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Knowledge Frontiers for Sustainable Growth and Development in Zimbabwe

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1. Introduction

Knowledge is increasingly driving growth and transforming nations and the way of life. The essence of sustainable development in Africa commands a dramatic reduction of poverty and hunger and improved development prospects for future generations (Hamel, 2004). Achievement of meaningful sustainable development requires considerable progress on these fronts. Knowledge-driven sustainable development requires relevant and efficient development knowledge. “Sustainable development” is development that meets the needs of the present without compromising the ability of future generations to meet their own needs¹.

Sustainable development has remained elusive for many African countries. Africa's efforts to achieve sustainable development have been hindered by conflicts, insufficient investment, limited market access opportunities and supply side constraints, unsustainable debt burdens, historically declining levels of official development assistance and the impact of HIV/AIDS². Zimbabwe is faced with the following three major sustainable development problems that require knowledge frontiers as a solution:

1. Attainment of the Millenium Development Goals (MDGs)
2. Poverty reduction
3. Social problems value chain

Knowledge has become the new currency in the modern age and in spearheading Zimbabwe to become a knowledge-based economy. On the contrary, knowledge deficiencies and shortcomings affect various forms of sustainable development (social, cultural, economic, technological, political, and anthropological). Zimbabwe, like other African countries, should establish African Knowledge Systems (AKSs) from which knowledge policies may precipitate. Knowledge is the centrality of sustainable growth and development in many ways, which is the main object of this paper. To some extent, knowledge for sustainable development is something knowable, modelable, reformable and manageable through effective knowledge policies (Hamel, 2004). However, sufficient

¹ World Commission on Environment and Development (WCED). *Our Common future*. Oxford. Oxford University Press, 1987 p.43.

² http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POIChapter8.htm.

understanding of knowledge in the context of an African knowledge corpus and AKSs brings some completeness in the achievement of sustainable growth and development. The changing global geography of knowledge and the character and perspectives of an AKS are uncovered in this case study for Zimbabwe with respect to:

- Knowledge for modernization and development
- Indigenous and traditional knowledge, and
- Faith-based knowledge.

The frontiers of knowledge are boundless, producing wealth for both entrepreneur and economy for *knowledge creation, commercialisation and innovation*. Recognising the critical need for knowledge as input, Zimbabwe has embarked on the transformation from an input-driven growth strategy that had served her well since political independence in 1980, so that our economy is increasingly driven by knowledge in order to achieve sustainable high growth and development. The intention to migrate from a production-based economy to a knowledge-based economy and the development of a Master Plan to chart the strategic direction towards the knowledge-based economy are now critical in Zimbabwe. The paper has a focus on the exploration of frontiers in order to encourage original innovation, integrated innovation and re-innovation based on the absorption and digestion of existing knowledge for sustainable growth and development. The New Partnership for Africa's Development (NEPAD) is a commitment by African leaders to the people of Africa and which provides a framework for sustainable development on the continent to be shared by all Africa's people. The four pillars of economic growth are:

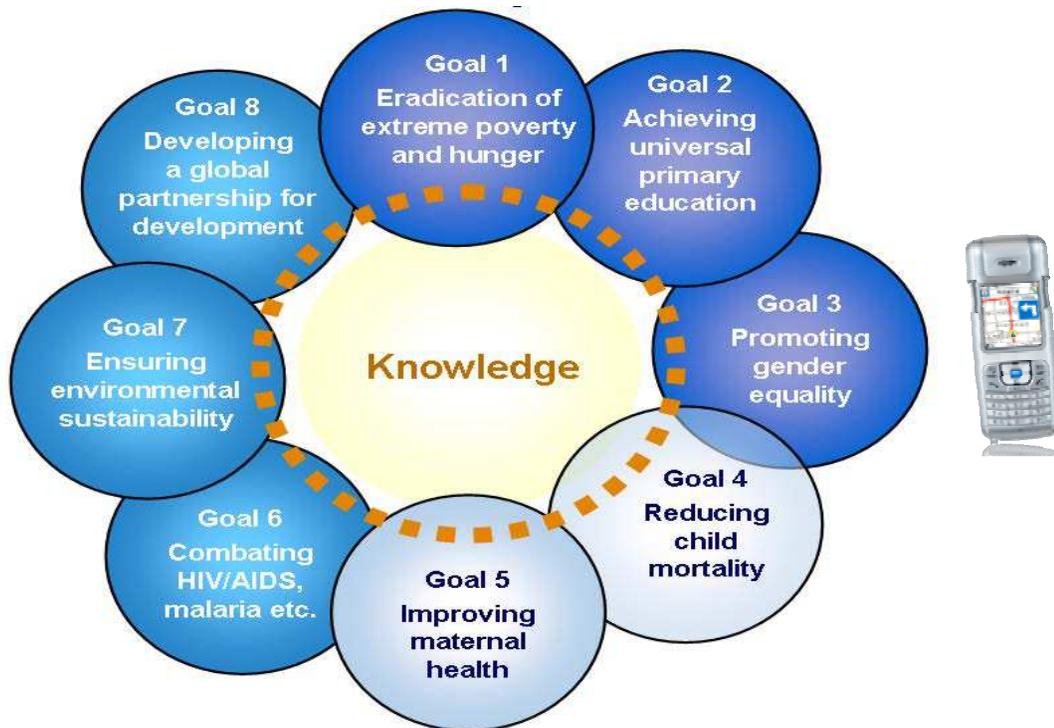
- An educated and skilled population to create, share, and use knowledge well.
- A dynamic information infrastructure to facilitate the effective communication, dissemination, and processing of information.
- An efficient innovation system comprising academia, firms, consultants, SMEs, etc.
- An enabling environment with supportive economic and institutional mechanisms.

1.1 Millenium development goals

The strategy for sustainable growth and development in Zimbabwe is to build a knowledge economy with more competitiveness and social cohesion. Knowledge is possibly the greatest producer of wealth, affluence, prosperity and 'development', and also of pollution, destruction, poverty, hunger and inequality between humans (Jamel, 2004). These are the most critical issues of sustainable development. This exciting wave of new knowledge provides knowledge opportunities for the sustainable development of the African continent, perhaps through adequate knowledge policies.

The Millenium Development Goals (MDGs) are illustrated in Figure 1 below. The ability to generate and harness sophisticated levels of knowledge is a necessary and sufficient condition to the attainment of the MDGs. Goal 1 (eradicate extreme poverty and hunger) directly affects Goals 2 to 7, and requires Goal 8 (develop a global partnership for development). According to World Development Indicators (2004), Sub-Saharan Africa (SSA) lags far behind in growth of income per capita with levels of 0.2% and 0.3% for the periods 1965-1990 and 1990-2003, respectively, as illustrated below in Figure 2. The key African problem on development is characterised by a world contribution to knowledge of only 0.03%, average tertiary enrolment ratio for school leavers of only 4% and university

Millennium Development Goals (MDGs)



2

Fig. 1. MDGs and Knowledge

fields of study largely dominated by social sciences/humanities with 47%, education 22%, agriculture 3%, sciences 9% and health sciences 9% (UNESCO, 2010).

The major problem of under-development characterised by the huge challenge to achieve the Millennium Development Goals (MDGs) is on knowledge empowerment mainly supported by Information and Communication Technologies (ICTs). The emergence and convergence of information and communication technologies (ICTs) has remained at the centre of global socio-economic transformations. As noted by the World Bank (2003), the effective use of technology is dependent not only on the technology but also on factors that are independent of the technology. ICTs increase productivity through:

- Better communication and networking at lower costs
- Digitalisation of production and distribution
- New trade opportunities through e-commerce
- Access to knowledge
- Increased competition

ICTs impact on all the MDGs in different ways (Kabanda, 2011). The fast track to the achievement of MDGs lies greatly in the ability to effectively manage the diffusion and adoption of ICTs for development. Debates have ensued on how information and communication technologies (ICTs) can help to alleviate poverty in low-income countries

Sub-Saharan Africa lags far behind in growth of income per capita...

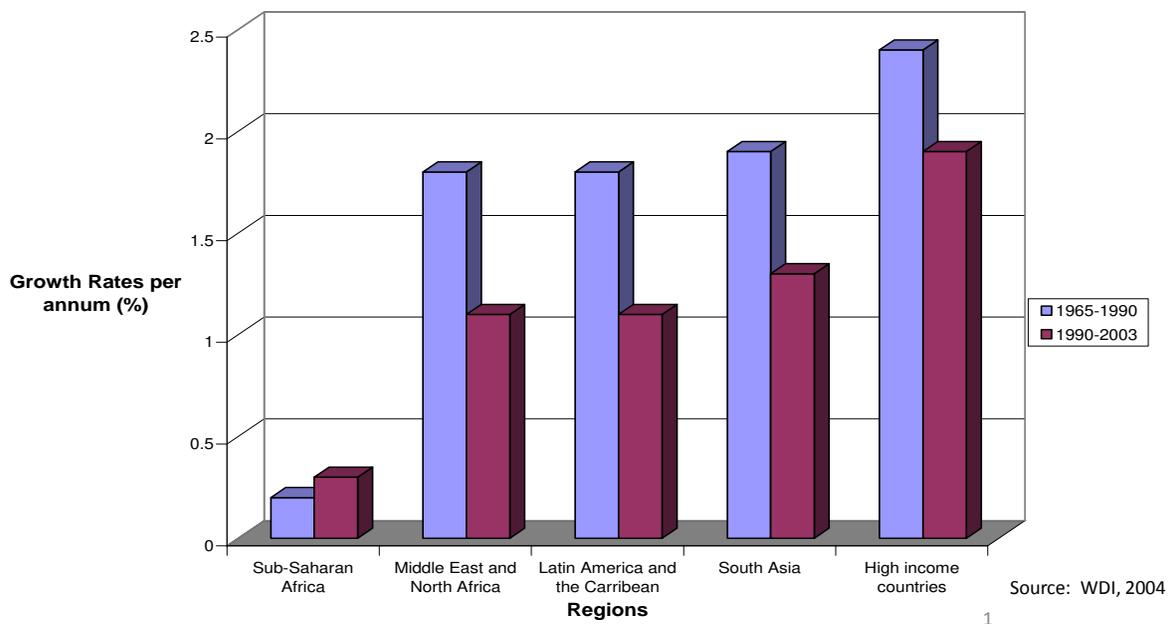


Fig. 2. Growth of income per capita in Sub-Saharan Africa

(Heeks, 1999). Advances in communication technologies have enabled many countries to improve the lives of their citizens through improved health, education and public service systems, and economies (Kekana, 2002). A knowledge economy requires:

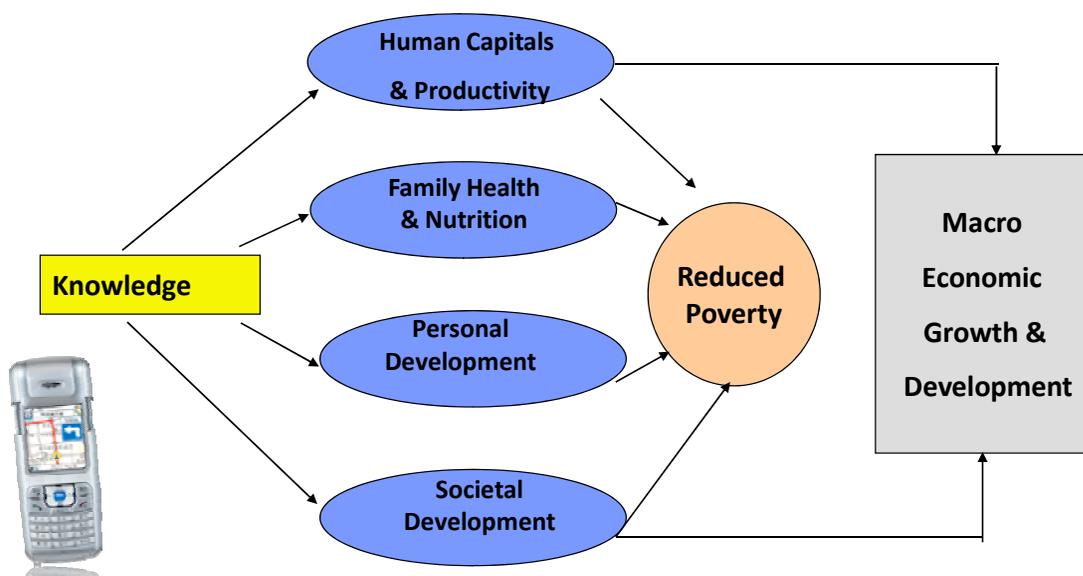
- widespread access to communication networks;
- the existence of an educated labour-force and consumers (human capital); and
- the availability of institutions that promote knowledge creation and dissemination.

1.2 Poverty

Research and technology are, together with education and innovation, the components of the “Triangle of knowledge”. Rich in human capital and natural resources, Zimbabwe can achieve sustainable growth and development. There is clear recognition that knowledge, not just science, technology and innovation, performs an important role in improving rates of development and growth. The solution to poverty is therefore knowledge, as illustrated on Figure 3 below.

A formalization of the impact of knowledge on growth, knowledge accumulation and application are necessary conditions that contribute to increased economic development and are at the core of a country’s competitive advantage in the global economy (World Bank, 2002).

The solution to Poverty is Knowledge for development



1

Fig. 3. Poverty and Knowledge for sustainable development

1.3 Social problems

The perspective on knowledge as a sustainable resource for development indicates that knowledge is a necessary condition for sustainable development in various constructed environments. Political environments require full universal access to relevant knowledge for making sound political choices and for meaningful, participative and democratic governance. Cultural environments require the full utilization of all talents and available knowledge, and a diversity of knowledge sources, including from women. Economic environments require full access to modern and efficient development knowledge. Commercially exploited knowledge is well justified in some environments (Jamel, 2004).

A social change value chain links people, communities, money and institutional capacity through knowledge frontiers, perhaps through unmet social needs. **The social** change value chain of Zimbabwe is faced with the following ethical problems (Kurasha, 2011):

1. Domestic violence
2. Corruption
3. Digital illiteracy
4. Abuse of public company and position
5. High crime rate

6. Child abuse and child labour
7. Lack of institutional commitment
8. Tribalism and other forms of segregation
9. Sexism
10. Lack of vision
11. Political Violence
12. Pollution

The solution to all these problems of the social value chain is knowledge for the Zimbabwean societies.

2. The research problem

The *major sustainable developmental problems* being faced by Zimbabwe are multi-faceted and include the following symptoms (Kabanda, 2011):

1. Many donor-driven initiatives that excluded both policy-formulation frameworks and sustainable capacity building have not brought meaningful development in these African countries.
2. The Government policies, donor interest and community development needs are totally divergent with respect to priority areas for development.
3. The under-development, poverty and illiterate cycles in Africa need to be broken in the long term and exploit the blessed resources available to create wealth. Extensive investment in technology and human capital development as a vehicle to exploit the vast mineral and natural resources has not been given sufficient attention.
4. Poverty reduction requires a sustainable solution that increases production capacity at individual, institutional, community and national levels. The impact of knowledge frontiers on MDGs and generally economic growth needs a detailed assessment.

The specific objectives of the research are to:

1. Assess the major sustainable development problems:
 - a. Attainment of the Millenium Development Goals (MDGs)
 - b. Poverty reduction
 - c. Social problems value chain
2. Explore the emerging knowledge frontiers for sustainable growth and development in Zimbabwe.
3. Ascertain the impact of knowledge frontiers on economic growth, innovations and education in Zimbabwe.

3. Literature review

In the modern world of continuous social and technological change, the demand for a workforce with capability of adjusting and attaining new skills constantly is increasing phenomenally. For example, investigative skills, thinking critically, working independently with others, and application of knowledge and skills to different situations and subject to constant change. However, knowledge can be viewed alongside a continuum: data – information – knowledge – wisdom.

3.1 African knowledge for sustainable development

Knowledge is extraordinarily elusive, indefinable, versatile, multipurpose, multifaceted, diverse, incommensurable, and heterogeneous (Jamel, 2004). However, knowledge is durable although its relevance or effectiveness may diminish. Development knowledge refers broadly to the totality of representative mental or abstract structures and constructions related to sustainable development. Knowledge is closely associated with beliefs and values. A good understanding of the complexity, diversity, heterogeneity, incommensurability, multidimensionality, uncertainty, comprehensibility, relativity and knowability of knowledge may facilitate the formulation of effective policies for knowledge-oriented sustainable development. Symbolical, mythological, magical, metaphorical, proverbial, and poetical knowledge pervades AKSs and is the social cement that holds them together.

3.2 Knowledge management

To attain business competitiveness, there is a great need for skilled knowledge workers and methods of managing the knowledge production by people, processes and business technologies. Future economic competitiveness is premised on knowledge management. The function of knowledge management is to allow an organisation to leverage its information resources and knowledge assets by remembering and applying experience (Watson, 2003). Through knowledge management, organisations can become more efficient and effective as employees share knowledge and learn from one another. *Knowledge management* (KM) is “a deliberate, systematic business optimisation strategy that selects, distils, stores, organises, packages and communicates information essential to the business of a company in a manner that improves performance and corporate competitiveness” (Bergeron, 2003). However, Malhotra (1998, 2005) cites that KM “embodies organisational processes that seek synergistic combination of data and information processing capacities of information technologies, and the creative and innovative capacity of human beings”. From these two contrasting definitions, one can view KM as an extension of traditional information management whilst focussing on the synergistic outcome of combining information management and human creativity. Knowledge synchronisation involves having every new insight and every new piece of knowledge becoming instantly available to every employee across the organisation.

Zimbabwean organisations have been implementing knowledge management initiatives. Knowledge acquisition is defined as the transfer and transformation of problem-solving expertise from some knowledge source to a program (Buchanan et al, 1983). The main usable resources of knowledge are experts, textbooks, data bases, and experience from humans. Knowledge elicitation is a special kind of knowledge acquisition where the source of information is the human expert and a knowledge engineer. The knowledge engineer then interprets the data by abstraction into types and structures of knowledge, or simply modelling. Learning is defined in a broad sense as the acquisition of new skills and knowledge that results in changed behavior (Snyder & Cummings, 1998). Knowledge resides in, and is created by, both individuals and collectives. Knowledge management activities occur in building databases, measuring intellectual capital, establishing corporate libraries, building intranets, sharing best practices, installing groupware, leading training programs, leading cultural change, fostering collaboration, creating virtual organizations, etc. Absorptive capacity refers to the ability to process new knowledge as a function of an

existing knowledge base. The primary purpose of knowledge management is to benefit the organisation and ultimately the customer. The use of information technology to exploit knowledge management has become a topical area. Knowledge embedded in products and services has been recognized as a primary source of sustainable competitive advantage in a knowledge-based economy.

Visible leadership and commitment of top management are prerequisites for successful knowledge management. There are six core processes of knowledge management that are all closely related and whose building blocks are illustrated by the figure 4 below (after Schulteis R., 1998):

The Building Blocks of Knowledge Management

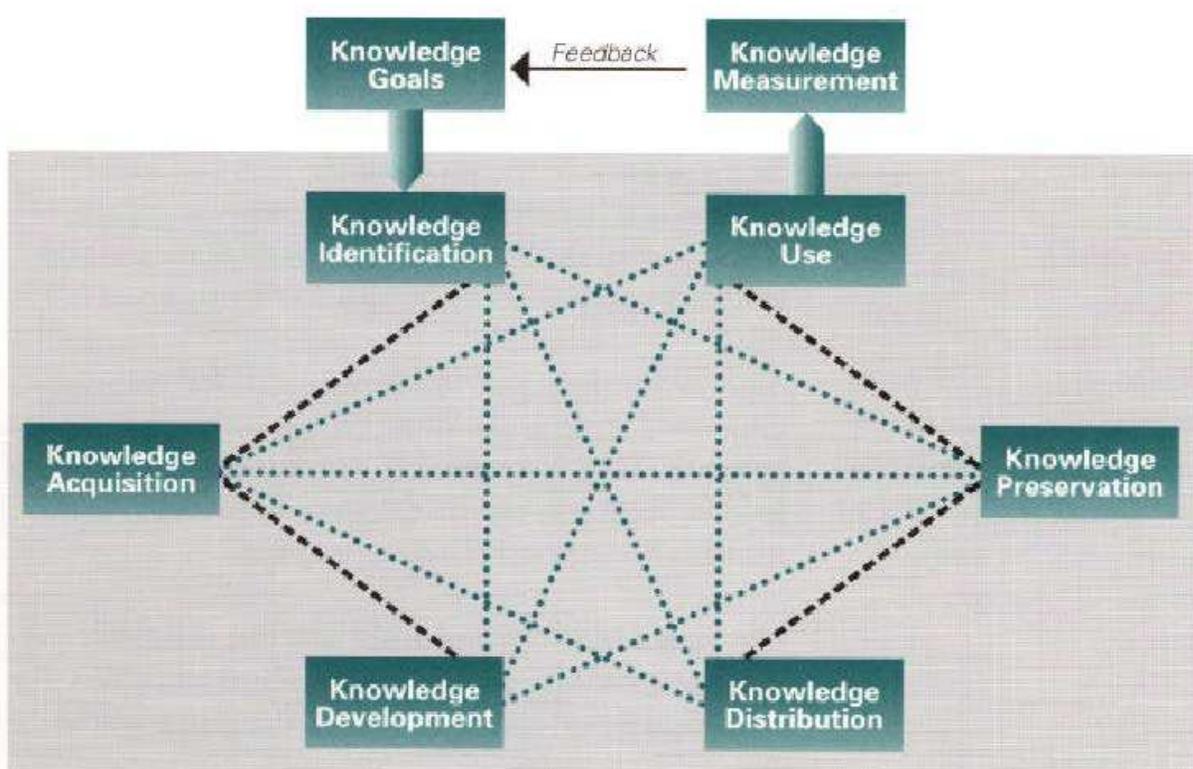


Fig. 4. Knowledge Management Building Blocks

Knowledge Management can be used to attain a cultural shift. Culture is an important contextual variable in the shaping and success of knowledge management, and knowledge sharing in particular. The New Generation of Knowledge Management is premised on the following perspectives:

- a. *Tactical perspective* considers exploiting knowledge processes to achieve more effective enterprise operations, e.g. cost-reducing KM-supported innovations.
- b. *Operational perspective* - attends to creating and fostering general KM practice and initiating and managing individual knowledge processes e.g. implementing lessons learnt programs.
- c. *Knowledge implementation, manipulation and application perspective* - focuses on manipulating and applying knowledge to reflect how people and organisations deal with knowledge.

Knowledge can exist in either the explicit or tacit knowledge format. Explicit knowledge is structured formal knowledge, easily codified and articulated, for example a computer programme. Tacit knowledge is less structured, difficult to codify, articulate and share, and requires basic knowledge, experience and expertise as its basis. Management and coordination of diverse technology architectures, data architectures, and system architectures poses obvious knowledge management challenges. The focus of the technology-push model is on mechanistic information processing while the strategy-pull model facilitates organic sense making (Malhotra, 2005). The missing link between technologies and business performance is often attributable to the choice of technologies intended to fix broken processes, business models, or organizational cultures.

Knowledge Management (KM) refers to practices used by organizations to find, create, and distribute knowledge for reuse, awareness, and learning across the organization. For highly successful, adaptive and modern organisations, these organizations should have a clearly-enunciated and well-developed strategic information system plan (SISP), that consists of a strategy for both information planning and management, including the use of functions, and the salient features of information technology (IT) (Galliers, Swatman and Swatman, 1995).

3.3 ICTs for development (ICT4D)

The emergence and convergence of information and communication technologies (ICTs) has remained at the centre of global socio-economic transformations. ICTs include a wide range of services, applications and technologies, using various types of equipment and software, often running over telecommunications networks. ICTs have fundamentally changed the way people live, work, and interact socially in developing countries like Zimbabwe. There is a growing need to evaluate the social and economic impacts of ICTs and to create opportunities for capacity building that will ensure their beneficial use and absorption within national economies and civil society. ICTs do in fact have an impact on the standards of living and on poverty alleviation at various community levels, hence the focus on poverty reduction and development in Zimbabwe. ICT investment fosters higher long-term economic growth. The potential impact that ICT can have on individuals, businesses, and governments depends largely on how policies are formulated and technology and markets evolve.

As a result of the convergence of information, telecommunications, broadcasting and computers, the Information and Communication Technologies (ICTs) sector now embraces a large range of industries and services. The potential of ICTs to transform development is now receiving greater attention worldwide. There are many opportunities for developing countries like Zimbabwe to advance development through the innovative use of ICT. Innovations diffuse through a social system explained by the diffusion of innovation theory (Rogers, 2003). Knowledge-based activities have become increasingly important and pervasive worldwide, and ICT is a key foundation. Access to and development of ICT resources are increasingly recognised as crucial instigators of economic and social development. If ICTs are appropriately deployed, they have the potential to combat rural and urban poverty and foster sustainable development (Samiullah & Rao, 2000). Generally, investment in the development of the ICT infrastructure will result in improved economic efficiency and competitiveness; more efficient and effective education; healthcare and public administration; opportunities to exploit low factor costs in international markets; opportunities to increase social capital; and opportunities to bypass failing domestic institutions.

3.4 Sub-themes for knowledge frontiers

Knowledge frontiers for the major research problem can be the solution for sustainable growth and development, presented below as sub-themes.

3.4.1 Indigenous knowledge systems

The ever-growing process of the division of labour is producing ever more specialized knowledge, understandable only by specialists and experts. Specialized knowledge tends to be organized in egotistical cliques with monopolistic powers and privileges. Integrative knowledge keeps AKSs from disintegrating, but requires leadership and vision, which need to be improved throughout AKSs in institutional policy-making, implementation, monitoring and in integration of science, technology, innovation and knowledge policies with other development policies³ (Jamel, 2004).

The African Indigenous Knowledge Systems (AIKS) and their contribution to knowledge frontiers for sustainable development are very important. Of interest in this context is the need to understand the importance and relevance of Indigenous knowledge systems and their link to sustainable growth and development in Africa and the world. It is also envisioned that priority be given to the significant contributions of Indigenous Knowledge Systems to knowledge creation, sustainable growth and development.

3.4.2 Transformational leadership

Leadership is “the ability to influence, motivate, and enable others to contribute toward the effectiveness and success of the organizations of which they are members.” (House, 2004). The sub-theme covers theories, models and components of transformational leadership as well as demonstrates how the leadership style influence sustainable growth and development. Our interest is on how transformational leadership is viewed and its place in extending knowledge frontiers for sustainable growth and development. Since there are different types of transformational leadership, the paper focuses on the types that have an impact on knowledge frontiers for sustainable growth and development.

Leadership has two main forms:

- *Transactional leadership* involves exchanging rewards for services rendered and has the following attributes:
 - hierarchical
 - senior management decision making
 - task and reward focused
 - disempowering strategies
 - reduced creativity
- Transformational leaders transform the organization by developing vision, building commitment, and empowering followers. Transformational leadership is characterized by the following key attributes:
 - team building
 - shared vision of staff and leaders

³ Science, technology and innovation constitute an important pillar of AKSs.

- staff involved in shared decision making
- feedback loop
- empowering strategies
- clear expectations and accountability of all

3.4.3 Open and distance learning and graduate employment

E-learning is learning supported or enhanced through the application of Information and Communications Technology (ICT), and has become an important pillar in open and distance learning. E-Learning can cover a spectrum of activities from supported learning to blended learning and to learning that is delivered entirely online. The Zimbabwe Open University (ZOU) is a State University, which was established on 1st March 1999 as an open and distance learning (ODL) university. The ZOU provides ODL throughout the ten (10) Regional Centres in each Province countrywide, as shown on the diagram below on Figure 5, and 1 Virtual Region for coordination and management of the e-learning platform accessible from anywhere in the world.

ZOU Regional Centres



Fig. 5. The Regional Centres of Zimbabwe Open University

The ZOU offers pre-service and in-service ODL certificate, diploma and degree programmes. As an ODL university, ZOU is *accessible* to students from remote districts in all provinces of the country and reduces urban bias, provides easy and convenient accessibility to higher education, and there are no emigration to far countries.

3.4.4 Ethics and values

The essence of ethics is in addressing morally questionable acts and other dynamic relationships that affect ethical decision making. Morality is a first-order set of beliefs and

practices about how to live a good life, whilst ethics is a second-order, conscious reflection on the adequacy of our moral beliefs. The essence of ethics takes note of the following observations and strategy:

- Codes of ethics do not necessarily lead to ethical behaviour.
- The core values we profess are not necessarily those by which we live.
- There is a place for compassion in leadership.
- Bureaucracy can come in conflict with ethics.
- Managers who vent their frustration on subordinates (who can do little about it) are not acting ethically.
- Study the ethics of organizations which have reputations for being ethical.
- Build ethics into organization policies and practices.
- Make sure quality and service and integrity permeate the entire organization.
- Develop high expectations of all members of your organization.

3.4.5 Emerging technologies

Current developments and debates on emerging technologies and their impact on knowledge creation, management and sustainable growth and development are consolidated. Trends and emerging technologies, innovations in various fields, and how emerging technologies are linked to knowledge frontiers for sustainable growth and development, is of paramount interest to this research problem, and can potentially make significant contributions to sustainable growth and development. The unceasing computing trends now focus on seamless integration, ubiquitous connectivity, embedded intelligence, user interface, and speed and capacity of computers. The notable key technology trends are in the following areas:

- Computing Hardware
- Networking and Wireless
- Knowledge Management
- Collaborative Software
- Security and Disaster Recovery

3.4.6 Entrepreneurship and community engagement

The main interest is on how the concepts of entrepreneurship and community engagement are impacting on expansion of knowledge and the sustainability of the systems. The paper is interested in seeking understanding on the perceptions of communities on academic institutions' role on knowledge, creation, development and dissemination.

3.4.7 Intellectual property and heritage

The links between intellectual rights and sustainable growth and development are important. The interest for the paper is on how to link intellectual property to challenges in intellectual property rights and impact on sustainable growth and development. Other related areas include intellectual property rights as a form of property rights, patents, and control over intangible and tangible assets. Intellectual property rules fundamentally affect the quality and availability of innovative ideas and products, and are therefore extremely important in achieving sustainable growth and development.

4. Methodology

Generally, the research design covers research philosophy, approaches, strategies, time horizons and methods. Research design involves the theory, conceptualization, formalization, operationalization of variables, choice of methods, data collection techniques, and data analysis (Deflem, 1998). The research is a case study for Zimbabwe. The methodology used was largely *qualitative on human capital development and knowledge management*, and also quantitative on Infodensity for Zimbabwe. The qualitative approach was focused on human capital development and knowledge frontiers in Zimbabwe. Data on Infodensity was obtained from the International Telecommunications Union (ITU, 2011).

The *qualitative research* was used to deepen our understanding of the human capital development issues and knowledge frontiers, and its link to economic growth. For this research external secondary data was largely used, for it saves on time and reduces data gathering costs. The following data collection techniques were used in this case study:

- Formal meetings and focus group discussions
- Face-to-face oral structured interviews
- Questionnaires on knowledge frontiers
- Secondary data and records observation

The face-to-face interviews allowed for in-depth knowledge sharing, helped to develop the bigger picture on knowledge frontiers and was good for networking. Focus group discussions were held with selected regulatory, training and research institutions to pick up grassroots input and in developing ideas, whilst sharing latent knowledge spontaneously.

5. Analysis of results

5.1 Infodensity for Zimbabwe

Data on infodensity was obtained from the International Telecommunications Union (ITU, 2011, <http://www.itu.int/en/publications/>), and the analysis is shown below on figures 6. Zimbabwe has about 10% internet penetration rate. The number of internet users per 100 inhabitants (%) in Zimbabwe is benchmarked against other 18 countries in East and Southern Africa for the period 2000-2010.

The mobile density of Zimbabwe more than doubled from 24% in 2009 to 60% in 2010. The number of mobile users for Zimbabwe is benchmarked against other 18 neighbouring countries in Africa for the period 2000-2010 and is shown on Figure 7 below. Botswana has the highest mobile density followed by South Africa and Mauritius.

The mobile density for Zimbabwe alone is shown on the Figure 8 below. The mobile density for Zimbabwe has risen astronomically between 2008 and 2010, and has one of the highest growth rate for mobile density among the 18 countries.

From the above chart on Figure 8, the mobile density for Zimbabwe has risen astronomically between 2008 and 2010, and has one of the highest growth rate for mobile density among the 18 countries in the region of Africa.

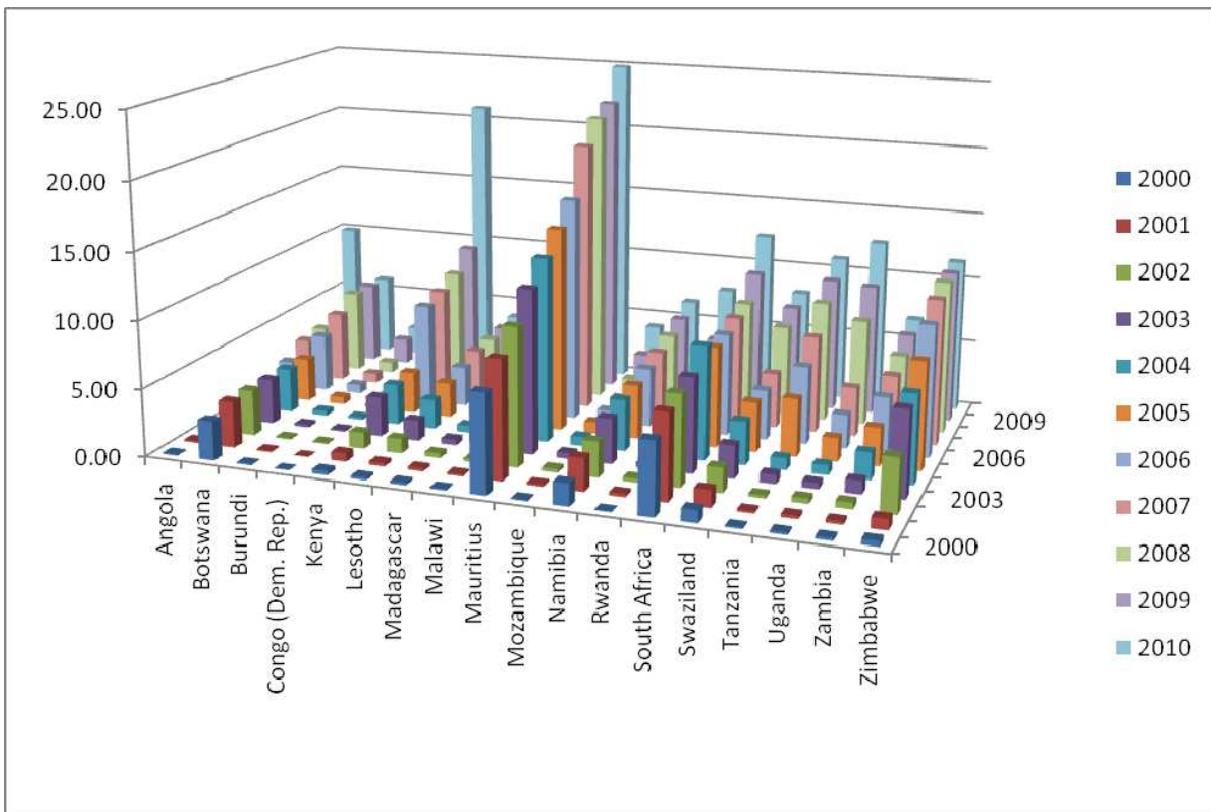


Fig. 6. Number of internet users for Zimbabwe benchmarked against others neighbouring African countries for the period 2000-2010

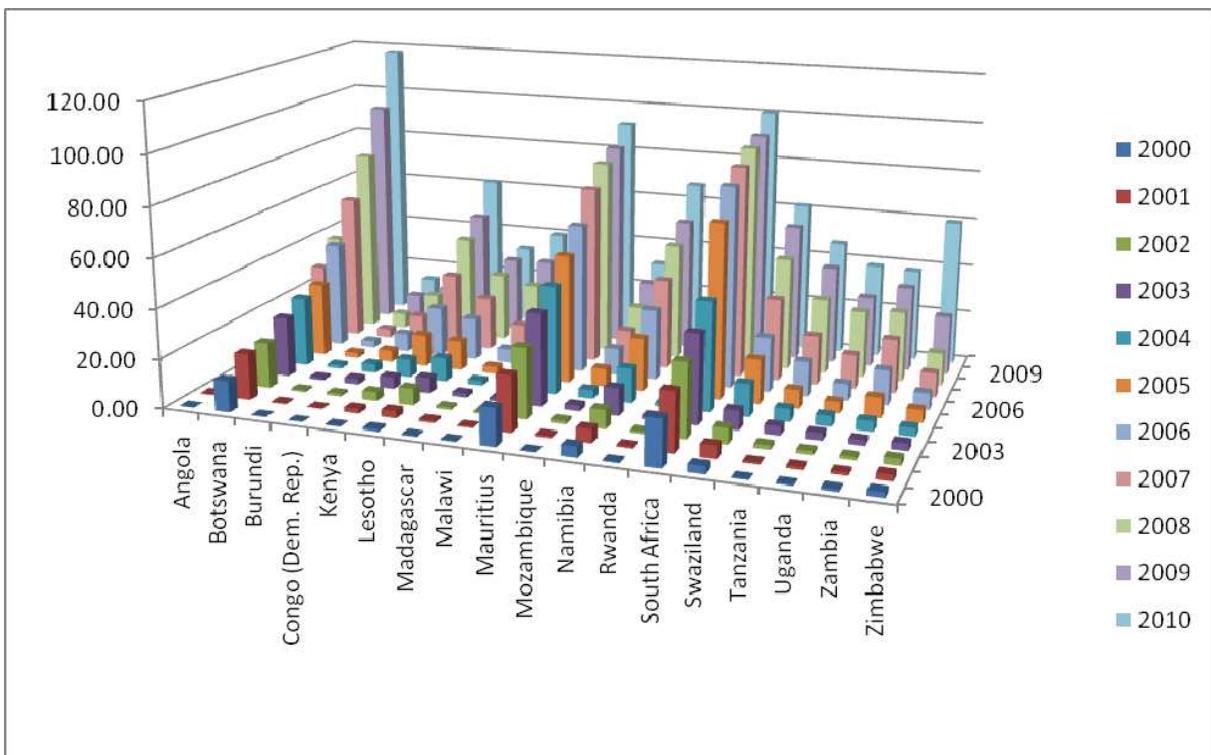


Fig. 7. Number of mobile users for Zimbabwe benchmarked against other neighbouring African countries for the period 2000-2010

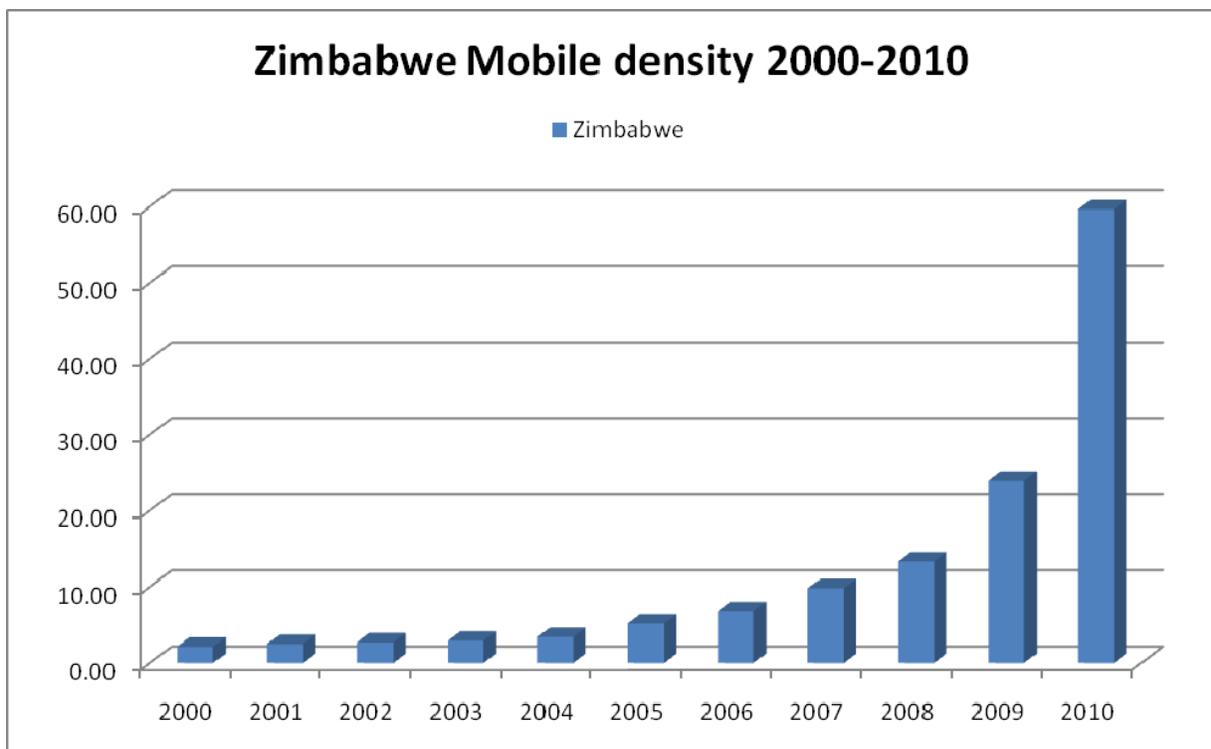


Fig. 8. Mobile density for Zimbabwe

5.2 Sustainable development and human capital

Human capital development is central to capacity development. Capacity development looks at the overall system, environment or context within which individuals, organisations and societies operate and interact. *Human capital* is about “the knowledge, skills and competences and other attributes embodied in individuals that are relevant to economic activity” (OECD, 1998). If education for sustainable development (ESD) is to become a central aspect of all education, supporting structures at the global, national and local levels are required. Investment in human capital and technology is the sustainable long-term solution to the above problem and its symptoms. Human capital is an asset and a factor of production, that can be measured at individual, corporate and national levels. The ICT revolution, at institutional and regional collaboration levels, requires extensive investments into people (labour) and capital for the infrastructure and equipment (Kabanda, 2008). The Cobb-Douglas production function relates the revolutionary technological change or productivity levels from ICT to labour and capital. A Cobb-Douglas production function of the form:

$$Q = A K^a L^b$$

is used for the analysis of technological progress and attended economic growth, where A, a and b are empirical parameters. In this context, the key parameters driving productivity include:

- K = capital input (very meaningful amounts)
- L = labour input (high technical competence and human capital)

Sufficient investment in human capital and technology increases the factor of production by numerous multiples, and consequently reduces the unit cost of production of items, e.g.

assembly of computers, printers, motor vehicles, etc., as illustrated in Figure 9 below (Kabanda, 2008):

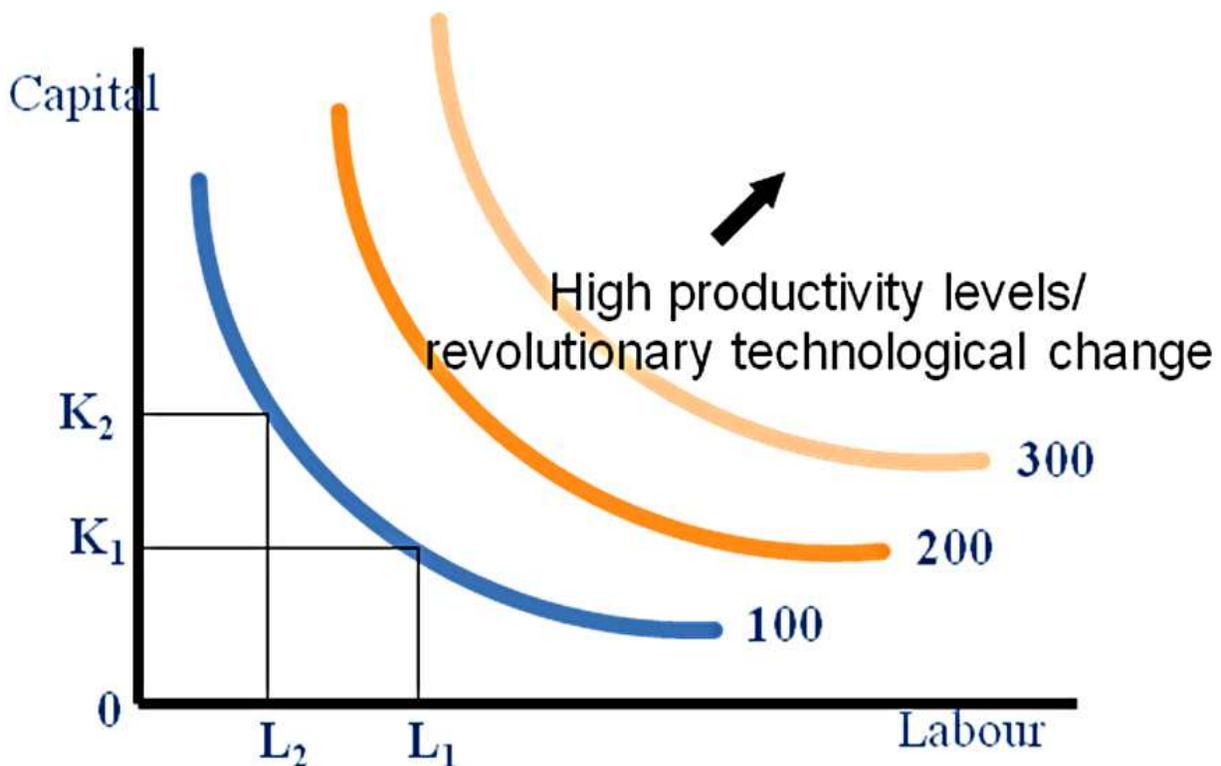


Fig. 9. High productivity levels due to extensive investment in human capital and technology

The unit cost in production decreases as a result of extensive investments in both technology for large throughput and human capital development.

Duration of schooling and levels of qualification are the standard measures used in human capital development, but these are far from capturing the extent of human capital. The major human capital development challenges faced in Zimbabwe in both education and technology development during the period 2005-2010 include the following challenges to:

1. Improve access, equity and retention
2. Improve quality assurance
3. Increase flexibility and responsiveness to meet market demand and the priorities of the national development agenda
4. Increase diversity in programmes and forms of delivery
5. Increase efficiency & effectiveness by rationalizing existing resources, improving management systems, and diversifying sources of finance.
6. Corporate Governance, e.g. regulatory mechanisms for policy implementation, facilitating regional integration and international cooperation, etc.
7. National level Institutional challenges:
 - Inadequate funding and inappropriate funding mechanisms
 - Maintenance of infrastructure, equipment, ICTs and facilities
 - Leadership development & planning capacity

8. General national Human Capital challenges identified across all sectors, e.g. brain drain, conditions of service and innovation, addressing gender and societal imbalances, curricular reforms, capacity building and re-skilling.

The current and future position of education for sustainable development (ESD) in Zimbabwe is guided by the following logical model that consolidates the Zimbabwean experiences during the period 2005-2010, and which model has the following 4 pillars shown on Figure 10.

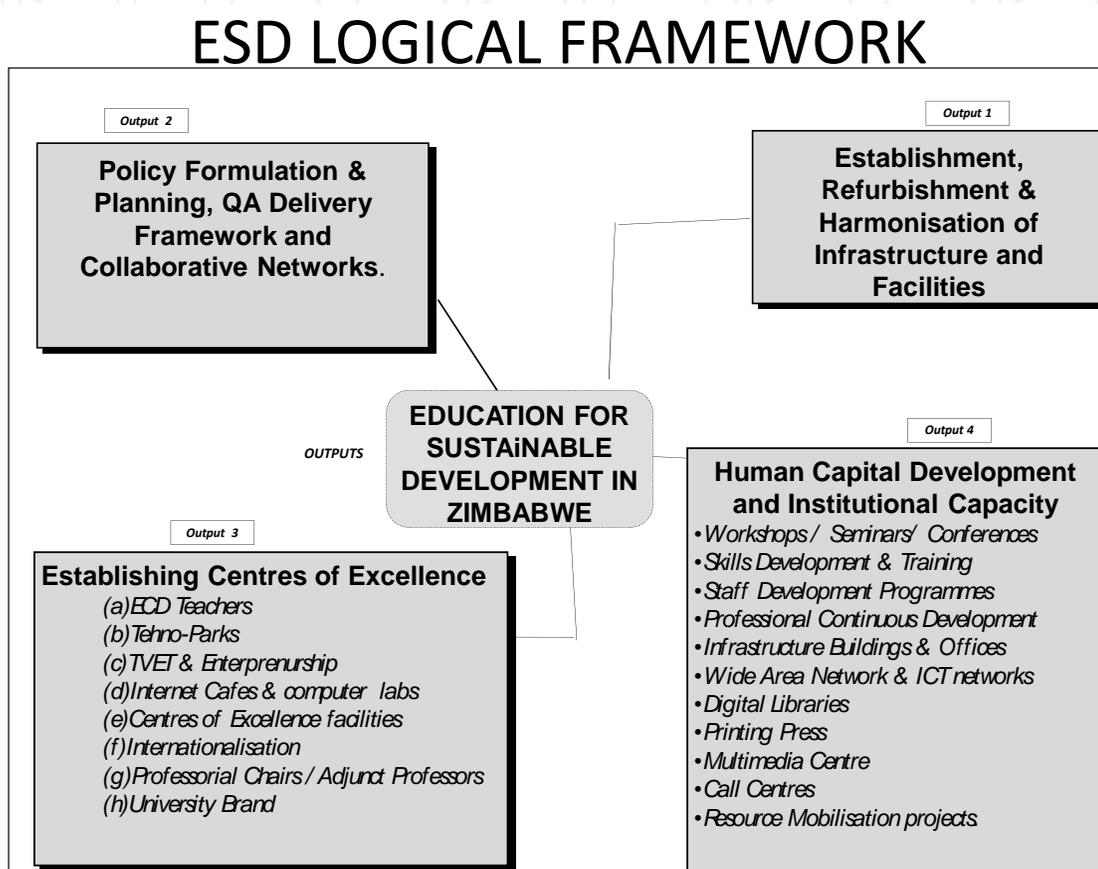


Fig. 10. The ESD Logical Framework for Zimbabwe

ESD in Zimbabwe provides a balance between human capital and social capital. Emphasis on social relationships *counteracts excessive individualisation and longer-term perspective* into policy-making. In the Zimbabwean context of ESD, social capital reintroduces a *moral dimension* into educational and economic thinking. The solution to the human capital development challenges in Zimbabwe is a long-term sustainable strategy. In 2011, the University of Phoenix Research Institute produced a 19-page publication (http://cdn.theatlantic.com/static/front//docs/sponsored/phoenix/future_work_skills_2020.pdf.) which indicated the following ten skills for the future workforce:

- Sense-making
- Social Intelligence
- Novel and adaptive thinking
- Cross-cultural competency

- Computational thinking
- New-media literacy
- Transdisciplinarity
- Design mindset
- Cognitive load management
- Virtual collaboration.

6. Conclusions

Knowledge-driven sustainable development requires relevant and efficient development knowledge. Zimbabwe, like other African countries, should establish African Knowledge Systems (AKSs) from which knowledge policies may precipitate. To some extent, knowledge for sustainable development is something knowable, modelable, reformable and manageable through effective knowledge policies (Hamel, 204). However, sufficient understanding of knowledge in the context of an African knowledge corpus and AKSs brings some completeness in the achievement of sustainable growth and development. The knowledge frontiers for sustainable growth and development are categorised into the following three areas:

- Knowledge for modernization and development
- Indigenous and traditional knowledge, and
- Faith-based knowledge.

Zimbabwe is faced with the following three major sustainable development problems that require knowledge frontiers as a solution:

1. Attainment of the Millenium Development Goals (MDGs)
2. Poverty reduction
3. Social problems value chain

This exciting wave of new knowledge provides knowledge opportunities for the sustainable development of the African continent, perhaps through adequate knowledge policies. The major problem of under-development characterised by the huge challenge to achieve the Millennium Development Goals (MDGs) is on knowledge empowerment supported by Information and Communication Technologies (ICTs). Rich in human capital and natural resources, Zimbabwe can achieve sustainable growth and development.

The perspective on knowledge as a sustainable resource for development indicates that knowledge is a necessary condition for sustainable development in various constructed environments. Economic environments require full access to modern and efficient development knowledge. Knowledge can also be viewed alongside a continuum: data – information – knowledge – wisdom. Development knowledge refers broadly to the totality of representative mental or abstract structures and constructions related to sustainable development. Future economic competitiveness is premised on knowledge management. Zimbabwean organisations have been implementing knowledge management initiatives. Knowledge elicitation is a special kind of knowledge acquisition where the source of information is the human expert and a knowledge engineer. The use of information technology to exploit knowledge management has become a topical area.

Knowledge frontiers for the major research problem can be the solution for sustainable growth and development, presented as sub-themes.

1. **Indigenous Knowledge Systems**
 - African Knowledge Systems (AKSs) &
 - African Indigenous Knowledge Systems (AIKS)
2. **Transformational Leadership**
 - *Transactional leadership vs Transformational leadership*
3. **Open and Distance Learning and Graduate Employment**
4. **Ethics and values**
5. **Emerging Technologies**
6. **Entrepreneurship and Community Engagement**
7. **Intellectual Property and Heritage**

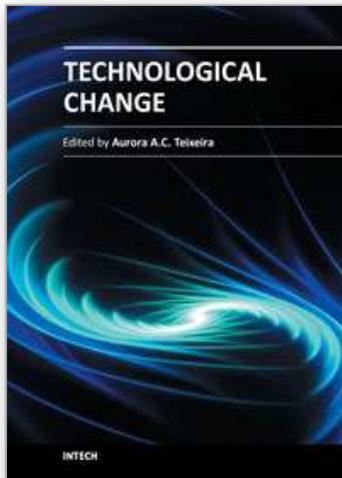
The way forward for sustainable development in Zimbabwe is on:

- Promotion of technology development, transfer and diffusion to Africa and further develop technology and knowledge available in African centres of excellence;
- Supporting African efforts to develop affordable transport systems and infrastructure that promote sustainable development and connectivity in Africa;
- Leadership development & planning capacity;
- Enhancing science, technology and enterprise (SMEs) development;
- Harmonisation & development of Private Public Partnerships (PPPs), and
- Utilisation of Human Capital.

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Technological change is today central to the theory of economic growth. It is recognised as an important driver of productivity growth and the emergence of new products from which consumers derive welfare. It depends not only on the work of scientists and engineers, but also on a wider range of economic and societal factors, including institutions such as intellectual property rights and corporate governance, the operation of markets, a range of governmental policies (science and technology policy, innovation policy, macroeconomic policy, competition policy, etc.), historical specificities, etc. Given that technology is explicitly taken up in the strategies and policies of governments and firms, and new actors both in the national and international arenas become involved, understanding the nature and dynamics of technology is on demand. I anticipate that this book will decisively contribute in this regard.

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