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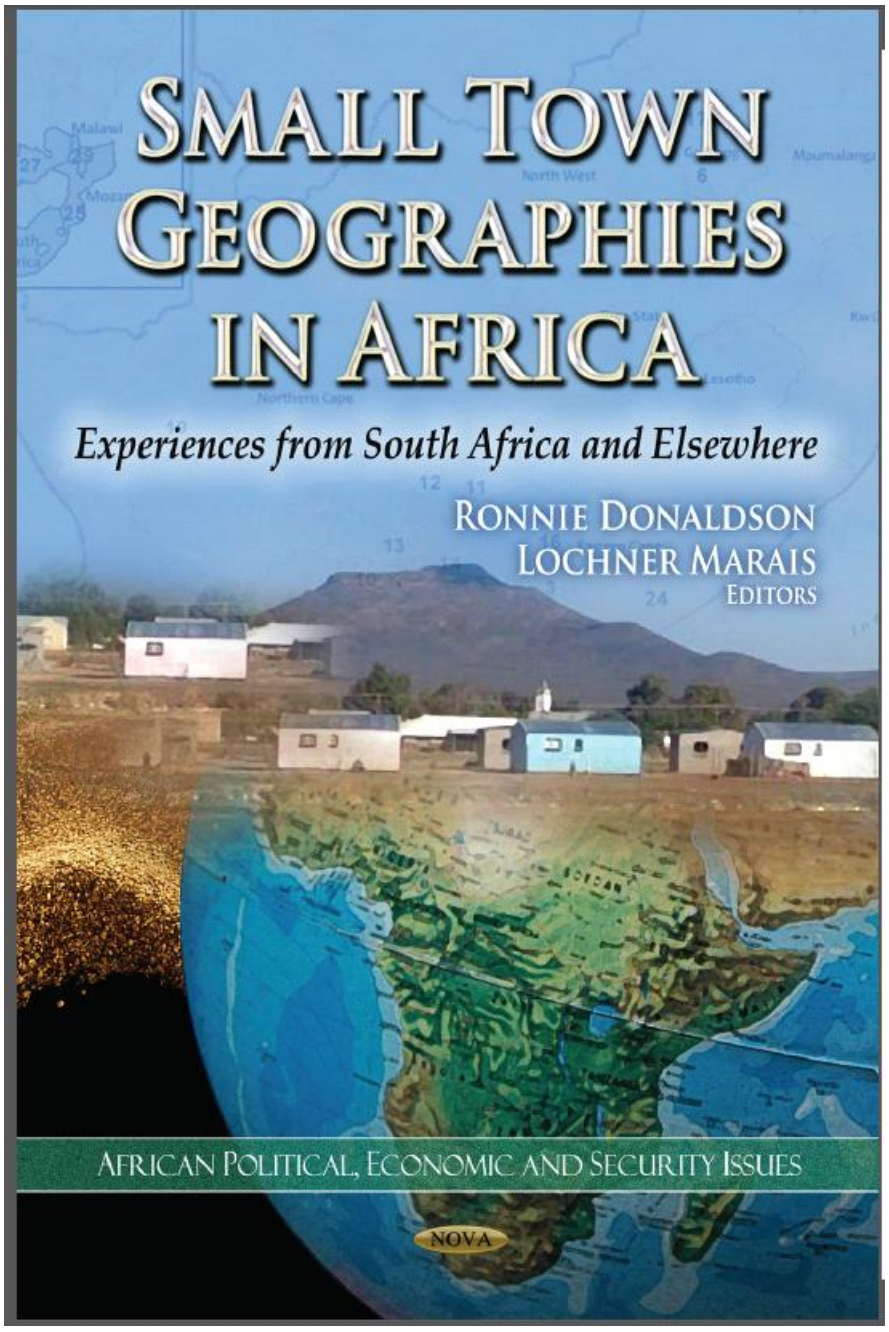

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AFRICAN POLITICAL, ECONOMIC, AND SECURITY ISSUES

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In: Small Town Geographies in Africa
Editors: Ronnie Donaldson and Lochner Marais
ISBN: 978-1-62100-001-3

Chapter 4

RETHINKING SUSTAINABILITY OF SMALL TOWNS: TOWARDS A SOCIO-TECHNICAL APPROACH

André Pelser, Alta van der Merwe and Paula Kotze

INTRODUCTION

Over the past few decades, issues such as stagnating and declining local economies, high levels of unemployment and poverty, and the out-migration of young, skilled and highly educated community members have taken their toll on the sustainability of small rural towns in Africa and elsewhere in the world. The declining economic function of such towns, often triggered by the demise of the core or dominant industry, results in numerous negative socio-economic and environmental consequences and so-called "ghost towns" (Pelser *et al.*, 2005).

Similar to elsewhere in the world, the South African rural landscape is dominated by economically undiversified, single-resource small towns that have rather bleak future development prospects. The overwhelming economic dependency on a single industry in such towns has resulted in descriptions such as the "company town syndrome" (Crabb 2002) and "the tyranny of single-industry towns" (Wolfe 1992). At the same time, single-industry towns form the backbone of resource economies, and therefore they often find themselves on the front line of both the creativity and the destructiveness that are unleashed by the extreme cycles typical of resource economies. Internationally, much has been written about the plight and crises of single-resource towns, especially those associated with the forestry, steel, chemical, paper and mining industries (Wolfe 1992; Nigel 1993; Norcliffe 1995; Phillimore & Bell 2005). Such towns enjoy rapid growth following the discovery of a new resource, but they are abandoned with equal haste when the resource runs out or when the industry falls victim to market fluctuations (Barnes, Hayter & Hay 2001). The monopolistic character of a large-scale operation often means that there are no competing industries in these towns to fill the gap in the absence of the core industry (Crabb 2002; Wolfe 1992),

Considering current trends in technology and the modern-day realities of a knowledge economy, the challenges faced by small, single-industry rural towns will worsen in years to come. Very few, if any, of these towns have the fiscal means to reverse their declining economic situation, despite the influx into some of these communities of younger, well-

educated and creative persons, including "bohemians" such as artists and crafters (Petrov 2008). Their dependency on and symbiotic relationship with a single-resource industry cause small towns to be ill-prepared to compete in a modern knowledge economy, because their economies are undiversified and particularly vulnerable to any negative impact. Municipalities and other decision makers must therefore have information about the impacts of the single industry (in this case, mining) on both the social and bio-physical environments in order to formulate appropriate policies and promote the sustainable development of their respective towns. Such a database of information provides the basis for making the best possible predictions and decisions about the socio-economic impact of the respective industry on the local community. Thus, decision makers can quickly and pro-actively position and steer the town towards sustained development and growth in the period following the demise of the core industry.

This chapter suggests that a socio-technical approach (STA) can support decision-making, enhance economic diversity and foster sustainable economic development within small, single-resource towns. For the purposes of this chapter, the concept *socio-technical* describes a multidisciplinary and interactive collaboration between the social sciences and information technology. Using the case of mine closure at Koffiefontein in the Free State Province of South Africa, it is argued that the optimisation of proactive economic and social development in small towns requires a systems approach that allows for continuous information capturing. This can then be used to mitigate and manage the impact of single-industry demise and enhance the social and economic sustainability of such towns. Conducting regular assessments of local socio-economic dynamics and tapping into the socio-economic information base of local agencies and stakeholders (such as a mining company), can provide a longitudinal database of social and economic status before, during, and after the various stages of mine development. This information base on "what is" can be used to introduce development initiatives that diversify and propel economic sustainability. In other words, intelligent tools can assist role players to more efficiently manage complexity and change within the affected town and to create a more sustainable economic environment.

The remainder of this chapter unfolds in four sections. Section 2 briefly explains the methodology used to gather information for the case study, while section 3 portrays the challenges of single-industry demise, economic diversification, and proactive planning in single-resource towns. Section 4 examines the small mining town of Koffiefontein as a case study that exemplifies the challenges of many single-resource towns in the face of a resource economy in decline or demise. Section 5 investigates the status of local government in the context of single resource towns and amidst the many challenges that municipalities face in such environments, while section 6 offers a framework for using intelligent tools to support decision-making in small towns. The proposed approach promotes continuous information capturing that will enhance initiatives aimed at economic diversity and propel sustainable development in small, single-resource towns such as Koffiefontein.

METHODOLOGY

This chapter draws mainly on the findings of a social-impact assessment (SIA) that was conducted in 2004-2005 prior to the closure of the Koffiefontein Mine (Pelser *et al.*, 2005).

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The SIA is supplemented by a literature review that reflects developments subsequent to the completion of the initial study in 2005. The SIA utilised a mixed methodology, gathering primary data by means of public meetings, interviews with key informants and interested and affected parties (I&APs), focus-group sessions with stakeholders, and a comprehensive stakeholder survey.

The main purpose of the SIA was to record the concerns of affected stakeholders and to determine the nature of impacts likely to result from mine closure. To capture information from all affected parties, the Koffiefontein social environment was divided into three broad sectors: the local economic sector, the public sector and the community sector. I&APs were identified and targeted within each of these broad sectors as well as several subsectors. The probable impacts of mine closure on the Koffiefontein environment were realistically projected by means of scenario simulation and linear extrapolation, as per recognised SIA methodology. The projected impacts were also informed by similar developments elsewhere in the world and in South Africa and by aggregated consensus of the various role players, including the professional members of the project team. Secondary data were obtained mainly from official records and historical documents.

The socio-technical approach (STA) outlined in this chapter complements the initial SIA. It argues that the inclusion of intelligent tools will enable policy makers to more efficiently manage the complexity of impacts and changes in a single-resource environment by allowing for continuous information capturing in the affected environment. The STA approach is based on a combination of systems-thinking principles and organisational learning theory.

THE CHALLENGES OF MINE CLOSURE AND ECONOMIC DIVERSIFICATION IN SINGLE-RESOURCE TOWNS

Mine closure affects communities in both the developed and the developing world. The 1960s in particular saw a significant decrease in mining operations in developed countries, accompanied by millions of job losses. Almost simultaneously, however, new mining operations increased dramatically in developing countries, with a surge in mining investments in the 1960s, 1970s and 1980s (World Bank 2002). Many of these mines are now approaching the end of their operating lives. At the turn of the century, the World Bank predicted that at least 25 large mines in developing countries would be closing by 2015 – with large-scale impacts on the local and national economies of affected countries (World Bank 2002).

Studies of previous mine closures have revealed that such closures have severe impacts on the socio-economic fabric of areas reliant on the mining industry. This is even more so in small "company towns". Towns that depend on mining as a mono-industry are hit the hardest because the town's economic base disappears upon closure of the mine (Laurence 2002). Strongman (2000:13) observed that "mine closure is often traumatic for local communities – especially in remote areas if local government is weak, labor productivity and non-mining income are low and labor mobility minimal". Kuyek & Courmans (2003) echo the same sentiment by pointing to the fact that the higher the dependency on the mining sector, the higher the social impact when the mine closes. Single-resource towns whose economies are predominantly reliant on mining are therefore particularly vulnerable in the face of the progressive demise of mining operations.

Mine closure deals the municipalities of affected environments a dual blow. On the one hand, local government is severely hit by the loss of the local tax base when the mine and other businesses close (Nel *et al.*, 2003), while on the other hand, the sudden unemployment of a large part of the community can lead to a dramatic increase in the number of people needing government support. In other words, in addition to the income and revenue base of the municipality decreasing, the service demands and expenditure obligations of the municipality simultaneously increase (Strongman 2000). In addition, the municipality must still maintain its infrastructure. Downsizing of communities to accommodate the reduced number of inhabitants is possible, but quite difficult, as various systems and facilities such as water and sanitation would have to be modified to serve only a pre-selected area. As municipalities face the double blow of maintaining infrastructure and dealing with an increased number of indigents while simultaneously losing a large part of their revenue, provincial and even national financial assistance becomes imperative (Wolfe 1992).

Upon mine closure, communities often continue to utilise mine-related infrastructure such as drinking water systems. However, these facilities could eventually break down because of a lack of maintenance. Local government is forced to take over the operation and maintenance of these facilities to ensure adequate service standards. Simply handing over mining infrastructure to local government rarely produces the desired results because local government is often not capable of maintaining the assets (World Bank 2002).

Liljenas (in Nel *et al.*, 2003) identifies four stages of local response to mine closure that can help a town's economy recover. Firstly, the community attempts to preserve existing economic life. This is followed by the second stage: economic diversification, which entails finding and expanding existing, alternative local jobs. The third stage involves the development of new economic activities, such as small-, medium- and microenterprise (SMME) development, tourism, etc. Once this has happened, the fourth stage consists of the affected town moving to high-technological sectors. It remains questionable whether small, rural, mono-industry towns that depend on mining will be able to carry out such changes.

Economic diversification of affected areas is the key element in successful mitigation strategies. Keyes (1992) identifies two kinds of economic diversification: vertical and horizontal. *Vertical diversification* in mining-dependent communities means the expansion of the economic base through mining-related activities such as processing, transportation and the mining of other commodities. This form of diversification perpetuates the dependency of a community on the mining and mining-related sectors. The second kind of economic diversification, *horizontal diversification*, aims at creating activities in entirely different economic sectors, for example in manufacturing, agriculture, or forestry. This kind of diversification is considered to be a more appropriate mitigation strategy in that it lessens a community's dependency on the mining sector. It is therefore important to establish before the mine closes whether there are any secondary industries or economic mainstays in the affected environment that residents are able to rely on (Nel *et al.*, 2003).

In the event of mine closure, the local economy has to absorb a large number of unemployed people. The economic environment should therefore be reshaped to enable it to accommodate the unemployed (Cronje 2000). Local Economic Development (LED) initiatives and Integrated Development Plans (IDPs) should aim to promote horizontal diversification and lessen mine dependency. Research conducted internationally, however, has shown that very few LED initiatives have significant positive effects (Nel *et al.*, 2003). At the same time, it should be borne in mind that LED initiatives might not create sufficient jobs

immediately, but in the long term, the potential impact of these initiatives on the local economy is crucial for the towns' survival.

As mentioned, LED strategies such as economic diversification, SMME development, credit provision and business-development assistance for entrepreneurs, and training and skills-development programmes only have an effect over a long period of time. Even using these strategies, local systems have limited capacity to react to the phenomenon of sudden large-scale job losses (Haney & Shakaratan 2003). In contrast to *local* economic development, Seidman (1993) argues that the only way to prevent economic disaster in an affected area is through large-scale job creation. He claims that retraining mine workers will not be sufficient as there are no local jobs available to retrained workers. He also claims that in most cases, LED strategies will not suffice, as few former miners are likely to be able to sustain independent small businesses. Therefore, traditional economic development techniques without the necessary local growth will not result in sustainable employment opportunities.

The ultimate survival of mining communities in the event of mine wind-down or closure is determined by the successful development of alternative local economic activities (Nel *et al.*, 2003). However, faced with a dramatic decrease in revenue and income and an increase in demand for services from residents, local government must be assisted with revenue stability initiatives in order to have the capacity to play a role in redefining the town's economy. Unfortunately, the reality is that the development of alternative economic activities is often low on the agenda of small towns during the life-span of the mine; it is left for the period *after* closure (Pelser *et al.*, 2005).

Even more problematic, in the absence of an information base of "what is" and "what can be", local authorities and stakeholders in small, single-resource towns struggle to introduce development initiatives that will ensure economic diversity and sustainability in the aftermath of mine closure. As demonstrated in the case study of the Koffiefontein mine closure below, an information base of this nature is a prerequisite for the effective management of the socio-economic impact associated with the demise of a mono-industry in a single-resource town. More importantly, such an information base can serve as an important tool to assist stakeholders and policy makers to plan proactively for alternative economic opportunities during the *operating life* of the mine instead of waiting until the mine closes.

THE PLIGHT OF A SINGLE-RESOURCE TOWN: THE CASE OF MINE CLOSURE AT KOFFIEFONTEIN

Koffiefontein is a small rural town with a population of approximately 12 000 people. It is situated on the banks of the Riet River in the southern part of the Free State Province of South Africa. The first diamonds in the area were discovered in 1870 on a farm that was later purchased by the *London and Orange Free State Exploration Company* when the Koffiefontein kimberlite pipe - i.e. a long, vertical volcanic rock pipe best known for sometimes carrying diamond ore - was discovered in 1880. A town soon developed around the mining activities. Following the registration of the claims of diamond diggers in 1881, Koffiefontein was officially recognised as a town in 1892, making it the second oldest town in the Free State (Kontrei 2004). The history of Koffiefontein has ever since been intrinsically

intertwined with the history of the international diamond market and with the related history of mine closures.

The Koffiefontein diamond mine has been shut down and reopened on a number of occasions during its 130-year history, due completely to external economic factors. The mine first came under the control of De Beers Consolidated Mines (DBCM) in 1911, after which mining operations continued intermittently until stopping in 1932 due to the depression (Diamond Fields Advertiser 1987). Between 1932 and 1950 the mine was not in use. DBCM resumed sampling operations in 1950, but withdrew again in 1953. It was only in 1971 that the mine was once more fully operational. In 1982 the mine closed yet again as a result of the depressed state of the diamond market, and it was maintained only on a care-and-maintenance basis. Upon closure of the mine in 1982, 1 200 employees were retrenched (Diamond Fields Advertiser 1987). The vicissitudes of the mining industry have clearly been part and parcel of the economic ups and downs of Koffiefontein.

Table 1 depicts the pre- (1980) and post-closure (1985) populations of Koffiefontein, clearly illustrating the out-migration of the town's population as a result of mine closure and the subsequent loss of job opportunities. Three years after the 1982 closure, Koffiefontein had almost one-third fewer people than in 1980. Table 2, on the other hand, shows that the resumption of mining operations in 1987 had the opposite effect on the town's population. The re-opening of the Koffiefontein mine in 1987 caused the total population of the town to increase by more than 105% – from the pre-opening total of 4 247 residents (1985) to 8 722 people in 1991 (Pelser *et al.*, 2005; Table 2).

Table 1. Pre- and post-closure population of Koffiefontein: 1980 and 1985

Total population 1980	*1982 Mine closure*	Total population 1985	Population change 1980-1985
6 046		4 247	-29.75%

Source: Statistics South Africa ,2004.

Table 2. Pre- and post-resumption population of Koffiefontein: 1985 and 1991

Total population 1985	*1987 Mining operations resumed*	Total population 1991	Population change 1985-1991
4 247		8 722	105.36%

Source: Statistics South Africa, 2004.

Starting in 2001, however, the mine began operating at a loss of R100-R150 million per annum as a combined result of depleting ore reserves and the strong exchange rate of the South African rand against the US dollar (Matthews 2006). It became clear that yet another mine closure was imminent, particularly when 132 mine employees were granted voluntary severance packages in December 2002 and December 2003 (Pelser *et al.*, 2005). The mine closed at the end of 2005, and a total of 329 workers were retrenched. Although only 5% of the town's labour force had been employed by the mine, the buying power of the mine and its

employees contributed a substantial amount to the Koffiefontein economy, and mine closure again caused a series of negative economic impacts. After lengthy negotiations, DBCM sold the mine to Petra Diamonds, which resumed production in late 2006. The new owners believe that the Koffiefontein mine will continue to yield diamonds for another 10-20 years, mainly because the cost structure of Petra Diamonds is significantly lower than that of DBCM (Matthews 2006). In the absence of any meaningful diversification of the local economy, however, the prospects for the town's long-term survival and sustainability are dim.

In the event of future mine closure, almost all I&APs expect increased unemployment and a decreased population size due to out-migration, with a resulting decrease in the general quality of life. Approximately 62% of municipal officials were of the opinion that it would not be worthwhile staying in Koffiefontein if mining operations were discontinued. Fifty-eight percent of the business sector, 55% of (then) mining employees and 41% of the residential sector were of the same opinion (Pelser *et al.*, 2005). Members of the business sector also expressed concern about the likelihood that a rapidly declining population would lead to a decrease in purchasing power and property values. The erosion of the consumer base would also lead to a decline in income for the business sector and eventually to the downscaling of many businesses in town. Approximately 52% of surveyed businesses indicated that they were either *entirely* or *very* dependent on the mine or mine employees for an income. This confirms that horizontal diversification of the local economy is minimal and that the local population is thus very vulnerable in the event of a drastic impact such as mine closure. Mine closure will also unavoidably lead to the downscaling of mine-related and mine-dependent businesses and inevitably to increased unemployment. This will result in a decrease in municipal revenue and an erosion of the municipality's ability to render services.

Demographic data gathered at the time of the SIA revealed much about the vulnerability of the local population to socio-economic impacts triggered by mine closure. Eight percent of male heads of households in Koffiefontein were above 65 years of age, while 19% of female heads of households were above 65 years; as many as 11% of all Koffiefontein households were headed by pensioners. Only 20% of the population of employment age had jobs, and 57% of the town's population was living in poverty, despite the fact that the mine and supporting businesses employed a large number of the local residents (Pelser *et al.*, 2005).

During previous mine closures, increased unemployment resulted in a dramatic rise in poverty levels with serious implications for people's health – particularly for vulnerable groups like the elderly, women, and children (Mathye, Botha & Brand 2003). Mine closure also increased the vulnerability of groups such as women, children, the elderly and HIV/Aids-affected households due to the loss of income and social services. Safety nets for these groups should therefore be established either by government or by the mining company. Persistently high unemployment increases social ills such as crime, violent crime, alcoholism, child abuse, female abuse, and family violence and breakdown (Mathye, Botha & Brand 2003). High levels of alcoholism, unemployment and poverty are also breeding grounds for the spread of the HIV/Aids virus, similar to what is happening elsewhere in the Free State Province and the country.

Despite the mine downscaling in recent years, formal employment opportunities in the Koffiefontein area are still largely limited to the mine, mine-related business, retail, the local municipal council and the civil service (Pelser at al. 2005). The challenge for Koffiefontein is to ensure that, upon final closure of the mine, costs to the community are minimised while benefits are optimised. Mining is such a pervasive part of life in Koffiefontein that any

proposed termination of mining activities is likely to produce extensive social and economic impacts. The gathering of relevant social and economic information on a continuous basis is thus crucial to ensuring that socio-economic impacts are managed proactively. In order to manage the impacts of mine closure, the stakeholders must have a sound knowledge of the strengths, weaknesses and development opportunities embedded in the socio-economic environment. This calls for continuous information capturing of current and changing dynamics and opportunities through collaborative efforts of all I&APs. The primary agent responsible for facilitating a diversified economy is the local municipality. Therefore, the chapter now turns to a more detailed assessment of local government and particularly of human capacity at this level.

THE MUNICIPALITY AS GOVERNING STRUCTURE

In South Africa, the lowest division of the democratically elected government structure is the local municipality. According to the 16th Amendment to the Constitution, the objectives of local government are "to provide democratic and accountable government for local communities; to ensure the provision of services to communities in a sustainable manner; to promote social and economic development; to promote a safe and healthy environment; and to encourage the involvement of communities and community organisations in the matters of local government" (SA Government 2010). It is explicitly stated that a municipality must "structure and manage its administration and budgeting and planning processes to give priority to the basic needs of the community, *and to promote the social and economic development of the community*" [italics added] (SA Government 2010).

In the Local Government: Municipal Systems Act 32 of 2000 (Government Gazette 2000), an entire chapter is devoted to the Integrated Development Plan (IDP). This chapter stipulates the contents of an IDP as well as the process for planning, drafting, adopting and reviewing IDPs. The Act clearly states that it is the responsibility of the municipality to draft a development plan that will foster *local economic development (LED)*. The question must then be raised as to whether the necessary capacity exists in local municipalities.

In addition to fostering LED, the elected council members are also responsible for local services such as electricity, water and infrastructure. However, they are often not properly trained in how to carry out local government's mandate and obligations. In order to enhance competence at the local level, government provides various training programmes and grants for the capacity building of council members (Standing Committee on Appropriations 2010). The Development Bank of Southern Africa (DBSA), one of the agents of capacity building, has also committed itself to supporting municipalities in order to maximise the impact of development finance in South Africa. According to the DBSA (2001), its mission is achieved through the delivery of:

Funding: capacity-building funding through grants.
Expertise: mobilisation and deployment of technical and financial experts for infrastructure project implementation.
Development facilitation: technical support and sharing of knowledge.

The *Standing Committee on Appropriations* (2010), however, alludes to the fact that municipalities lack planning capacity. The South African Local Government Association (SALGA) (2005) echoes a similar sentiment by stating that it is necessary to address the poor skills base, lack of career-path opportunities, lack of skills-development programmes, and under-investment in technical, management and leadership skills in municipalities. A lack of capacity at the local government level seems to seriously hamper the development and implementation of IDPs. This in turn hinders the creation and implementation of initiatives towards a more diversified economy and places the long-term sustainability of any single-resource town in jeopardy.

SUPPORT FOR COMPILING THE INTEGRATED DEVELOPMENT PLAN (IDP)

Small-town municipal councils face many challenges, including lack of management skills. Innovative thinking regarding economic development and diversification of the town's economy is often not a high priority, since there are many other crises to address. Most of these towns face major challenges in providing the basic infrastructure to the community; it is therefore understandable that the IDP does not always enjoy the priority that it deserves. In 1993, the Education Training Unit (ETU) suggested a five-phase approach to compiling an IDP (ETU 1993). The proposed approach is shown in Table 3.

Table 3. Summary of the IDP approach suggested by ETU (1993)

Planning phase	Activity	Means of participation
1. Analysis	Information is collected on existing conditions within the municipality. The analysis focuses on the types and causes of problems faced by people in the area.	• Community meetings organised by the ward councillor • Stakeholder meetings • Surveys and opinion polls (getting views on how people feel about a particular issue).
2. Strategies	The municipality works on finding solutions to the problems assessed in Phase 1.	• IDP Representative Forum • Public debates on what can work best in solving a problem • Meetings with affected communities and stakeholders
3. Projects	The municipality works on the design and content of projects identified during Phase 2.	Stakeholder representation on project subcommittees
4. Integration	After confirming that the objectives set out in Phase 2 have been met, the development plans must be integrated.	IDP Representative Forum
5. Approval	The IDP is presented to the municipal council for consideration and adoption. The council may adopt a draft for public comment before approving a finalised IDP.	Public discussion and consultation with communities and stakeholders
Monitoring and Implementation	The project is monitored.	IDP Representative Forum

In addition to the trainings mentioned in the previous section, there are also specialised training programmes available for municipal managers involved in development planning. In 2009, SALGA and the South African LED Network (2009) presented an extensive series of courses addressing eight different areas related to IDPs. However, we have been unable to find any evidence that these programmes were repeated in 2010. This may be because the sponsored programmes failed to deliver the expected outcomes (Standing Committee on Appropriations 2010).

MUNICIPALITIES AS LEARNING ORGANISATIONS

The previous sections of this chapter demonstrated that single-resource towns are struggling for sustainability and survival, a situation that is even more serious in the current economic climate. This is especially true of towns dependent on industries such as mining, which depend on international trade and are particularly vulnerable to external factors such as fluctuations in the exchange rate. In the previous paragraphs an overview was provided of local municipalities' responsibilities in regards to economic growth and the rules laid down by government with regard to development programmes. In this section, it is argued that municipalities should approach economic development as a learning organisation and from a systems-thinking perspective.

According to Senge (2006), the primary threats to human survival emanate not from sudden events, but from slow, gradual processes. One of the challenges facing organisations and societies is that the system-wide consequences of decisions may stretch over years or even decades. It is therefore important that the focus of those entrusted with managing a single-resource town should not be limited only to short-term benefits. In fact, local authorities must realise that some impacts will only materialise in the future and that the current council may not witness all the benefits of a decision. No municipality can stimulate innovation and economic growth in a single-resource town if the focus is solely on short-term management activities at the expense of long-term planning.

Senge (2006) further argues that organisations (in this case municipalities) should have a systems-thinking approach to innovation. Systems thinking is the process of understanding how various factors influence one another within a whole. Problems are viewed as part of the overall system rather than as isolated parts, outcomes or events. Taking this big-picture view helps avoid potential unintended consequences. Systems thinking is based on the theory that an organisation or society should recognise patterns and understand what causes such patterns. The argument is that informed decisions and long-term gains are possible only if these patterns are understood. In other words, single-resource towns should be managed as "learning organisations" that reutilise existing patterns and knowledge to make the informed decisions necessary to facilitate long-term economic growth. The reuse of captured information can play an important role in strategic initiatives to diversify the economy of single-resource towns. A socio-technical approach (STA) is proposed next as a good method to capture the relevant information.

TOWARDS A SOCIO-TECHNICAL APPROACH (STA) TO LOCAL ECONOMIC DEVELOPMENT

Theoretical Principles

One of the major breakthroughs in learning organisations has been the use of mental models. Models are used in various domains; an *enterprise model*, for example, describes the objectives pursued by an enterprise (Rolstadas & Andersen 2000). Wilson (1990:11) defines a *model* as "the explicit interpretation of one's understanding of a situation, or merely of one's ideas about that situation. It can be expressed in mathematics, symbols or words, but is essentially a description of entities, processes or attributes and the relationships between them". Curtis *et al.* (1992) define a model as an abstract representation of reality that excludes much of the world's infinite detail. Models are used for three purposes: to describe reality, to explain the past and present, and to predict and control the future (McNamara 1996). It is impossible for people to "carry all the information" of an organisation in their heads (Senge 2006), and therefore models assist people to record what they know (to explain the past and present) and to take action accordingly (predict and control the future).

One way of capturing and storing the models within an organisation is a repository. A *repository* is defined by Von Wedel & Marquardt (2007:535) as "a central storage system for models from various sources represented in various formats". The value of this tool is that information is stored in only one location, simplifying access to the information and increasing its reusability. Using well-developed software to manage the repository results in benefits such as lower costs (since information is captured only once) and time saved on recapturing and remodelling existing information. Based on the concept of systems thinking (Figure 1), the focus of the STA approach is to store "what we know" in a single storage space (repository) and to reuse this information during decision making.

As shown in Figure 1, there are three main sources of information that are stored in the repository. This repository assists in decision-making, strategic planning and during the compilation of IDPs. The information itself as well as the models that encapsulate the information should be captured in the repository (illustrated on the left-hand side of Figure 1):

- Demographic and socio-economic profiles of the affected community and current and previous development initiatives of the specific single-resource town.
- Information from the core industry such as the mining industry (if available).
- Examples from other single-resource towns that successfully managed to stimulate economic diversity. This enables the compilation of an inventory of best practices and lessons learned.

In addition to the different sources of information, there are also different *modelling concepts* (Figure 1) that provide guidelines for capturing information into the repository. These mechanisms should specify *what* information should be captured and *how* it should be captured. One such model is the harmonisation cube, which is used by the Living Lab researchers (Mulder, Velthausz & Kriens 2008) (Figure 2). The Living Lab approach "represents a research methodology for sensing, prototyping, validating and refining complex

solutions in multiple and evolving real-life contexts" (Mulder, Velthausz & Kriens 2008:2). This approach differentiates between six perspectives that stimulate innovative information gathering: *user involvement, service creation, infrastructure, governance, innovation outcomes and methods and tools*. Each perspective is represented on one face of a Rubik's cube, and each face of the cube is divided further. The three rows of each face facilitate interoperability by representing the different developmental phases of a Living Lab including setup, sustainability and scalability. The different aspects of a Living Lab are reflected in the cube's three columns, i.e. the organisational, technological and contextual issues (Mulder, Velthausz & Kriens 2008).

As an alternative, Zachman's (1987) framework allows for different perspectives by describing any object (an enterprise, a department, a value chain, a town, etc) in terms of six different descriptions or abstractions (Zachman 2007): *what, how, where, who, when* and *why* (Figure 3). Each of these descriptions can be viewed from a different perspective (row), depending on the level of modelling. At the highest level, where the scope of the task is defined, the focus is on the planners or strategists. The requirements defined on the higher levels are implemented in physical applications on the lower levels. In a single-resource town, this lower level could consist of software used to extract information from the repository for decision-making.

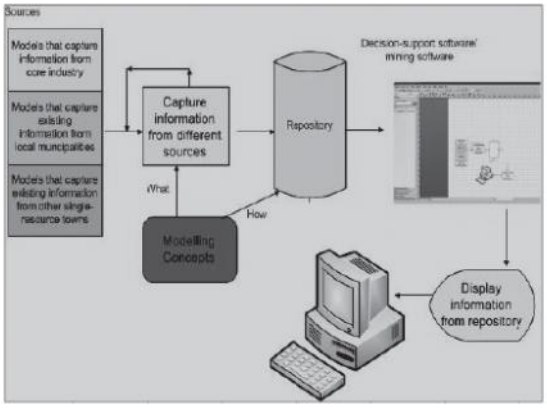

Figure 1. An STA approach for the reuse of existing information.

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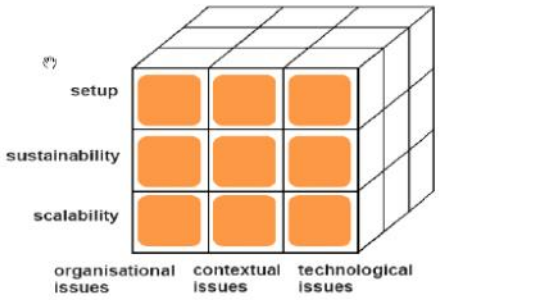

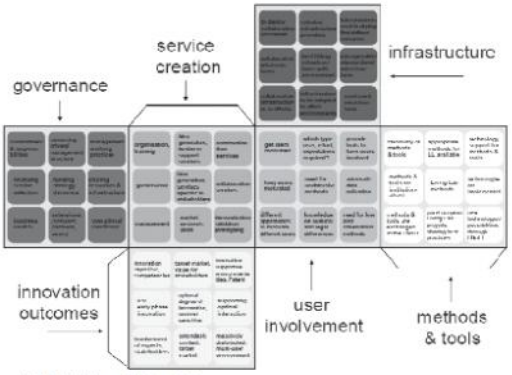

Source: Mulder, Velthausz & Kriens 2008.

Figure 2. The Living Lab Harmonisation Cube.

	What	How	Where	Who	When	Why	
Scope	Inventory identification	Process identification	Network identification	Organisation identification	Timing identification	Motivation identification	Strategists as theorists
Content Business concepts	Inventory definition	Process definition	Network definition	Organisation definition	Timing definition	Motivation definition	Executive leaders as owners
System logic	Inventory representation	Process representation	Network representation	Organisation representation	Timing representation	Motivation representation	Architects as designers
Technology Physics	Inventory specification	Process specification	Network specification	Organisation specification	Timing specification	Motivation specification	Engineers as builders
Component Assemblies	Inventory configuration	Process configuration	Network configuration	Organisation configuration	Timing configuration	Motivation configuration	Technicians as implementers
Operations Instance Classes	Inventory instantiation	Process instantiation	Network instantiation	Organisation instantiation	Timing instantiation	Motivation instantiation	Workers as participants
	Inventory sets	Process transformations	Network nodes	Organisation groups	Timing periods	Motivation reasons	

After Zachman International, 2010.

Figure 3. Six different descriptions.

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APPLICATION OF THE SOCIO-TECHNICAL APPROACH (STA): THE CASE OF MINE CLOSURE AT KOFFIEFONTEIN

Koffiefontein is the headquarters of the Letsemeng Local Municipality. In its Municipal Turnaround Strategy (Letsemeng Municipality 2010), the municipality allocated an amount of R300 000 for the development of an LED strategy and implementation plan (including a Tourism Development Plan) and a further R50 000 for the establishment of a functional municipal LED forum. Other LED focal areas of the municipality are a coordinated SMME development plan, the registration of SMMEs as cooperatives, the establishment of a reviewed organogram, a training plan, a reviewed Spatial Development Framework, a commonage management plan and a youth development strategy.

The LED plan contained in the Municipal Turnaround Strategy includes the towns of Koffiefontein (the municipal head office), Jacobsdal, Luckhoff, Oppermansgronde and Petrusburg. Considering the survey data regarding the current status of Koffiefontein (presented in Section 4), it is imperative that the Letsemeng Local Municipality realise the urgency of the situation in Koffiefontein. Diversification is urgently needed in order to make the town sustainable after final mine closure in the next ten to twenty years. An STA as suggested in Section 6 would enable the town to make informed decisions based on information from different sources. One of the modelling concepts, such as the Zachman Framework or the Living Labs Harmonization Cube, could be used as a guideline for capturing information in the repository (Figure 4). For illustrative reasons, it is assumed that the IDP team in the case study described below used the Zachman Framework and therefore focused on the six descriptives of *what, how, where, who, when* and *why* as a guideline for capturing information in the repository.

According to the suggested STA approach, the first source of data to be included in the repository is Petra Diamonds. By law, mine industries must continuously provide feedback on data related to the impact of the mine on both the environment and the town's development. The Mineral and Petroleum Resources Development Act (28 of 2002), for instance, regulates the process by which a mining right is granted and stipulates that an application for a mining right must also contain a Social and Labour Plan. Such plans should include information about the social and economic background of the area in which the mine operates, the key economic activities of the area and the impact that mining operations would have on the affected community. The Act further states that the closure of a mining operation is "a process which must start at the commencement of the operation and continue throughout the life of the operation" (Pelser *et al.*, 2005:6). It is therefore explicitly recognised that minerals are non-renewable natural resources, and that preparing for mine closure is an inevitable and continuous responsibility of the holder of a mining right – in Koffiefontein's case Petra Diamonds.

In order to maximise the usefulness of the information captured in the repository and to conduct comparative studies from the different sources, it is important that the IDP team specify the information that needs to be captured from the different sources. Using the Zachman descriptives as a guideline, the IDP team may focus on questions such as: *What* are the demographic trends in the affected area, and *what* is driving these trends? *How* are these demographic trends impacting the socio-economic and financial sustainability of the business sector and the municipality? *Where* will inhabitants of Koffiefontein relocate to in the case of

mine closure? *Who* are the community members that are most likely to leave the town? *When* is the mining operation at Koffiefontein likely to be terminated permanently?

The second source of information for the repository is the town itself. The local municipality already has data about the current economic and socio-demographic status of the Koffiefontein community. Again using the Zachman Framework as a guideline, the IDP team should respond to questions such as: *What* processes and factors are hampering economic development in the town? *What* initiatives are currently driving the town's economic development? *How* was vertical economic diversification previously promoted in Koffiefontein? *What* are the latent processes that have an impact on the economic sustainability of Koffiefontein? *Who* are the most vulnerable members of the Koffiefontein community? *Why* did previous attempts at economic diversification not have long-lasting results?

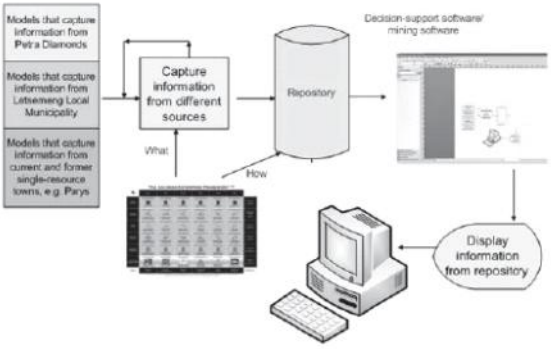

Figure 4. STA applied to the Koffiefontein case study.

The third source of information is former single-resource towns that successfully managed to diversify their economies. Koffiefontein needs to investigate how towns experiencing a similar crisis managed to change their economic profile to become more sustainable. The towns of Parys in the Free State and Cullinan in Gauteng are two examples of communities whose economies once revolved primarily around servicing the agriculture or the mining sectors. Following the decline of these sectors, the economic sustainability of the two towns has been strengthened by various initiatives that promoted tourism, arts, culture, and lifestyle living for retired and affluent people. Once again using the Zachman Framework as a guideline for what should be modelled, one could ask: *What* actions did former single-resource towns take to overcome their social and economic impediments and embark on a more sustainable future? *How* did other single-resource towns achieve horizontal diversification of their economies? *Where* are these towns located and *why* did they

successfully diversify? *How long* did it take other single-resource towns to diversify their economies? *Who* were the primary drivers and facilitators of successful initiatives towards economic diversification?

All this information should be captured in a single repository and updated continuously to enable the LED team to make informed decisions about the type of development that will promote sustainability. The development of front-end data mining or decision-support software is necessary to allow this information to be used in the creation and management of IDPs. Once the information is captured within the repository, the models should be provided and explained to decision makers so that they can understand the impact of mine closure and compare the town's current situation with similar scenarios elsewhere. The IDP management team should have the information necessary to make informed decisions and answer the following questions: *How* does the socio-economic profile of Koffiefontein differ from the profiles of other single-resource towns that have successfully diversified? Compared with these other towns, *what* are the strengths and weaknesses of Koffiefontein as it moves towards diversification?

CONCLUSION

This chapter has proposed a socio-technical approach (STA) underpinned by continuous information capturing. This approach enables the IDP management team in single-resource towns to have the information necessary to promote economic diversification. Utilising a systems-thinking approach, it was argued that single-resource towns are learning organisations that could benefit by drawing on existing information about the town itself, its core industry and other single-resource towns that have successfully diversified. Although an introduction to the STA concept was presented, it could be further refined and developed. Future research could develop the decision-support software that would assist single-resource towns in the decision-making process. Given the human capacity constraints in municipalities, additional research into issues of human-computer interaction (HCI) is also necessary. If towns such as Koffiefontein follow the suggested approach outlined in this chapter, they will be better able to successfully diversify their economies and avoid, or at last significantly mitigate, the economic collapse that too often results from mine closure.

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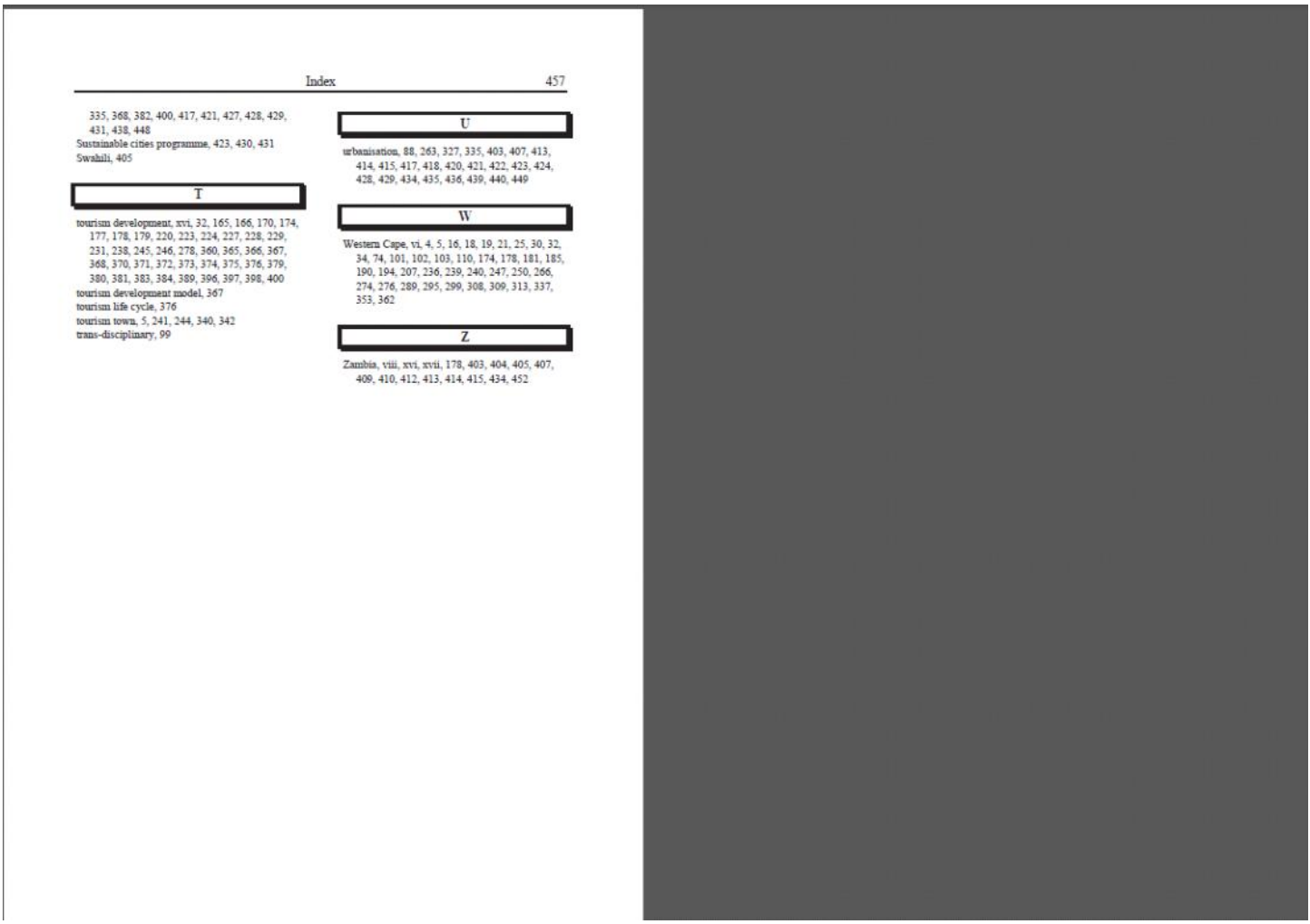

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