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Human Capital and the Innovation System – Case Study of the Mpumalanga Province, South Africa

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***Abstract*—**Innovation plays an important role in economic growth and development. Evolutionary economics has entrepreneurs at the centre of the innovation system, but includes all other participants as contributors to the performance of the innovation system. Education and training institutions, one of the participants in the innovation system, contributes in different ways to human capital. The gap in literature on the competence building as part of human capital in the analysis of innovation systems is addressed in this paper. The Mpumalanga Province of South Africa is used as a case study. It was found that the absence of a university, the level of education, the quality and performance in the education sector and the condition of the education infrastructure have not been conducive to learning.

***Keywords*—**Education institutions, human capital, innovation systems, Mpumalanga Province.

I. Introduction

HUMAN capital is one of the essential factors in an innovation system. Soete [1] refers to it as the cement that holds the knowledge and innovation systems together. Urriago et al. [2] imply that human development is an indispensable or essential condition for, or ingredient of, innovation by stating, "… the supply of physical and human infrastructure is a *sine qua non* condition for innovation …" The importance of human development is confirmed by a publication of The World Bank [3] that offers:"... a good educational and training system is fundamental to building a population receptive to innovation, able to tap into and absorb the sources of global knowledge, and creative in terms of technology and entrepreneurship."

Innovation is the driving force of economic growth and development [4]-[8]. Schumpeter [4] (known as the founder of innovation theory) focused on the entrepreneur as innovator, but the evolutionary economists shifted the focus to all participants in the innovation system. An innovation system is a complex system that includes participants or actors, their activities and interactions, as well as the socio-economic environment within which these participants or actors function, that together determine the innovative performance of the system [9]. The actors or participants include the firms as the centre of the system, but functions within an environment influenced by the other actors such as government, education and training institutions, financial institutions, competitors, suppliers, customers and science, technology, research and development intermediaries. Eggink [10] developed a conceptual innovation system framework and found that education and training bodies are amongst the most important participants in the innovation system due to their contributions to the development of sufficiently qualified human resources and by their contribution to research and development (R&D) capacity.

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Despite the increasing importance of human development in the innovation system, there is a gap in literature on competence building as part of the analysis of innovation systems [11].Most literature on innovation systems is based on developed countries in which a highly developed human resource component is often a given. This may be the reason for the relative low attention that the human capital development role of universities has received in literature. For the improvement in innovation systems of developing countries, human development is one of the components that needs most attention.

The roles of universities changed from only knowledge creation, through competence building of the human resource component and research and development (R&D), to include knowledge transfer [12]-[19]. The roles of universities changed since the 1980s. The change in roles of universities as actors in innovation systems coincide with the change in views on economic theories from the neo-classical theories to evolutionary neo-Schumpeterian economics [20], [21]. Although the roles of universities changed to include more than just a competence building role, this paper will focus on the competence building role only, due to the negligence of this role in studies of innovation.

The Mpumalanga Province of South Africa is a region in need of a significant improvement in the performance of the regional innovation system, considering the high unemployment rate and the high rate of poverty in the province. In this paper the education and training institutions' competence building role in the innovation system is examined. The Mpumalanga Province is used as a case study and the education and training institutions are evaluated to determine these institutions' contribution to the performance of the regional innovation system and subsequently economic development.

II. Methodology

The discussion on the role of education and training institutions in the innovation system is conducted by means of a literature review. The Mpumalanga Province of South Africa is used as a case study due to the development need of this region and the human resource competence building component is evaluated and reported on. The evaluation is

conducted by means of a descriptive analysis as compared to elements described in literature. Data collection consists of reports by relevant official government departments, parastatals and international authoritative bodies. In order to ensure reliability, different documents on the same element are compared. It is then indicated if the pattern is similar or different in the documents.

III. Background

Mpumalanga is one of the nine provinces of South Africa and it covers approximately 6,5% (79 490km^2) of the land surface area of South Africa [22]. Mpumalanga borders the Free State and KwaZulu-Natal in the south, the Limpopo Province in the north, Gauteng in the west and Swaziland and Mozambique in the east. The Mpumalanga Province is a region characterised by high potential with many natural resources such as fertile soils, beneficial climatic conditions, minerals, scenic beauty and others, but also by high unemployment and poverty levels, and poor health and education conditions.

The need for economic development is imminent in Mpumalanga. The unemployment rate was 29,4% for the first two quarters of 2013 and decreased to 26,6% in the third quarter 2013 (strict definition). These are higher than the rates for South Africa as a whole at 25,3% and 25,6% respectively for quarters one and two and 24,7% for quarter three. A more realistic picture is portrayed by the expanded definition of unemployment (including people who want to be employed but not actively seeking employment) with Mpumalanga's first three quarters of 2013 at alarming rates of 43,3%, 42,2% and 40,5% respectively comparing to South Africa as a whole at 36,7%, 36,8% and 35,6% for the same periods [23]. The need for development in the province is further emphasised by the poverty line. If the household expenditure poverty line is set at R2 500(2012) per month, it implies that 65,5% of households in Mpumalanga are poor [24].

The population in Mpumalanga is very young. Approximately 41,7% of the population of Mpumalanga is younger than 20 years and 62,0% is younger than 30 years [25]. The high unemployment rate illustrates that the current firms are not able to create sufficient job opportunities to accommodate the large numbers of new entrants into the labour market. There is increased pressure on the regional innovation system to improve its performance to address this need and without a strong human capital component it will not be possible.

IV. The Development of Human Capital

The development of human capital contributes to the enhancement of economic development [16]. Goldstein [26] stated: "We know there is no more important ingredient for sustained economic development than a supply of creative and highly skilled members of the labor force". The development of human capital forms an essential part of the innovation system, but is often neglected in the studies of the innovation system. Liefner and Schiller [21] call education the most basic requirement of technological upgrading, but stated that it is often not part of the analysis.

Some publications concerning innovation systems include only the tertiary education sector as participant and not the primary and secondary education. The reasons for this exclusion might be that, firstly, research (which is regarded as crucial for enhancing innovation) in the education sector is done at universities and not in the primary or secondary schools. Secondly, in the developed countries (from where most publications originate) quality primary and secondary education is assumed and is seen as a given factor. Unfortunately, in many countries, especially developing countries, the standard of primary and secondary education is of such a quality that the majority of pupils attending public, government funded schools, are not able to qualify for university education.

No-one knows in advance which children have the potential to become inventors, innovators or entrepreneurs. Therefore, all children should be taught the basic skills needed for invention, innovation and entrepreneurship. The role of the primary and secondary schools in the innovation system should be to provide quality education that can prepare people for tertiary education, a sufficiently literate workforce and potential entrepreneurs. The innovation system must therefore include the primary and secondary education, as well as tertiary education, as participants if the enhancement of innovation is aimed for.

Education-related issues such as primary- secondary- and tertiary enrolment and the quality of the whole education system arguably head the list of the complex human development concept. The quality of math and science education, quality of management schools, internet access in schools, availability of research and training services and extent of staff training each need to be addressed. Then too, other innovation-related issues such as the quality of scientific research institutions and the availability of scientists and engineers are all related to the human development scenario [27]. The education system (primary, secondary and tertiary) must be adequate to equip people with the foundational knowledge sets that are needed for people to become entrepreneurs or productive workers. Industry too must play its part and become involved in on-the job training and further development of staff. The alignment of the education system with the needs of an innovative industry is crucial. The retention of the qualified and experienced workforce too can be just as important as the recruitment and maintenance of human capital, particularly in the light of the cost of the so-called "brain drain".

In a publication by The World Bank [3], the quality and reach of the primary and secondary education and the competence of the teachers is most accurately called the, "spine of any educational system in the innovation-driven economy ..." The World Bank publication mentions basic mathematical and literacy skills, the quantity of schooling, and the quality of education and the relevance of education as the challenges to be overcome if well-developed human capital is to be available.

Apart from supplying firms with competent workers, the university also supplies firms with competent research personnel. These researchers in industry contribute positively to the innovation activities of the firms [16]. The development of human capital requires the education of research personnel, engineers and mathematics and science teachers [26], [28]. Porter & Stern [29] emphasised the importance of scientists and engineers for an innovation system by calling them the "foundation of a nation's common innovation infrastructure". Bramwell & Wolfe [16] reports on a case study of a highly dynamic cluster of information and communications technology firms in Waterloo, Canada, with the University of Waterloo as an example of an entrepreneurial university actively involved in the economic development of the region. One of their observations is that "...perhaps the University of Waterloo's most important contribution is its role in training a significant proportion of the local labour force. It has developed an international reputation for producing highly trained, innovative and entrepreneurial individuals in math, computer science and engineering, and graduates make up a major proportion of the valuable high-tech human capital in the region".

Human capital development includes the enhancement of entrepreneurial skills. Orford, Herrington & Wood [30] are of the opinion that not only is quality education needed to enhance innovation, but that entrepreneurship teaching must be done at primary and secondary school level. Orford et al. maintain that the education system plays an important role in "developing entrepreneurial skills and shaping attitudes". Nafziger [31] agrees that most studies indicate that there is a direct relationship between education and an entrepreneur's success. However, he notes that the contrary can also be true due to the time and money spent on formal education, as opposed to entrepreneurial activities, or due to other occupational choices that obviate the need to become entrepreneurs. Entrepreneurship training is not the only aspect that prepares potential entrepreneurs, for example, the quality of mathematics and science education at school can also be regarded as contributing to an improvement of entrepreneurial activity [30]. One of the causes that Bramwell & Wolfe [16] postulate as part of the success of the University of Waterloo is the inclusion of entrepreneurial and innovation skills as an integral part of their courses. Wong et al. [15] agree with the importance of the inclusion of entrepreneurship in the contents of university education, especially in countries with a low entrepreneurial propensity. Wong et al.'s study is based on a "Newly Industrialised Economy" (NIE) Singapore and they indicate that NIEs have a greater need for universities to play an entrepreneurial role due to the lack of local universities to commercialise knowledge generated from universities.

There is sometimes a perception that people cannot be taught to become entrepreneurs. Thomas [32] reaches the following conclusions about the, "… nurturing of … entrepreneurs" in his study of entrepreneurship:

1) With very few exceptions, entrepreneurs are not "born", but evolve through a lengthy process of education, training, learning-by-doing, experience transfer, capturing opportunities and through trial-and-error practice;
2) Parental background, childhood experiences, the nature of school and post-school education and the broader business and economic environment that shape any person, can all play a significant role in the acquisition of entrepreneurial abilities and business disciplines;
3) The "apprenticeship model" best describes the process of intensive experience transfer that usually constitutes the skill basis of any effective entrepreneur. Such apprenticeship need not be formalised in a conventional sense, but demand aspects like technical skill transfer, observational and practice learning, acquisition of a work ethic, self-discipline, self-respect and pride in the vocation, a grasp of the broader environment in which the "business" is situated, and a strong sense of responsibility;
4) Effective and lasting entrepreneurship creation takes time; and
5) Many of the aspects usually linked to successful business leadership – like effectively communicating with clients, colleagues or business contacts, establishing and utilising networks, assessing risks, planning new ventures, tapping experience from knowledgeable persons, etc. – are, as a matter of routine, instilled in the mind of entrepreneurial trainees during those years of "apprenticeship".

These conclusions of Thomas emphasise the importance of an effective education and training system, with well-qualified teachers and trainers, and in an environment with role models whose examples are worth following. Vosloo [33] confirms the importance of the development of entrepreneurs. He states, "It is no exaggeration to say that the overall health of our economy depends largely on dynamic entrepreneurial activity …. It is therefore vital that the development of an entrepreneurial society, through appropriate educational and training programmes and with a high degree of youth involvement, become a key component in any new order for the future of South Africa".

Although it is important for an education system to be aimed at improving and increasing entrepreneurial capabilities in people, not every person has the aptitude to become an entrepreneur. Creativity and a willingness to take risks are skills that some people may have, that some people may be able to learn and that some people may not be able to learn. Teachers are usually not entrepreneurs themselves, which creates some doubt if the entrepreneurial skills can be effectively enhanced by the education system. An education system should therefore focus on overcoming these obstacles. Nafziger [31] mentions some other factors that were identified by different studies that may have an influence on entrepreneurship, especially from a less developed country perspective. Here are examples of what Nafziger describes and which indicate that there are many different factors that should be considered for the development of entrepreneurs:

1) Generally, entrepreneurs come from a much higher socioeconomic background than the general public;

2) Societies where children are raised democratically, so that they are encouraged to take initiative and be self-reliant, are more likely to produce entrepreneurs; and
3) Cultural norms in less-developed countries, defining how women should behave at work, limit female entrepreneurial activity.

Human development is a long complex process that does not only depend on the education and training provided by the state. The *milieu* within which a person grows up has an impact on the development of the person. The home environment in which a person grows up plays an important role. Scerri [34] stated, "While the specifics of the location of human capital formation is often contingent on cultural, political and economic factors, it is generally the family unit, however that is defined, that is the main formative context for human capital." Fedderke [35] emphasises the important influence that human capital has on the institutions of society that determine the long-run productivity of all factors of production, and confirms that human capital is in turn influenced by these institutions. The society or community shapes the values honoured in family units. It might be important to determine whether the society or community tolerates change. This is probably related to the main religion observed, as well as other sources of values.

Although human capital development is important in the developed world due to increased international competition and the fast pace of technological development, this role of education and training institutions is even more important for the developing world. Most technology is created by developed countries [21] and in underdeveloped regions the absorption of knowledge and technology is low. Goldstein [26] emphasises the relative importance of teaching and training in regional economic development over research and knowledge spill-over, especially in more rural areas. Firms need to have the ability to absorb knowledge and technology and it is the role of education and training institutions to contribute to the skills development and research capacity of the firms [18], [36]. Bramwell & Wolfe [16] confirms the importance of absorptive capacity by stating that "…firms require a strong contingent of highly qualified research scientists and engineers, recruited primarily from universities, to maintain an internal ability to assess and absorb scientific knowledge". According to Liefner & Schiller [21], deliberate action of knowledge providers and knowledge absorbers is necessary, because diffusion is not an automatic process.

V. The Case of the Mpumalanga Province

The condition and performance of education and training bodies in the Mpumalanga province is a huge constraint in the innovation system of the province and seriously hampers the knowledge flows in the innovation system. South Africa's global ranking of the education system shows a gloomy picture and Mpumalanga performs even worse than most other provinces do. The quality of higher education in South Africa, as found by The Global Competitiveness Report 2012-2013 [37] ranks 140th, quality of primary education come in at 132nd and tertiary enrolment, a disappointing 101st of 144 countries. The quality of math and science education ranked an alarming 143rd of the 144. Internet access in schools in South Africa is ranked 111th of the 144. The quality of education in South Africa, therefore, is among the worst in the world. Von Broembsen et al. [38] concluded in the Global Entrepreneurship Monitor, South African Report 2005, that "… the South African school system is failing to provide the vast majority of its students with the basic knowledge and skills required to start a business …. All the evidence suggests that the overwhelming majority of young adults do not and historically have not received education of an adequate quality, even by the standards of developing countries that are far poorer than South Africa".

In Mpumalanga, the level of education, quality and performance in the education sector and the condition of the education infrastructure are, to say the least, not conducive to learning. The performance and pass rates at schools on average are low and the literacy rate in the province is alarming, as deduced from the following evaluation:

A. Primary and Secondary Education

The level of literacy in the Mpumalanga Province is part of the evidence of a human resource component that is not conducive for a high performance innovation system. According to the General Household Survey, 2010, 11,3% (6,9% for South Africa) of the people in Mpumalanga aged 20 and older have no schooling, 17,5% (17,7% for South Africa) have completed primary school or lower, only 24,4% have completed Grade 12/Standard 10 (25,7% for South Africa) and 9,5% (10,6% for South Africa) have qualifications higher than Grade 12/Standard 10, as indicated in Table I [39]. This literacy rate has a negative impact on the quality of human resources and potential entrepreneurs. The number and percentages of the population attending the different levels of educational institutions are shown in Table II [39] for the provinces of South Africa. According to the General Household Survey, July 2003 [40], there are also approximately 13 000 children aged 7 to 15 that do not attend an educational institution at all. The General Household Survey, 2010, states that just under 89% of individuals above the age of 5 years in South Africa attend school [39].

There are exceptions where some schools in the province are of a very high standard, but there are too many schools in which education is not conducive to a well-developed innovation system. The matric pass rate has been declining during the period 2006 to 2009 with some improvement in 2010, but remains lower than that of the country as a whole (Table III) [41]-[43]. In 2010, the matric pass rate was 56,8% compared to 67,8% for the country as a whole. Apart from the low pass rate, there have been well-documented irregularities regarding the matric examinations during the past years. In "The Teacher", [44] an overview is provided of these irregularities and reads as follows: "Over the past 10 years the province's education department has been notorious for matric examination paper leaks which have cast a shadow over the overall credibility of the entire examinations….In 2004 the

results were withheld due to irregularities, while in 1998…the province was in the news after it was discovered the matric results were inflated by 20%.

TABLE I
HIGHEST LEVEL OF EDUCATION BY PROVINCE AMONGST THOSE AGED 20 AND OLDER (PERCENTAGES)

Level of education	No schooling	Completed primary	Grade 12/ Std 10	Higher
Western Cape	2,1	6,5	28,1	13,8
Eastern Cape	8,5	6,5	19,7	7,6
Northern Cape	10,9	8,7	19,0	5,5
Free State	5,9	6,9	23,8	8,4
KwaZulu-Natal	8,1	5,3	27,0	8,2
North West	10,2	7,0	20,9	6,9
Gauteng	2,9	4,0	33,5	16,0
Mpumalanga	**11,3**	**5,6**	**24,4**	**9,5**
Limpopo	13,4	6,1	15,3	8,4
South Africa	**6,9**	**5,7**	**25,7**	**10,6**

TABLE II
PERCENTAGE OF PERSONS AGED 5 YEARS AND OLDER ATTENDING EDUCATIONAL INSTITUTIONS (NUMBERS IN THOUSANDS), 2010

Educational institution/ Province Number	Pre-school	School	ABET	Literacy classes	Universities & Universities of Technology	FET	Other colleges	Home based education	Other
Western Cape	59	1 161	7	1	100	20	33	2	8
Eastern Cape	68	2 156	14	2	56	20	9	0	4
Northern Cape	18	305	2	0	5	4	2	0	0
Free State	46	811	8	1	54	16	13	0	4
KwaZulu-Natal	105	3 279	15	1	124	48	16	2	2
North West	32	922	14	3	24	14	5	1	3
Gauteng	131	2 250	21	0	231	43	57	11	18
Mpumalanga	**38**	**1 150**	**13**	**0**	**39**	**17**	**23**	**0**	**4**
Limpopo	30	2 000	20	4	46	21	10	0	5
South Africa	526	14 034	113	11	679	202	169	17	48
%									
Western Cape	4,3	83,5	0,5	0,0	7,2	1,4	2,4	0,2	0,6
Eastern Cape	2,9	92,6	0,6	0,1	2,4	0,9	0,4	0,0	0,2
Northern Cape	5,3	90,6	0,7	0,1	1,4	1,1	0,7	0,0	0,1
Free State	4,8	85,2	0,8	0,1	5,7	1,7	1,4	0,0	0,4
KwaZulu-Natal	2,9	91,3	0,4	0,0	3,5	1,3	0,4	0,1	0,1
North West	3,1	90,6	1,4	0,3	2,4	1,4	0,5	0,1	0,3
Gauteng	4,7	81,5	0,8	0,0	8,4	1,6	2,1	0,4	0,7
Mpumalanga	**3,0**	**89,6**	**1,0**	**0,0**	**3,1**	**1,3**	**1,8**	**0,0**	**0,3**
Limpopo	1,4	93,7	0,9	0,2	2,2	1,0	0,5	0,0	0,2
South Africa	**3,3**	**88,8**	**0,7**	**0,1**	**4,3**	**1,3**	**1,1**	**0,1**	**0,3**

ABET: Adult Basic Education and Training; FET = Further Education and Training

TABLE III
NUMBER OF MATRIC PASSES AND PASS RATES, 2006-2008

	2006		2007		2008		2009		2010	
	No. of learners who passed	**% pass rate**	**No. of learners who passed**	**% pass rate**	**No. of learners who passed**	**% pass rate**	**No. of learners who passed**	**% pass rate**	**No. of learners who passed**	**% pass rate**
WC	33 316	83,7	33 787	80,6	34 393	62,2	34 017	75,7	35 124	76,8
EC	41 268	59,3	39 358	57,1	30 525	50,6	34 731	51,0	37 364	58,3
NC	5 753	76,8	7 141	70,3	7 251	72,7	6 356	61,3	7 366	72,3
FS	21 582	72,2	21 522	70,5	21 644	71,6	20 680	69,4	19 499	70,7
KZN	82 460	65,7	94 421	63,8	80 301	57,2	80 733	61,1	86 556	70,7
NW	25 440	67,0	21 372	67,2	22 470	67,9	20 700	67,5	21 876	75,7
GP	57 355	78,3	63 287	74,6	71 797	76,3	70 871	71,8	72 537	78,6
MP	**25 479**	**65,3**	**31 449**	**60,7**	**27 883**	**51,7**	**25 854**	**47,9**	**29 382**	**56,8**
LP	58 850	55,7	55 880	58,0	48 530	52,7	40 776	48,9	54 809	57,9
Total	351 503	66,6	368 217	65,2	344 794	62,2	334 718	60,6	364 513	67,8

WC = Western Cape, MP = Mpumalanga, LP = Limpopo, GP = Gauteng, NW = North West, KZN = KwaZulu-Natal, FS = Free State, NC = Northern Cape, EC = Eastern Cape

The 2009 exams saw investigations into leaks in maths, science and accounting exams papers…The province's grade 12 pass rate was 47%." These irregularities have been confirmed by the SABC News [45] and the report stated: "The provincial education department has been completely discredited. National officials will assume control of the exam unit until Mpumalanga cleans up its act and meets all criteria" Mpumalanga has been indicated as one of the provinces in South Africa with the lowest quality of education. The Department of Education [46] confirmed the low quality of service in the province as follows: "Compared to other provinces on matters of performance, the department's rating on performance targets in critical service delivery support programs to the benefit of the core business is amongst the lowest". The learner-educator ratio is a contributing factor to the low quality of education in the province. The learner-educator ratio in ordinary public schools (32:1) is slightly higher in Mpumalanga than that of the country as a whole (31:1) and the learner-school ratio is amongst the highest (552:1) of the provinces in the country (480:1 for South Africa), as indicated in Table IV [41]. Although larger schools may lead to more opportunities for learners if the infrastructure is sufficient, a lower learner-educator ratio may positively influence pass rates.

The National Treasury [41] found that one of the main contributing factors to the poor quality of education in South Africa is the low skills of many teachers. The Department of Education [46] indicated that Mpumalanga has a shortage, specifically, of mathematics, science, mathematical literacy and of Further Education and Training (FET) teachers and lecturers.

The basic facilities at schools may contribute to the performance of the students. In Table V, the number of schools without electricity, water, adequate toilet facilities and schools with more than 40 learners per class is shown. From Table V, it becomes clear that there are still many schools without the basic facilities such as electricity, water and toilets and that many schools do not even have sufficient classrooms [46]. Apart from the health risks involved, learners are not exposed to technology such as computers and the internet under these conditions.

B. Tertiary education

Rooks & Oerlemans [47] noted that, quite apart from the low levels of education in South Africa, there is also the problem of many technical or professional people who leave the country as part of the so-called "brain drain". Porter & Schwab [48] also found that South Africa has a competitive disadvantage concerning the "brain drain". The provision of education by tertiary institutions becomes, therefore, increasingly more important.

In Mpumalanga, only 3,1% of the people attend university (outside the province) while 4,3% of the people of South Africa attend university. These percentages for Gauteng and the Western Cape are 8,4% and 7,2% respectively (Table II). The low percentage of learners who obtain a matriculation pass with university endorsement may be a reason for this low percentage of people attending university (Table VI) [41]. Only 12,0% of the matric candidates in Mpumalanga obtained university endorsement in 2008, compared to 19,1% in South Africa as a whole. In Gauteng and the Western Cape, these percentages were 29,3 and 32,4 respectively.

One of the most serious weaknesses that are experienced in Mpumalanga is the absence of universities in the province. Universities play a role in the innovation system by developing human resources, potential entrepreneurs, as well as by contributing to the R&D that can lead to innovation. Universities can be the hubs for centres of excellence, business development centres, science and technology parks and the like. Therefore the absence of a university leaves a gap in the development of other participants in the innovation system and in the knowledge flows that should take place among these participants. There has not been a university in the Mpumalanga province until 2014. The South African government has decided to establish a university in the province and the Mpumalanga University opened its doors for 140 students in January 2014. The three programmes offered are Bachelor degrees in Education (Foundation Phase) and in Agriculture as well as a Diploma in Hospitality Management. The Mpumalanga University does not yet have the capacity to contribute significantly to the capacity building or innovation system of the province. Future planning includes programmes in Life Sciences, Business Economics, Management Studies, Communication and Health. For the university or universities to develop centres of excellence and participate in science and technology parks, in order to contribute significantly towards innovation, will take a considerable time.

The Tshwane University of Technology (TUT), on the other hand, has been functioning in the province since 1992 (then called Technikon Pretoria) in the form of two satellite campuses. Since the change from a Technikon to a University of Technology in 2004, the emphasis shifted to a more research orientated institution. The two campuses of TUT in the Mpumalanga province are 200km apart. The eMalahleni Campus is situated in the industrial heartland of the province and the Mbombela Campus near the rural less developed area of the province.

Tecknikon Pretoria, Mbombela Campus, started in Mbombela in 1992 with four programmes: National Diploma's in Commercial Administration; Public management and Administration; Personnel management; and a National Higher Diploma in Fire Fighting Technology. In the following years the National Diploma's in Engineering; Agriculture; Information Technology; Marketing; Internal Auditing; Cost and Management Accounting; and Municipal Administration was added to the programme mix. At the end of 1993 there were 21 full-time lecturers and 11 support staff members. In January 2004, Technikon Pretoria, Technikon Northern Gauteng and Technikon North-West merged and became Tshwane University of Technology [49]. This, unfortunately, resulted in the relocation of some crucial programmes such as Engineering, Information and Communication Technology, Office Management and Technology and Human Resource Management from the Mbombela Campus to the eMalahleni

Campus. There are currently, in 2014, just more than 2000 students registered at TUT, Mbombela Campus. The limited variety of programmes and number of students serviced is not sufficient to address the skills need of the province.

A number of 719 656 new jobs is necessary in the Mpumalanga Province to reach 1.6 million jobs by 2020 and subsequently reduce the unemployment rate to 15%. (over the ten year period between 2010 and 2020)[50]. The Provincial Human Resource Development Strategy of the Mpumalanga Provincial Government [51] identifies priority areas that need to be addressed such as entrepreneurial skills, engineering, artisans, business skills and information and communication technology skills. TUT, Mbombela Campus, with its current capacity and programmes contributes to competence building in the province, but should further expand their capacity and especially the programmes offered in order to address the skills need in the province. Although the TUT, eMalahleni Campus offer some of the critical programmes needed, it is situated far from the rural, less developed part of the Mpumalanga province and does not service the need of the province in general. The new Mpumalanga University is also situated in Mbombela and can potentially play a central role in the development of the more rural part of the Mpumalanga Province.

TABLE IV
PUBLIC ORDINARY SCHOOL STATISTICS BY PROVINCE, 2008

	Number			Ratio	
	Learners	**Educators**	**Schools**	**Learn : Educator**	**Learner : School**
Western Cape	937 887	31 214	1 451	30	646
Eastern Cape	2 037 777	64 371	5 686	32	358
Northern Cape	263 086	8 835	602	30	437
Free State	656 074	22 696	1 614	29	406
KwaZulu-Natal	2 725 855	83 760	5 783	33	471
North West	765 762	25 736	1 730	30	443
Gauteng	1 716 196	53 017	1 989	32	863
Mpumalanga	**1 034 719**	**32 784**	**1 873**	**32**	**552**
Limpopo	1 735 806	55 647	4 023	31	431
Total	**11 873 162**	**378 060**	**24 751**	**31**	**480**
	Percentage of national total				
Western Cape	7,9	8,3	5,9		
Eastern Cape	17,2	17,0	23,0		
Northern Cape	2,2	2,3	2,4		
Free State	5,5	6,0	6,5		
KwaZulu-Natal	23,0	22,2	23,4		
North West	6,4	6,8	7,0		
Gauteng	14,5	14,0	8,0		
Mpumalanga	**8,7**	**8,7**	**7,6**		
Limpopo	14,6	14,7	16,3		
Total	**100,0**	**100,0**	**100,0**		

TABLE V
MPUMALANGA – FACILITIES IN PUBLIC ORDINARY SCHOOLS

Facilities	**2005/2006 Actual**	**2006/2007 Actual**	**2007/2008 Estimate**
Number of public ordinary schools with a water supply	1 514	1 558	1 768
Number of public ordinary schools with electricity	1 382	1 412	1 451
Number of schools with adequate number of functional toilets	388	417	512
Number of schools with more than 40 learners per class	446	432	312
Number of schools with section 21 status	1 876	1 824	1 910

TABLE VI
NUMBER AND PERCENTAGES OF CANDIDATES WHO OBTAINED UNIVERSITY ENDORSEMENT PER PROVINCE, 2006-2008

	2006		2007		2008	
	Number of learners with endorsements	**Endorsements percentage rate**	**Number of learners with endorsements**	**Endorsements percentage rate**	**Number of learners with endorsements**	**Endorsements percentage rate**
Western Cape	10 589	26,6	10 300	24,6	14 167	32,4
Eastern Cape	7 002	10,1	6 466	9,4	8 447	14,0
Northern Cape	1 163	15,5	1 208	11,9	1 937	19,4
Free State	5 901	19,7	5 776	18,9	6 293	20,8
KwaZulu-Natal	19 116	15,2	21 443	14,5	23 846	17,0
North West	5 537	14,6	5 060	15,9	6 213	18,8
Gauteng	17 012	23,2	17 307	20,4	27 608	29,3
Mpumalanga	**5 481**	**14,0**	**6 561**	**12,7**	**6 493**	**12,0**
Limpopo	14 029	13,3	11 333	11,8	11 043	12,4
Total	85 830	16,3	85 454	15,1	106 047	19,1

VI. Conclusion

For a country to develop economically, a well developed innovation system is essential. The responsibility does not only lie with the firm, as was believed by Schumpeterian economists, but has shifted, as postulated by evolutionary economists, to a multiple of actors or role-players in the innovation system. Some of the most influential role-players include education and training institutions. Although universities can play and is increasingly playing a more comprehensive role in innovation systems with regard to knowledge transfer, this paper only focused on the capacity building role of institutions.

The education and training institutions build capacity by developing human capital, a *sine qua non* condition for innovation. The roles that the education and training institutions play in capacity building have many facets. The first is that of creating a skilled workforce for the firms. Secondly, researchers are developed by universities. These researchers contribute to the innovative activities of the firms. Transfer of technology takes place through human vessels. In the third place, entrepreneurs are trained by these institutions. Although not every person can be trained to become an entrepreneur, many skills can contribute to the development and improvement of entrepreneurs. Mathematics, engineering and entrepreneurship training has been indicated in literature as important to innovative performance.

The performance and conditions of the Mpumalanga Province's education and training institutions was evaluated, and it was found that the level of education, quality and performance in the education sector and the condition of the education infrastructure are, to say the least, not conducive to learning. The performance and pass rates at schools on average are low and the literacy rate in the province is alarming. There has not been a university in the province until 2014 and this university still needs to be built and developed. It may still take many years before the university can address the skills and development need of the province. The current role that the satellite campuses of TUT play contributes to the development of the human capital in the province, but is not sufficient to address the skills need of the province.

In order to determine the comprehensive role of education and training facilities in the innovation system, further research is needed to include their potential role in knowledge transfer such as science and technology parks, incubators, etc. If the education and training institutions are not yet ready to contribute significantly to the competence building of human resources, they will most probably not be ready to play a strong role in knowledge transfer.

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