy in China. The plan specifically identifies scientific and technological advancement and the building up of human resources as necessary factors to achieve innovation and development (Kai, 2006). Before the 11th FYP was released, China was recognised as a country where the inputs of the process of innovation – specifically HRST and R&D expenditure – were growing rapidly. However, enrolments in HEIs were still low. The growth in the number of personnel in S&T and research outputs was largely attributed to China's enormous population base (Criscuolo & Martin, 2004).

China acknowledged its reliance on the large population base, and the 11th FYP indicates that the country's growth can no longer rely so heavily on the nation's cheap labour, lack of environmentally sustainable production processes, high levels of pollution, cheap water and abundant land resources. The plan identified the need to "enhance independent innovation capability vigorously and increase the contribution of science and technology advancement to economic growth notably. In the 11th Five-Year Plan period, [China] will implement the strategy of rejuvenating [its] nation

through science and education and take science and technology advancement and innovation as a major driving force of economic and social development" (Kai, 2006). Emphasis is placed on the need to further develop the education system, and bolster the generation of talented human resources in STEM fields; with the objective of steering China's economy towards one built on innovation, science and technology, and talented human resources (Kai, 2006).

The National Medium- and Long-Term Program for Science and Technology Development (2006 – 2020)

The National Medium- and Long-Term Program for Science and Technology Development (PSTD) discusses both the development of the NSoI and the promotion of HRST. The PSTD explains that, by 2006, China's NSoI was insufficiently developed. It was characterised by weak capacity and capability for innovation, it did not meet the needs of the socialist market economy in the country, nor was it adequate for S&T development. Enterprises were not key players in the NSoI, and the S&T sector in the country was compartmentalised which resulted in duplicate work and poor performance. Lastly, the NSoI was uncoordinated and poorly managed at the macro-level (TSC, 2006).

In order to address these weaknesses, the following guiding principles were outlined in the PSTD: 1) promote the construction of a NSoI with Chinese characteristics, 2) efficiently distribute and integrate S&T resources, 3) build an enterprise-centred innovation system that coordinated efforts from academia, industry, and research institutions, and 4) enhance the nation's indigenous innovation capability.

The PSTD established nine policies aimed at building up the NSoI, as envisioned by the guiding principles stipulated above. The ninth policy is relevant to this research. Point nine states: "improve scientific and cultural literacy of the entire nation and build a social environment conducive to S&T innovation, entails the implementation of a nation-wide scientific awareness action plan". The policy aims to improve 'scientific spirit, spread scientific thinking and practices, and diffuse scientific knowledge'. This is to be achieved through improved S&T training systems, building systems for scientific exploration and experiences on and off education campuses, strengthening innovation oriented education, and raising innovation awareness and capability of the youth. The policy includes building popular science facilities and improving existing science awareness facilities in order to implement public S&T projects and programs. Additionally, the policy mentions strengthening the relationships and efforts of and between government agencies, the private sector, large enterprises, educational facilities and the media to encourage popular science activities (TSC, 2006, p. 58).

A primary objective of the PSTD is to develop a talented workforce of S&T personnel. The document identifies five strategies to build up a talented work force. These are:

1. "Accelerate the nurturing of a contingent of world calibre experts" by boosting scientific research, and building innovative teams through international exchanges and cooperation projects. (TSC, 2006, p. 62).
2. "Bring into full play the important role of education in cultivating innovative talents" through S&T innovation, and the promotion of a culture of nurturing young research talents at institutions. The strategy aims to get undergraduate students increasingly involved in research and scientific projects, in order to spark their interest in S&T exploration, research, and innovation. Certain disciplines and subjects should be restructured at university level to adapt to the requirements of the market and provide the personnel output with the necessary skills for innovation and that can aid in the country's S&T development strategies. With regards to education reform, the strategy does not only recommend reforms at the higher education level as described in the previous point; but also promotes the idea of reforming curricula at junior and middle school levels to promote quality centred education that raises student's scientific and cultural awareness and literacy (TSC, 2006, p. 62).
3. "Support enterprises' efforts in nurturing and attracting S&T talents" through supporting industry to attract foreign S&T personnel, build up HRST capability and capacity, and implement policies that support these initiatives (TSC, 2006, pp. 62-63).
4. Intensify efforts to attract high calibre international experts in S&T fields, and increasing financial support for returning Chinese S&T personnel who studied or worked overseas.
5. "Create a cultural environment conducive to the nurturing of innovative talents" through advocating patriotism amongst citizens and learners; promoting the ideals of being hardworking and dedicated, having a pragmatic perspective, innovation, and 'indifference to fame and wealth'. This strategy includes encouraging citizens to have the skills of critical, innovative and rational thought, respecting individuality and being tolerating of others, embracing democracy, aiming to excel amongst peers, and respecting diverse theories and concepts. The objective of enhancing these human traits is to create a culture of innovation within the Chinese society and state (TSC, 2006, p. 63).

EDUCATION POLICY IN CHINA: 2010

NATIONAL MEDIUM- AND LONG-TERM TALENT DEVELOPMENT PLAN (2010 – 2020)

The TDP was compiled in order to provide the country with a strategy to address certain changes being experienced in China. According to Huiyao (2009), these changes include:

1. That China is seeking to move from the 'made in China' model, to the 'created in China' model.
2. That the country sends a number of talented individuals overseas to better their education, and many do not return. An example being that out of the total number of STEM related PhD students who chose to study in the United States of America in 2002, 92% of them remained in the USA rather than returning to China by 2007.The country is now faced with the challenge of attracting human capital, rather than only financial capital.
3. The country needs to urgently begin investing in not only physical developmental projects, but 'software' development. The shift in attention is to increase investment in education, R&D, public health, social institutions, think tanks, and other priority social structures that will aid in promoting a balanced and sustainable development.
4. China has actively decided to move away from an investment in hard commodities and manufacturing economy, to a talent-driven economy.

In order to meet the changing demands of the Chinese society and developmental objectives, the TDP provides a number of targets that will aid in addressing the above 4 changes. The targets relevant to this research paper can be summarised as follows:

1. Increase spending on human resource development, including investment in education and in R&D to 15% of GDP by 2020.
2. Increase the percentage of labourers in the work force that have higher education to 20% of the total work force, by 2020.
3. Emphasise the development of talented individuals in technical professions, and create a pool of highly skilled talented professionals in selected industries.
4. Develop 5 million talented individuals in the fields of equipment manufacturing, information technology, biotechnology, aeronautics and astronautics, energy resources, agricultural technology, and environmental protection by 2020.
5. Increase the number of professional working on R&D to 43 out of every 10 000 active labourers in the workforce, by 2020.
6. Increase spending on R&D specifically, to 2.5% of GDP by 2020; and increase spending on education to 4% of GDP by 2012 (Huiyao, 2009).

Outline of China's national Plan for Medium and Long-Term Education Reform and Development (2010-2020)

The Outline of China's National Plan or Medium and Long-term Education Reform and Development (OERD) identified certain issues facing the education system in China that require urgent reform,

should the country reach its objective of becoming an innovation based society by 2020. These issues include outdated teaching methods, overburdened students at the middle and senior school levels, arrested quality of education, and students that are weak in adapting to the requirements of society, and have passive outlooks, thus resulting in a shortage of versatile and innovative professionals entering the labour market (MOE, 2010).

In order to address these issues, the OERD developed 5 executive principles. The principles were:

1. Giving strategic priority to education development
2. Regarding the cultivation of people before everything else as the bottom line for education; as human resources are the foremost of all resources for China's economic development and education is the main channel through which they can be developed.
3. Treating reform and innovation as a driving force for education development
4. Making equal access to education a basic state policy
5. Considering quality improvement as the core task for education reform and development.

"China should upgrade its capabilities in indigenous research and innovation in science, technology and administration, train more innovative talents and improve education for workers" (CPC, 2010, p. 3)

These executive principles are aimed at guiding China's education system towards its central strategic goal, which is to modernise education and turn China into a country rich in human resources by 2020. This central goal is to be achieved by increasing the percentage of working age citizens with higher education to 20% by 2020; by increasing access to and enrolment in pre-primary school; by drastically improving the "ideological awareness, moral conduct, scientific and cultural attainment, and physical health" of students; and by developing an education system that is prepared to provide the human resource inputs for a socialist market economy (MOE, 2010, p. 9).

An important aspect of the OERD is to cultivate talents. The objectives are to foster young talents through urging students to participate in scientific research and provide them with career guidance and entrepreneurial education. Additionally, the outlined sought to assign mentors to oversee science and engineering research projects; and develop an innovation plan for post-graduate study was to be formulated. However, young talent development is not only viewed through the lens of creating new researchers and boosting HRST; the objective is also to create citizens who are useful members of society through developing them both intellectually and morally. The OERD describes

the need to shift teaching methods from creating passive, rote-studying learners, to teaching in a "heuristic, exploratory, discussion-based and participatory" manner.

Additionally, the need to elevate research levels is pointed out, specifically with regards to the role that HEIs play in conducting research. The OERD emphasises that HEIs should be actively encouraged to contribute to the building up of the NSoI by conducting research, and contributing to innovation and knowledge generation. Innovation in the areas of physical science, national defence, and technology are highlighted as key areas in which HEIs should focus their research.

Education Policy in China: 2011

China's 12TH Five-Year Plan

According to the 12th FYP, transformation of China's economy is to be achieved through scientific progress and innovation, as well as boosting education to develop human resources. The objective is identified as speeding up the "construction of an innovation country" (CPC, 2010, p. 3). Part VII of the FYP is dedicated to the creation of an innovation-based society. Part VII: "Innovation drive, implementing the strategy of reinvigorating the country through science and education and the strategy of strengthening the country through human resource development" places three core goals at the centre of achieving an innovation-based society. These goals are: 1) strengthen the capacity of technological innovation; 2) speed up the reform and development of education; 3) establish a high-quality pool of talented individuals (CPC, 2010, p. 9).

The FYP also acknowledges that education alone will not improve the well-being of China's citizens. It therefore indicates that peoples' overall livelihood should be improved. This is to be done through improving employment opportunities, improving income distribution; and providing housing, medical and social security.

Education Policy in China: 2012

Opinions on Deepening the Reform of the Scientific and Technological System and Speeding up the Building of a National System of Innovation

This document was issued 6 years after the publication of the National Guideline for Medium- and Long-term Plan for Science and Technology Development (2006 – 2020). By 2012, the CPC recognised that further reforms were required, in additional to the current reforms suggested in the National Guideline for Science and Technology Development; should China wish to meet its objective of becoming a reasonably prosperous and innovative society by 2020.

The document lists a number of restraints that, by 2012, were inhibiting the development of an innovative society with a strong NSoI. According to the CPC (2012, p.2), "China's capacity for innovation remains inadequate, and the country's systems and mechanisms for science and technology area unable to meet the demands of economic and social development and international competition. The status of enterprises as the major driving force for technological innovation has not been truly established; collaboration among enterprises, universities, and research institutions remains weak; technology and the economy are not yet truly integrated; the number of indigenously generated advances in science and technology is too low, and there is a lack of self-sufficiency in regard to key technologies".

> *"Scientific and technological professionals will be guided in practicing the system of socialist core values and upholding the spirit of truth-seeking, pragmatism, and innovation"* (CPC, 2012, p. 17)

In order to address these shortfalls, the CPC identified guiding thoughts and major principles to achieve the 2020 objective. The guiding thoughts included further deepening the reform of the S&T system in the country; and establishing an NSoI with Chinese characteristics, with improvements in innovation capacity and the integration of science, technology, economic development, and social development. The major principles included drawing on innovation to serve, and drive development; to prioritise the role of S&T in achieving innovation-driven development; to create an enabling environment for innovation; and adopting a market-oriented approach with state support, whilst placing enterprises at the forefront of driving innovation in the country.

The CPC identifies the need to further enhance the capacity of HEIs, specifically with regards to their R&D capability and capacity. It is recommended that a technological innovation support mechanism be established to aid in the boosting of R&D in selected fields. The document also proposes launching projects to foster the development of "world-class scientists, technology leaders, outstanding engineers, and high-calibre innovation teams" (CPC, 2012, p. 16).

The CPC seeks to create an enabling environment for scientific and technological innovation through improving relevant laws, regulations, and other policies. The National Guideline for Science and Technology Development shall continue to be implemented and improved on, and government shall play a greater role in generating investment for science and technology and R&D.

3.6 Trends in Human Resource Development in China

China's policy documents reflect a long-term consistency in the understanding of issues facing the country, as well as the nation's development priorities. Policy documents and speeches indicate that

the role of the state is clearly understood, with the state being positioned as the central coordinator of developmental efforts. The role of education is emphasised throughout the 10 year period of 2006 – 2015. The same applies for science and technology, and the need for the country to shift to an innovation-based economic model. Policy documents highlight the centrality of human resource development, and strongly promote the need to invest in human resources, whether it be directly by the state, the private sector, the education sector, or higher education institutions. However, despite the consistency of priorities represented in policy documents and speeches, there is a lack of clear plans on how these objectives are to be achieved. Specific guidelines, projects and programmes are not described, to indicate how the country proposes to achieve its objective of becoming an innovation-based society by 2020.

Despite the general vagueness of objectives and strategies detected in official documents, expert interviews, and ministerial speeches; certain trends can be identified over the 10 year period. Changes can be identified in the following four elements:

1. National developmental priorities
2. The responsibilities given to the private sector and enterprises
3. The responsibility of the education system
4. Initiatives to build up HRST

National Developmental Priorities

Prior to 2006, China's developmental focus was primarily on creating strong economic growth through exploiting the country's abundant natural and human resources. In 2006 this focus shifted to prioritising sustainable and environmentally responsible growth. The role of state-guided economic development and redistribution, rather than 'trickle down' development from economic growth (as envisioned in the Deng Xiaoping theory) became central to the country's understanding of development. In 2006 the country made a clear shift towards 'putting people first' and centering national development on human resource development. Balanced social and economic development became the guiding principle of the government's strategies and policies.

2006 also marked the start of the country's engagement with the concept of becoming an innovation driven society. The role of science, technology, and innovation in development is increasingly stressed from 2006 onwards. Additionally, the focus given to expanding the pool of talented professionals in science and technology appeared to increase in importance over the 10 year period in question. Between 2006 and 2015, the emphasis placed on certain aspects of the country's developmental priorities fluctuated.

The priorities of the government appear to start with prioritising human development in a holistic manner in 2006. For the years between 2006 and 2012, focus is placed on innovation and talent development to drive economic growth. By 2012, the emphasis is shifted away from developing HRST, back to the goal of overall human development.

THE RESPONSIBILITIES GIVEN TO THE PRIVATE SECTOR AND ENTERPRISES

Prior to 2006, the role of the state in economic development and growth was intricate and involved the state playing a central part in almost every sector and aspect of economic growth. However, with 2006, and the 11th FYP, the government shifted towards increasing the independence of the private sector. The plan sought to increase the private sector's capacity, autonomy, and ability to innovate. The objective was to allow the Chinese private sector to become more globally competitive whilst the country further opened up and adopted a more market-oriented economic system.

Prior to 2006, enterprises and the private sector were not considered key players in the development of the country's NSoI. The PSTD aimed to reposition enterprises, whether private sector or state-owned, to become drivers of innovation. The document also proposed to invigorate and coordinate efforts between the SOEs, the private sector, and HEIs to collaborate on building up the NSoI and promote economic development through innovation. The PSTD included the policy of creating tax incentives and venture-capital opportunities to encourage innovation by enterprises.

By 2012, the CPC acknowledged that the objective of boosting collaboration between SOEs, HEIs, and the private sector was not being fulfilled, and that enterprises were not the leaders in innovation – as envisioned in 2006. The CPC's document, "Opinions on Deepening the Reform of the Scientific and Technological System and Speeding up the Building of a National System of Innovation" recommended further enhancing the environment for enterprises and the private sector to grow their innovation capabilities and capacities by adopting a market-oriented economic approach with additional state support. The government re-emphasised that enterprises should be the driving force for innovation in the country.

THE RESPONSIBILITIES OF THE EDUCATION SYSTEM

HEIs, like enterprises and the private sector, are identified as strategic players in building China up to become an innovation-driven economy and country by 2020. HEIs are positioned as crucial institutions for conducting research, and contributing to knowledge generation and the development of talented HRST. However, responsibility is not only placed on HEIs, but on the education sector more broadly, with regards to the developmental objectives of the country.

The role of education in human development is continuously stressed. The education system is tasked with not only creating educated individuals, but with creating citizens that uphold Chinese ideals. The education system is tasked with promoting the ideals of socialism, modernisation, and innovation. It is required to build up citizens who embody the values of respect, patriotism, collectivism, and traditional Chinese virtues. In 2006, the role of the education system expanded to also build up talented students with the potential to innovate; and to raise student's scientific and cultural awareness. The role of education institutions was shaped around the strategy of creating critically and rationally thinking citizens, who embrace democracy, and who are pragmatic and hardworking. In 2010, the above roles of the education system were further adapted, with the OERD, to shift teaching methods from passive learning to discussion based and participatory learning.

In 2010, China also began emphasising the need to invest in pre-primary education (MOE, 2010). The OERD indicates that by 2020, compulsory education shall be universalised, and that access to pre-primary school for 0 – 3 year olds shall be developed, across all regions. In order to address the regional disparities, the document indicates that financial resources shall be intentionally channelled to rural areas in order to improve teacher quality, build new education facilities, and fund education for the less privileged. The less privileged include those living in poverty stricken areas, ethnic autonomous regions, and border regions (MOE, 2010, p. 15).

INITIATIVES TO BUILD UP HRST

In 2006, China was considered to be the second largest producer of S&T graduates (OECD, 2006). The country has indicated, throughout the policy documents analysed in this research report that building up HRST remains a priority – especially through the building up of a pool of talented individuals and increasing the number of researchers. However, this is also tied in with increasing the quality of HRST. As described above, the country is attempting to reform the education system from one that is based on passive learning, to one that develops engaging, entrepreneurial and innovative thinkers. In 2006 the policy focus changed to include reforming curricula in order to teach entrepreneurial and management skills, and develop skills necessary for innovation (OECD, 2006).

In 2006, the policies in the PSTD aimed at building up HRST through developing a nationwide scientific awareness action plan. This plan included the development of science facilities that could sensitise both prospective STEM students, and communities to science and innovation. The plan also indicated that attracting international HRST was apriority for building up a talent workforce with skills in S&T.

In 2010, the government began to vocalise its plans to increase government expenditure on education, through the TDP. The TDP also reflected the desire of the Chinese government to attract Chinese S&T students who were studying overseas, to return back to the China. The OERD (2010) added to the above initiatives to build up HRST by including the objective of mentoring young talents in S&T, and encouraging them to engage in scientific research whilst receiving entrepreneurial education and career guidance.

3.7 CONCLUSION

China has shown a clear understanding of what it wishes to achieve, and within what timeline. The objectives that the country has stated as its national medium and long term priorities are the following: 1)become an innovation driven society and economy by 2020; 2) become a moderately prosperous society by 2020; 3) develop a pool of talented individuals by 2020; 4) embrace a holistic approach to human development primarily through education, but also through improving state capacity to address regional inequalities and improve the lives of all Chinese citizens with regards to health care, service delivery, and social welfare; 5) instil the ideals of an innovation society with Chinese characteristics throughout society, which includes developing citizens who embrace the developmental objectives of the country and strive to be hard-working, innovative, and dedicated members of the Chinese society. These objectives are reflected in every policy document and speech that was analysed in this research report, which indicates a conscious coherence to, and adoption of, national development priorities by the CPC, the Ministry of Education, and the Chinese government.

From the information and analysis presented in this chapter it is evident that China is actively promoting the features of the NDS model in, and through, its policies and ideals. The country is consistently pushing towards increasing innovation, R&D, commercialisation of research, the building up of HRST, and all with the end goal of developing an innovation based society and economy. China also consistently acknowledges the need to build up human resources, through a holistic approach to human development which encompasses the alleviation of poverty, addressing unemployment, creating a sustainable economic model for long-term sustainable growth, and the need to actively redistribute economic resources to the least developed regions and communities in the country. The country appears to have embraced the notion of human capability development, and does reflect an understanding that investment in human resources is essential for the nation to develop and achieve its goals. However, despite the apparent close engagement with the NDS model, the country has not explicitly stated the desire to become a developmental state.

CHAPTER 4: HOW DO THE BRICS STATES ENGAGE WITH THE DEVELOPMENTAL STATE MODEL?

4.1 INTRODUCTION

The Developmental State model as defined in this research report is based on three focuses: building up a knowledge economy, human resource development, and building up state capacity and legitimacy. Additionally, the NDS does not assume a 'one size fits all' approach to a developmental model; but assumes that each nation should mould the concept of a developmental state to meet the unique needs facing that country, so that the developmental model adopted will be suitable to each nation's unique histories, situations and priorities (Williams, 2014).

This chapter will discuss how the BRICS states, as represented by China and South Africa, have engaged with the developmental state model as described in this research report, since 2006. In order to adequately address this question, this chapter initially provides an overview of any patterns of convergence or divergence between the two countries' policies, and general shifts in developmental strategies made by the two sample countries. This overview is based on the trends analysis at the end of chapters two and three. This chapter concludes with answering the primary research question, "How have the BRICS states engaged with the developmental state model since 2006?"

4.2 CONVERGENCE, DIVERGENCE, AND SHIFTS

CONVERGENCE AND SHIFTS IN GENERAL DEVELOPMENTAL PRIORITIES

Both South Africa and China have clearly defined their developmental priorities with regards to human development, and the building up of a knowledge and innovation economy, respectively. Despite the two countries' unique histories, differing political ideologies, and vast differences in terms of natural, financial and human resources; both countries have started to share similar ideas on how to develop.

Prior to 2006, both countries reflected a general understanding that economic growth was the primary goal, and that human resource development would be an almost natural outcome of increased economic growth. In the early years of post-apartheid South Africa, the country actively promoted export-led growth strategies and neoliberal economic policies under the growth, employment and redistribution strategy. Similarly, China had prioritised the Deng Xiaoping model of development which pushed for economic growth first and economic development later. From the

early to mid-2000's both countries started to shift their understanding of how economic development occurred. This period marked the shift from economic and human development being outcomes of economic growth, to economic and human development being areas that require clear state intervention and guidance in order to achieve economic growth.

Apart from this fundamental shift in the understanding of the relationships between economic growth and development, both countries started to emphasise the need for sustainable and environmentally conscious development. South Africa reflected this need from the early 2000's, and China began actively promoting environmentally sustainable development from 2006 onwards; albeit with a deeper sense of urgency than South Africa.

With regards to human resource development, both countries showed a decisive move towards prioritising human development as a task for the state to directly manage and invest in. With the publication of the policy document, "Innovation Towards a Knowledge-based Economy: Ten Year Plan for South Africa (2008 – 2018)" in 2007; South Africa made a decisive shift towards understanding the role of human resource development as central to national development. It repositioned the development of the country's human resources to be the foundation for further development; rather than being a branch of development stemming from economic growth. Similarly, with the publication in 2006 of China's 11th FYP and PSTD, economic growth is replaced with human resource development as central for economic and national development.

The publication of the PSTD in China, and the Ten Year Innovation Plan in South Africa's, marks the start of a convergence between the two countries' developmental strategies. Both countries clearly shifted towards seeking to build up their NSoI, and develop a knowledge and innovation economy. Neither country clearly defines what is meant by a *knowledge* or *innovation* economy. However, their objectives are similar. South Africa envisions an economy that is based on R&D, improving commercialisation of the products of R&D, building up the human resources in STEM fields to boost the country's innovation capacity; and creating a diversified and solid NSoI. China describes an economy that is built on private sector and enterprise innovation, building up a pool of talented individuals in S&T, increased R&D, and a strong NSoI. Both countries place education at the centre of achieving these goals, as they each view education as the central pillar for human resource development (as reflected in policy documents from 2006 onwards).

Convergence, Divergence and Shifts in Human Resource Development Strategies

Both China and South Africa view education as the necessary platform for human development, economic development, and improved national capacity for innovation. Both countries followed a similar path to understanding which aspect of education is the most important. Both initially placed emphasis on improving senior and higher education outputs to increase the number of skills labourers in STEM fields. In South Africa, 2006 – 2008 marked the period whereby direct intervention in MST education was promoted, at senior and FET education levels. In China, 2006 to 2010 marked the time frame in which the education system was tasked with building up a pool of talented HRST, especially at tertiary education level. However, by 2010, both countries had converged in their general objectives around foundation phase education. Both South Africa and China indicated the need to further invest in early childhood development and pre-primary education, as well as promote either mathematics or scientific literacy at the early phases of education. This reflects a convergence in the adoption of the concept that human development occurs at all stages of education; and that early childhood development is a crucial investment for a state to make should it wish to promote human resource development in the medium and long term. Table 4 below presents the key policies around foundation phase learning taken by both countries:

Table 4: A comparison of the Foundation Phase Education Policies Adopted in South Africa and China between 2006 and 2010

	China			South Africa	
Year	Policy document	Objective	**Year**	Policy document	Objective
2006	11th FYP	Reform curriculum at junior school level to promote scientific literacy amongst learners	**2008**	Foundation for Learning Strategy	Improve the mathematics and language foundation of Grade R- Grade 3 learners
			2009	MTSF	Policies to improve access to, and quality of, early childhood development
2010	OERD	Increase access to and enrolment in pre-primary school; and develop the schooling system for 0 - 3 year olds	**2010**	HRDS-SA	Improve universal access to basic education

The two countries also reflected a shift in the expected outcomes of the education system. Both countries defined the type of student they wished to be produced by the education system. In 1995,

South Africa overhauled the NQF with the objective of creating learners who are capable of critical and rational thought and who can use mathematics, science and language to communicate effectively. In 2008, the MTSF set the objective of creating learners who embraced a culture of achievement. In the same year, the restructuring of the national curriculum aimed to allow students to develop whilst embracing and adopting democratic principles. In 2010, the HRDS-SA further expanded the outcomes of education to include the creation of learners who have the capacity for good citizenship.

By 2006, the Chinese education system was tasked with creating citizens who uphold Chinese virtues and the ideals of socialism. Students are expected to embody the values of respect, patriotism, and collectivism. In 2006, this expanded to create students who have the ability to innovate, and who can think critically and rationally. Students, like in South Africa, are expected to embrace democracy and be pragmatic and good Chinese citizens. In 2010, learners were expected to engage in participator learning and discussion-based learning. As a result, both China and South Africa have converged in their vision of the student. The student is expected to be a person who is a good citizen, who embraces national priorities and ideologies – including democratic principles, who seeks to innovate, be pragmatic, and think rationally and critically, who can work as a member of a team and uphold the values of being part of a community, and who has the ability to utilise mathematics and science-based skills.

At secondary phase education, both countries indicated the desire to increase enrolments in secondary/ middle phase education. Tied in with this objective was the goal of making all 12 years of basic education compulsory. South Africa reflected this goal in the MTSF. China has already begun implementing this policy, as seen in key metropolitan areas.

With regards to developing HRST, and promoting STEM education, both countries adopted similar objectives and strategies. In 2006, both countries discussed the need to build centres that could be portals for educating students and communities about STEM subjects. In 2006 in China, and 2008 in South Africa, both released policy documents that mentioned a restructuring of higher education courses in S&T to better educate students around the intersection of commercialisation, innovation, and S&T. in 2010/2011, the countries emphasised the need to develop a talented pool of individuals. China developed the national TDP which sought to develop talented S&T students at the tertiary education level. South Africa promoted the need to strengthen the strategies aimed at developing young talents in MST at senior school level. In 2010/2011, both countries also adopted policies around mentoring (in the case of China) and tutoring (in the case of South Africa) young learners that are studying STEM subjects. China expanded this policy to include the overseeing of S&T

projects by mentors. Lastly, both countries sought to build world-class higher education institutions that can specialise in STEM subjects. China implemented this strategy prior to 2006 with the 211 and 985 projects; whereas South Africa only mentions creating such institutions in 2011 in the NDP. These similarities are detailed in table 5 below:

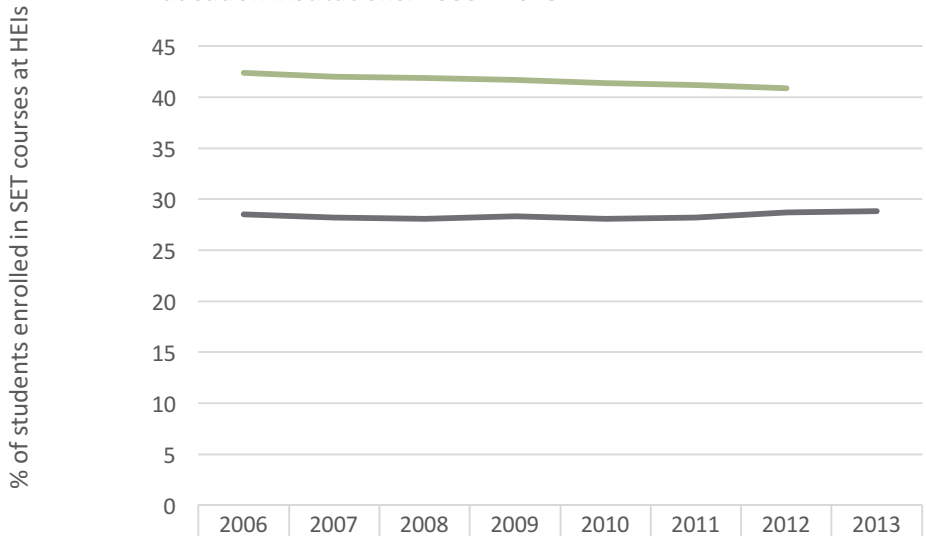
TABLE 5: A COMPARISON OF CONVERGING POLICIES ON HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY DEVELOPMENT IN CHINA AND SOUTH AFRICA: 2006 – 2011

China			South Africa		
year	Policy	strategy	**year**	Policy	Strategy
pre-2006	211 and 985 Projects	Develop a few high-calibre, world-class universities and courses; specifically in STEM-related fields			
2006	PSTD	Build popular science facilities to educate the youth, and communities about science and technology. Implement S&T projects for the public to engage with.	**2006**	Youth into Science Strategy	Improve public awareness of, and student engagement with, STEM at the community level through national science centres.
2006	PSTD	Restructure courses at higher education level to incorporate necessary skills training on innovation and entrepreneurship for S&T students	**2008**	Ten Year Innovation Plan	Hone specialised skills at the interface between engineering, technology and economics. Revise curricula for post-graduate students to include courses on innovation, management, technology incubation, project management and business management
2010	TDP	Develop a pool of young, talented individuals in S&T through higher education institutions	**2011**	NDP & the Dinaledi Schools initiative	Develop young talents in STEM subjects at high-school level, through the Dinaledi schools and through developing MST colleges in each province
2010	OERD	Assign mentors to oversee S&T projects at tertiary institutions	**2011**	Dinaledi Schools Initiative	Provide supplementary tutoring for grade 10 - 12 students
			2011	NDP	Develop a few world-class centres and programmes in the Higher Education Sector

Both countries appear to have made a clear commitment to boosting the development of young, talented learners as an element of overall human resource development. However, despite the above-discussed convergences and similarities, there are a few areas where the countries differ. South Africa places a strong focus on mathematics, as well as SET. China promotes S&T heavily, but does not discuss development in mathematics, and only occasionally refers to engineering. South Africa makes clear reference to STEM education on a number of occasions and in a variety of policy documents and speeches. China however does not mention the term "STEM" in any document or speech.

Secondly, South Africa focuses on building up HRST from promoting STEM education at school level through initiatives such as YiSS and the Dinaledi Schools initiatives; whereas China focuses talent development objectives at the tertiary education sector. Both countries do however place a strong focus on the need to increase the number of researchers. South Africa seeks to increase researchers in all STEM fields, and China focuses on S&T researchers. It is noticeable that despite clear objectives by both countries to increase the number of researchers in STEM or S&T fields, and to increase the number of talented human resources in the same fields, both countries have not seen a complimentary adjustment in tertiary education enrolments in SET fields. This is represented in graph 5 below:

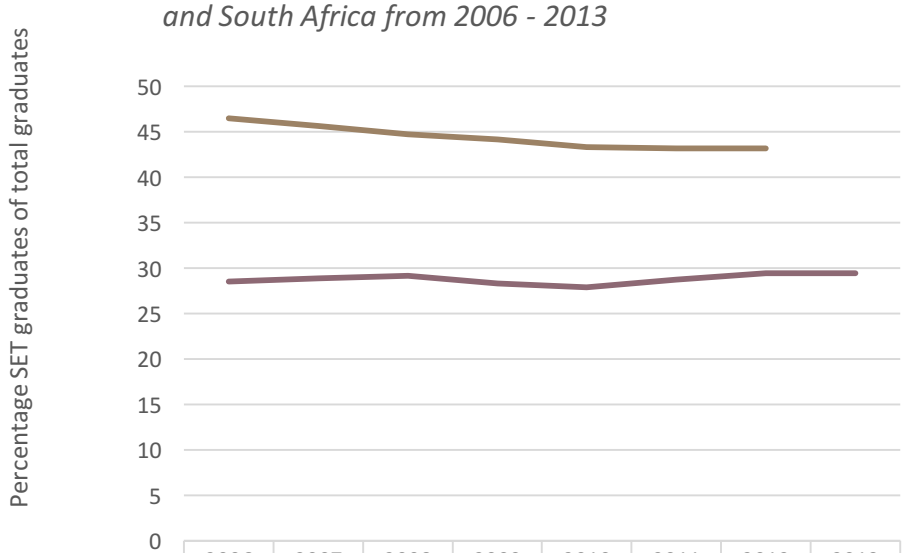
Graph 5: Comparison of percentage of enrolled students in China and South Africa studying in the fields of Science, Engineering and Technology at Higher Education Institutions: 2006 - 2013*



	2006	2007	2008	2009	2010	2011	2012	2013
% of HE students studying in the fields of SET in South Africa	28,5	28,2	28,1	28,3	28,1	28,2	28,7	28,8
% of HE students studying in the fields of SET in China	42,4	42	41,9	41,7	41,4	41,2	40,9	

Similarly, graduates in SET fields hardly fluctuate over the period of 2006 and 2013, in both countries. This is reflected in graph 6 below:

Graph 6: Comparison of Higher Education** SET Graduates in China and South Africa from 2006 - 2013*



	2006	2007	2008	2009	2010	2011	2012	2013
% of total SET graduates in South Africa	28,52	28,87	29,14	28,29	27,89	28,7	29,43	29,41
% of total SET graduates in China	46,45	45,64	44,735	44,135	43,335	43,205	43,16	

**Graph 5 and 6 are compiled by the author using statistics from South Africa's annually released statistical publications, "Education Statistics in South Africa"; published by Statistics South Africa; and China's annually released statistics, as obtained from the online statistical database which is accessible via http://www.stats.gov.cn*

*** "Higher Education Graduates" includes Undergraduates, Honours, Masters and Doctoral graduates for South Africa; and Undergraduate and College, Masters and Doctoral graduates for China.*

Convergence, Divergence and Shifts in Building up National Systems of Innovation

Both countries stress the need to increase the number of HRST, and of researchers. This is closely linked with the strategies and objectives that each country has identified to boost the NSoI. The onus to boost research is placed heavily on future researchers. However, South Africa places HEIs at the centre of future R&D projects that will aim in building up the NSoI. The role that HEIs play in the NSoI, in R&D, and in HRD is stressed throughout policy documents. HEIs are considered the key link in the NSoI that can drive innovation and knowledge development, to achieve the end goal of becoming a knowledge economy. This emphasis on HEIs is increasingly visible from 2006 onwards, as prior to 2006 the private sector was considered the strategic role player in R&D. Additionally, a number of policy documents refer to the fact that the portion of R&D produced by the private sector

is slowly decreasing, which has led to the government's change in focus to task the higher education sector with producing more R&D.

Conversely, in China, the private sector and other enterprises are tasked with being the driving force behind innovation. Stronger emphasis is placed on the role that enterprises should play in building up HRST, boosting R&D outputs, and strengthening the NSoI. This prioritisation of enterprises is only visible from 2006 onwards, as the 211 and 985 projects placed HEIs as central role players in the NSoI. These differences represent a clear divergence in policies between South Africa and China. South Africa places emphasis on the Higher Education sector as a key role player in the development of a knowledge economy; whereas China increasingly places enterprises at the core of building up an innovation economy.

Despite this divergence, both countries state the need to fortify links between the relevant role players in the NSoI. Partnerships are sought to be strengthened, and coordination to be improved. Both nations discuss the need to strengthen ties between the private sector and the higher education sector in order to allow for collaborative innovation projects and better utilisation of resources to develop. Both countries have also indicated that increased state resources shall be allocated to R&D, as well as to education.

In order to boost HRST development, and HRD, both countries have shown the desire to attract foreign skilled personnel. South Africa is more vocal about attracting foreign students to promote international exchanges at HEIs, with the goal of boosting R&D and innovation as diverse talents will be incorporated into the pool of HRST. The country makes specific reference to attracting international exchanges from the BRICS countries, and the SADC nations. China has a clear policy stance on attracting external talent, as well as creating an enticing environment for Chinese nationals studying and/or working abroad to return to the country. However, China's focus is more on attracting already-skilled personnel in S&T to directly aid in increasing innovation, R&D, and better educate local talented individuals in S&T. Chinese policy documents give the sense that skilled personnel from the developed world are sought after; rather than from other developing countries - which is the case in South Africa.

4.3 How have the BRICS States engaged with the Developmental State Model?

Both sample countries have a number of converging strategies on how to boost the development of a knowledge or innovation-based economy; how to promote HRD; and the role that STEM education plays in achieving these goals. However, the most notable convergence in these two countries'

strategies and policies can be identified in their general approach to development. This research paper seeks to understand how the BRICS states (as represented by China and South Africa in this study) have engaged with the developmental state model since 2006. The following section discusses how the two states have engaged with the developmental state model with regards to the following three elements of the NDS definition:

1. Adapting the NDS model to meet national priorities and serve national interests and issues
2. The NSoI and the building up of a knowledge economy
3. Human resource development

Adapting the New Developmental State Model

South Africa has customised its understanding of a developmental state to be focused primarily on alleviating poverty and inequality through democratic practices and institutions. The unique target areas for South Africa's developmental state can be summarised as: addressing unemployment, building up human resources to alleviate the mismatch of skills in the labour market as well as aid in boosting economic growth, generating transformation of society – specifically along racial lines in order to combat the structural inequalities inherited from Apartheid and colonialism, improving service delivery, and building up state capacity in order to be a state that can actively implement policies and regulations.

The Developmental state model is seen as more than a tool to develop the country, but is seen as the framework through which all social redress, transformation, and growth can take place. It is also the framework through which society can be strengthened, active citizenship can be promoted, and 'institutions can embrace democratic transformation' (Pandor, 2010). A noticeable feature of South Africa's adoption of the developmental state model is that the country consistently identifies itself as not only a country, but as a member of the African continent. Policies are cognisant of the role that a developmental South Africa can play in the African Union, in SADC, and in boosting development more generally on the continent.

In comparison, China has implicitly embraced NDS strategies in order to address the following national issues: providing employment for a rising number of tertiary educated citizens; the increasingly urgent need to provide for a rapidly aging population; reducing inequalities between regions; improving service delivery and state capacity; and addressing economic inequalities in the country. The Chinese state sees developmental objectives as the platform for Chinese ideals and ideology to be embedded in, and embraced by, society. Democracy, the Three Represents, Deng Xiaoping theory, and socialist ideals are the foundation for developmental strategies and policies in

the country. All of these factors reflect a nation that has actively adapted developmental strategies to cater for national priorities.

Both countries have reflected an understanding that national priorities and concerns should be prioritised; and that any developmental strategies should be moulded to meet each nation's unique needs and issues. The countries have thus presented a clear move away from adopting the "one size fits all" understanding of developmental models.

Building up a Knowledge Economy

Apart from the unique priorities of what South Africa envisions for itself as a developmental state; the government also places strong emphasis on the need to boost innovation and R&D, build up an NSoI, and drive the country towards a knowledge economy – away from a largely resource economy (Hannekom, 2012). The tie between innovation and addressing the above-mentioned unique target areas is often made; especially with regards to using innovation to alleviate poverty, address inequality, and boost economic growth. The country has identified the building up a knowledge economy as a source of pressure-alleviation with regards to rising unemployment and stagnating economic growth. The country seeks to become a knowledge economy in order to keep pace with international development, to create a culture of innovation and research, and to carve out a unique location in the global economy through becoming a specialist in a select few fields.

Similarly, China seeks to develop an innovation-based economy in order to become the innovator of the world, rather than its current and dominant role as the factory of the world. Sustainable development is at the centre of the country's understanding of development. The country is cognisant of its historical role in environmental degradation and seeks to improve on this drastically by shifting away from manufacturing towards innovation. Like South Africa, it identifies an innovation economy as a source for job creation, economic growth, and the source of resources to feed into national developmental goals.

Both countries have unique reasons for why they wish to build up a knowledge or innovation economy. However, both have reflected an understanding that the NSoI is an essential cog in the building up of such economies. Both nations have recognised the need to improve their NSoI capacity and capability. This includes improving on, and building new, linkages between the various actors in the NSoI. The NSoI is seen as the framework through which R&D, commercialisation, innovation, and knowledge generation can take place. It is envisioned as the framework that needs to be filled by talented HRST, who will drive knowledge-based and innovation-based development.

The integration of all parts of the innovation system is understood as essential for the system to function and grow.

Human Resource Development

The NDS model rests on the concept of a people-centred approach to development. Both China and South Africa have repositioned human development, understood in a holistic manner, at the centre of their developmental strategies since 2006. Both countries have repeatedly mentioned the need to develop HRST, but this is understood as not only an essential element of the building up of a knowledge economy. It is also seen as a fraction of overall human development and national prosperity. South Africa has incorporated elements of early childhood development, general education reform, using S&T to alleviate poverty, and strategies to create skilled, educated and responsible citizens. Similarly, China has indicated that early childhood development, increased attention to developing talented human resources, and creating an increasingly skilled workforce are important. Both nations have highlighted the need to not only increase access to education, but to drastically improve on the quality of education.

In both countries, education is seen as the foundation for human development. Investment in the education sector is seen to increase in both countries over the period of 2006 to 2015. According to James* (2015), this is an area where South Africa and China have clearly followed a similar strategy. Both countries have dedicated larger portions of national funds to developing the basic education sector – specifically foundation phase and primary school education. South Africa has also developed a number of policies and strategies to address the poor quality of mathematics, language, and science skills amongst South African learners. China on the other hand has a history of understanding the importance of a solid foundation in mathematics, and this value is promoted in schools, by the state, and within the family unit. According to Mary* (2015), this culture of high-standard mathematics skills is part of the reason for China's focus on SET, rather than STEM – as in the case of South Africa.

Analysis Conclusion

Both South Africa and China have shown to actively engage with the NDS model since 2006. Both countries have re-assessed their national development priorities; moving economic growth away from the centre and repositioning human development as the primary goal for development. The relationship between the state and human development has also changed to become more direct, with both countries claiming that the state needs to directly intervene with, and invest in, human resource development and overall human development. Additionally, human development is no

longer measured in a simplistic fashion based on GDP per capita, but has expanded to include a deep understanding of the role that education, health, service delivery, the family, and social well-being play in human development. Both BRICS countries have shown to understand education as the foundation for human development, but have also indicated the need for the state to invest in improving the other elements that affect human development.

South Africa has made the decision to slowly move away from a primary commodities-based economy towards a knowledge economy. Similarly, China has stated the goal of moving away from a primarily manufacturing economy towards an innovation-based economy. Both countries stress the role that S&T plays in development, and are actively seeking to embrace S&T to aid in achieving their developmental objectives. Both countries have also positioned the NSoI as central to being able to properly utilise and exploit S&T in development, as well as in HRD.

Despite these close similarities and convergences in the general approach to development, China has not explicitly noted the objective of embracing the developmental state model. The Chinese state has a clear understanding of its role in development, which by definition aligns closely with the 20th century developmental state model. The country has also emphasised a number of key aspects of the NDS model as national objectives. These include building up state capacity; directly investing in HRD; and building up a knowledge economy. However, unlike South Africa, China has not made the ideological decision to become a developmental state. It has however closely engaged with the NDS model.

4.4 Chapter Conclusion

This research report has sought to understand how the BRICS states engage with the 21st century developmental state model. Chapter two has detailed policies around how South Africa has engaged with the concept of human resource development through education (and specifically through STEM education), how the country aims to build up a knowledge economy, and proposed strategies to build up an NSoI. In Comparison, Chapter 3 has discussed how China has planned to become an innovation-based economy by 2020, how the country envisions human resource development, how education is prioritised to achieve this; and how the NSoI and the development of HRST can achieve the country's 2020 goal.

Both of these BRICS countries have indicated the desire to change their economic models of growth from being based on primary commodities and manufacturing, to being based on knowledge and innovation. They have both actively engaged with the NDS model, and shown a clear understanding of what is understood to be encompassed by the notion of 'development'. Despite vastly different

histories, economic trajectories, populations, ideologies and levels of influence in the global economy; these two countries have shown an overall convergence in their developmental strategies when considering the knowledge economy and HRD aspects of the NDS.

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