MINEWORKERS' QUALITY OF LIFE IN REMOTE COMMUNITES: A MULTIPLE CASE STUDY IN THE BRAZILIAN AMAZON

by

Silvana Dunham da Costa

B.A., Universidade Federal da Bahia, 1996
M.Env.Des., University of Calgary, 2000

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ABSTRACT

The mining industry has long played a significant role in regional development in remote regions throughout the world. For the last two decades, the industry has faced high expectations regarding sustainable development and corporate social responsibility, particularly in remote and environmentally sensitive areas. Mining community models and mineworkers' accommodation strategies in remote locations have varied greatly, yet there has been little documented reflection on the various models' performance or on their implications for the quality of life (QOL) of mineworkers and their families and for the pre-existing local communities.

This multidisciplinary case study research used a subjective quality of life approach to investigate the levels of satisfaction with QOL and specific aspects of QOL domains in three communities: the *company town*, the *gate development community* and the *integrated community*. The triangulation of data from qualitative and quantitative methods was used to examine the major QOL factors that should be taken into account by mining companies, local governments and policy makers when planning for mine development in remote areas.

Findings of this research suggest that differences exist between the mineworkers' levels of satisfaction with specific QOL aspects and how QOL predictors are defined in distinct mining community models. Even though the case studies represent three clearly different models of mining communities, in general, mineworkers in all three communities seem to be only moderately satisfied with their quality of life. It is also suggested that employees living in two almost opposite models—the company town and the gate development community—seem to have similar levels of satisfaction with overall quality of life, suggesting that the investment in infrastructure and services limited to the boundaries of the company town is not reflected in a generally improved perception of overall quality of life in this community.

Findings also support the argument for an environmental and social impact assessment process for new mines in remote areas. This process should include a full and integrated consideration of the economic, environmental and social impacts of the workforce migration to remote areas and the consequent intensification of the already rapid urbanization of environmentally sensitive areas such as the Brazilian Amazon.

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GLOSSARY

AQOL: Average quality of life

CVRD: Companhia Vale do Rio Doce (Vale)

DIFN: Diretoria de Ferrosos (Ferrous Metals Division)

DIOC: Diretoria de Operações de Não-ferrosos de Carajás (Non-ferrous Metals Division)

HDI: Human Development Index

LAW: Life as a whole

IBAMA: *Institute de Meio Ambiente e Recursos Naturais Renováveis do Brasil* (Brazilian Institute for Renewable Natural Resources)

PWI: Personal Wellbeing Index

QOL: Quality of life

QWL: Quality of work life

SWB: subjective wellbeing

SWI: Subjective Wellbeing Index

WHO: World Health Organization

WHOQOL: World Health Organization Quality of Life

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CHAPTER 1: INTRODUCTION

1.1. Problem Statement

The mining industry has long played a significant role in regional development in rural and remote regions throughout the world. More recently, the industry has been challenged with social expectations regarding sustainable development and corporate social responsibility, particularly in remote locations. Mining community models used by the industry in remote locations have varied greatly throughout history, from paternalistic company towns to fly-in-fly-out remote mine camps (Storey 2001; Costa, 2004). Over time, there has been little documented reflection on and analysis of the various models' performance or the implications they have for the quality of life of mineworkers and families living in these communities. In Brazil, this is also reflected in a general lack of coordinated and defined policy on frontier development (Godfrey, 1990; Hecth and Cockburn, 1990; Palheta da Silva 1998).

In the last century, significant mining activity has occurred in the world's frontier regions, such as the Canadian North and the Brazilian Amazon, and has often resulted in the prosperity of communities and corporations alike. However, economic prosperity and development often occurred with little formalized consideration for the wellbeing of the people and communities that fuel and provide critical support to the mining industry. The International Institute for Environment and Development's Mining, Minerals and Sustainable Development (MMSD) Project's South American Regional Report concluded that mining is necessary for the strategic development of countries such as Brazil, Peru, Chile and Bolivia. However, the report also points out that there is a clear need to reconsider where and how mining development takes place. Specifically, MMSD's South American Regional Report indicates that one of the priorities for the mining industry in Latin America should be making a more direct and equalitarian contribution to local development (Mining Minerals and Sustainable Development, 2000). In many parts of the world, the resource industry's lack of consideration for social and economic local development has resulted in communities with low urban standards, challenging living and working conditions and considerable psychological stress (Burvill, 1975; Riffel, 1975; Beach, 1999; British Columbia & Yukon Territory Building and Construction Trades Council, 2004; White, 2004; Costa et al., 2005; Sibbel et al., 2006).

Individuals and families in remote mining communities constitute a particular sociological group living under unique geographical and socio-cultural circumstances. Isolation from relatives and friends and the typically limited resources and opportunities for family members of mineworkers are some of the distinct disadvantages of these communities (Riffel, 1975; Sharma and Rees, 2007). Challenges such as harsh environmental conditions, feelings of isolation and inadequate social stimuli are significant for employees and families in remote mining communities (Riffel, 1975; Storey, 2001) and have resulted in cases of depression and incipient neuroses (Burvill, 1975), as well as high rates of divorce among mineworkers in such communities (Sharma and Rees, 2007). Other challenges identified in the resource community literature include inadequate housing, services and facilities, the predominance of single men and the absence of female companionship, inadequate educational and medical services, and few opportunities for employment for married women (The Institute of Local Government, 1953; Riffel, 1975; Neitzert et al., 1999; Storey, 2001; Sharma and Rees, 2007).

Traditionally, human wellbeing has not been a critical consideration in decision making during mine lifecycle planning. Mineworkers' accommodations (e.g., company towns, community-based housing, permanent and temporary mine camps and mineworker hostels) tend to be secondary planning concerns, subordinate to operations, and historically have not received much consideration[1] (Riffel, 1975; Bray, 1991; Costa, 2004). Decisions and investigations on workforce accommodations are mainly based on economic performance measures (Skaburskis, 1980; Bottge, 1986;) and, to a certain extent, on considerations such as the supply and local availability of skilled workers and training needs (Costa and Scoble, 2006). Decisions regarding the settlement mode chosen are typically made by the company, with little or no involvement of the workers and people who eventually will live or spend considerable amounts of time in these communities or camps (Canada Employment and Immigration Advisory Council, 1987). This trend is clearly observed in the Brazilian Amazon (Almeida, 1986; Perz, 2000; Godfrey, 1997; Hecth, 1990; da Silva, 1998; Barros et al., 2002).

Even though mineral development is consistently accompanied by economic development and wealth creation, pre-existing local communities affected by mining development often do not

[1] In Canada, a surge of research and reflection on the resource community seems to have started in the 1950s, upon the recognition of the severe shortcoming of this model of frontier development (e.g., Bancroft, 1975; Robinson, 1962; The Institute for Local Government, 1953). The recognition of the need to make life in resource communities more appealing was reflected in the development of towns with high levels of consideration for physical standards, such as Leaf Rapids in Manitoba in the 1970s and Tumbler Ridge in British Columbia in the 1980s (Costa, 2004).

participate and share in economic prosperity brought about by mineral exploitation in a meaningful way. Thus, they have experienced only marginal positive impacts on their wellbeing and quality of life (Weitzer, 2006). These communities have, however, often lived with the negative social and environmental impacts of such operations (Cleghorn, 1999; McAllister and Wismer, 1999; Veiga et al., 2001; Remy and McMahon, 2002; Dreyer and Myers, 2004) and shaped by powerful forces of metropolitan-based corporations (Bowles, 1982).

Decisions regarding mineworkers' settlements and accommodations, and the interface between the workforce and the existing local communities, are critical to the sustainable development of remote regions (Costa and Scoble, 2006) and reflect a company's commitment to corporate social responsibility. Particularly in the developing world, the socio-economic characteristics of remote locations often are such that large industrial development projects attract large numbers of migrants to these communities. Most of these migrants come from poverty-stricken areas or neighboring countries, and they often have no relevant training. Small and remote communities worldwide are often not prepared—physically, socially or culturally—for such rapid and dramatic growth and change. This phenomenon is apparent in the Brazilian context (de Castro et al., 1995) and is also evident in many other areas throughout the world (de Castro et al., 1995; McMahon and Remy, 2001; Weber-Fahr, 2002; Weitzer, 2006). As stated by Veiga et al. (2001), mining companies' attention to the surrounding social environment has historically been focused on reducing conflicts and complying with legal requirements rather than on the local communities' long-term sustainability.

The quality of life—that is, the level of wellbeing of residents and the suitability of the physical environment—in remote mining communities around the world significantly impacts the industry's ability to attract and retain high-quality employees in these areas (Costa and Scoble, 2006). Satisfactory quality of life is also expected to promote higher productivity and efficiency and better health and safety performance of operations (Bancroft, 1975; Riffel, 1975; Costa et al., 2005).

The rapid growth of mining development, along with the global shortage of skills and training[2] (Canadian Mining Industry Human Resources Council, 2005), makes it increasingly necessary to

[2] According to the Canadian Mining Industry Human Resources Council, the mining industry is facing a human resources crisis, the effects of which are both global and long term, significantly impacting the ability of mining companies worldwide to attract and retain skilled workers (Canadian Mining Industry Human Resources Council, 2005).

identify the ideal conditions for employee wellbeing and investigate ways to improve the quality of life of miners and their families in remote locations. It is imperative that mining companies and governments recognize that their decisions impact not only the industry's ability to fulfill mining workforce needs, but also the efficiency and health of the workforce and their families, as well as the sustainability of the local existing communities. It is critical that companies and government agencies involved in evaluating and permitting large-scale mines consider, from the earliest stages of mine planning, the human and social implications of mine development, particularly in remote locations. A significant change in practice is needed to favor the adoption of a new approach to planning the development of resource-based communities, an approach that focuses on human wellbeing.

1.2. Rationale

The Núcleo Urbano de Carajás, Parauapebas and Canaã dos Carajás, located in the Brazilian Amazon, presented an opportunity for a close examination of the quality of life in remote mining communities. These communities were considered suitable for this research because:

- they represent 3 different mining community models;
- they support operations of a single company; and
- they are located in relatively close proximity to one another.

Different mining community models offer distinct implications for the quality of life of mineworkers and their local communities. This research borrows its definition of mining community from Bowles (1982): "a community is the base camp or general headquarters where individuals engaged in work meet (as best they can) their daily needs for shelter, food, and rest so that they may work again another day." The purpose of this particular definition is to emphasize the diversity of settlements in which individuals working in mining may live.

In the context of this research, 3 mining community models were examined: the *company town*, the *gate development*[3] and the *integrated community*. Respectively, these models represent three distinct approaches to mineworkers' accommodations: the paternalistic approach of a company-controlled community (in which all housing and facilities are owned and operated

[3] Gate development refers to an informal settlement located adjacent to the entrance gate of the mine property. This term makes no reference to "gated communities", which denotes a community with high level of security, usually accessible thorugh a gate.

directly or indirectly by the company); the "hands-off" approach (in which the company avoids intervention and allows for the local government and market forces to dictate the quality of the social and physical environment); and the collaborative approach, resulting in an integrated community development (in which the company works in partnership with the local government to provide for adequate development of the community). The 3 communities hence provided a unique opportunity to investigate the implications of these distinct approaches to mining communities and compare their impacts on the quality of life of mine employees in remote locations.

The three case study communities are associated with three large-scale mining projects: Carajás Iron-ore Mining Complex, Azul Manganese and Sossego Copper Mine. These three operations are owned and operated by a single mining company, Vale[4]—the largest Brazilian mining company and the second-largest diversified mining company in the world (Vale, 2007b). The single ownership is considered an advantage to this research as it is reflected in similar work and corporate cultures in the three communities and workforces.

The fact that the 3 communities are located in a similar geographical location implies that environmental and political contexts are largely similar to one another, and it provided for short travel times between communities and thus more efficient use of limited research funds and time available.

1.3. Objectives and Research Questions

The objectives of this research are:

1. To identify and prioritize factors that can impact mineworkers' quality of life in remote mining communities;
2. To identify opportunities to improve mineworkers' quality of life in the communities investigated;
3. To develop a quality of life framework that can be integrated into life-cycle planning of new operations in remote areas worldwide; and

[4] In 2007, the Companhia Vale do Rio Doce (CVRD) announced its global brand unification and as of November 29th 2007 it is identified as *Vale* (Vale, 2007).

4. To develop a quality of life monitoring tool that can be used in remote mining communities.

To reach the above objectives, this research examined mineworkers' perceptions of quality of life in 3 case study communities to answer the following research questions:

1. What appear to be the main factors that impact the quality of life of mineworkers in the Núcleo Urbano de Carajás, Parauapebas and Canaã dos Carajás?
2. How differently do mineworkers living in these 3 communities perceive their quality of life?
3. What appear to be the most and least satisfying aspects of the quality of life in these communities?
4. How do the mineworkers' characteristics appear to impact their perceptions of their own quality of life?

1.4. Approach: Subjective Quality of Life

Subjective quality of life, or subjective wellbeing, is the theoretical approach for this research. The rationale for this approach is based on the limitations of externally measured quality of life evaluations and the need for deeper and more holistic measurements of quality of life as perceived and experienced internally by individuals. Quality of life researchers have defended this conceptual approach since the 1970s (e.g., Dalkey 1972; Andrews and Withey, 1976).

The relevance of subjective quality of life also lies in the evidence that the more people become satisfied with their lives, the more they contribute positively to society. It has been widely argued that "happy" people have identity integrity, ego strength, mental maturity, inner control, social ability, activity and perceptual openness. Happiness and satisfaction lead people to become actively involved in society; positive perceptions of wellbeing free people to be creative and foster better social relationships; enjoyment of life fosters activity, strengthens social bonds, and preserves health (Veenhoven, 1991). Thus, to promote social and societal development, we need to enhance people's perceptions of their quality of life—in other words, their subjective wellbeing (Sirgy, 2002).

The Subjective Wellbeing approach considers a human-focused framework that can be used to support decision making regarding workforce accommodations and settlements that support natural resources development in remote areas. This framework takes into consideration the

wellbeing of workers, their families and their relationships with the local communities, and can be applied in other investigations of remote mining communities throughout the world.

Subjective Wellbeing has been the approach taken by several quality of life studies, and several subjective wellbeing instruments have been created (e.g., Diener et al, 1985; Cummins, 1996; The International Well Being Group, 2005). A review of the literature and close examination of these instruments was critical when defining the conceptual model for this research, particularly regarding the definition of the quality of life domains and indicators adopted in this research.

1.5. Applied Contribution of Research

Large-scale mining activity has long been an engine of development and employment of countries rich in natural resources, such as Canada (Robinson, 1962; Cranstone, 2002), Australia (Barnett, 1979) and Brazil (Koshiba and Pereira, 2006). However, the mining sector has also had to deal with negative public perception of its activities. Mining is an industry that has been widely perceived as a producer of a great deal of pollution. It has also been viewed as dangerous and negligent in protecting the health and safety of its workers and communities close to mining operations (Hilson, 2000; Richards, 2002; Schiavi, 2005). The early 1900s saw substantial efforts towards advancing mineworker health and safety (Hilson, 2000; Richards, 2002; Schiavi, 2005; National Institute for Occupational Safety and Health, 2008). Even though performance varies significantly from country to country, the mining industry of the 21st century has made some significant progress in health and safety performance (Hilson, 2002; National Institute for Occupational Safety and Health, 2008).

The next revolutionary industry transformation occurred in the 1980s in response to growing environmental management and protection requirements. As a direct result of new regulations, intricate environmental and waste management systems were created. In addition, reclamation and mine closure procedures were taken into greater consideration. Today, there is evidence that the mining industry around the world is continuing to take steps to reduce its environmental footprint and ensure that land can be used in a productive and safe manner after mine closure (Hilson, 2002; Hodge, 2004).

Since the early 1990s, the mining industry has faced the challenge of understanding and earning a “social license” to operate (Joyce and Thompson, 2000; Costa and Scoble, 2005; Kogel, 2006). The social license to operate concept implies the consideration of societal expectations that go

beyond workforce health and safety and environmental management. A social license to operate includes corporate social responsibility requirements, such as extensive community consultation, shared decision making and more equitable distribution of the costs and benefits of mine development (Joyce and Thompson, 2000; Kogel, 2006; Business for Social Responsibility, 2007). In this context, there is a need for companies to significantly change their approach to planning and developing mines in remote locations. There is also a need for changes in how government policy addresses mine development in remote areas.

This research is timely with regards to the evolution of the global mining scenario. Mine development is experiencing a significant boom worldwide, particularly in countries where operations in remote locations are or will become increasingly common, such as Canada, Brazil and Australia. Mining companies and governments need to define appropriate approaches to development in remote areas whilst struggling to address the challenges of recruitment and retention of mining workforces. Combined with the typically high turnover rates in remote operations (Bancroft, 1975; Riffel, 1975; Bowles, 1982), the current skills shortage represents a human resources crisis for remote mining operations. A negative perception of the quality of life in remote mining communities compromises the industry's ability to attract and retain high-quality employees in remote areas (Bancroft, 1975; Riffel, 1975) and, arguably, the industry's ability to acquire and maintain a social license to operate.

This research examined, through the perspective of mineworkers, the major quality of life factors that should be taken into account by both mining companies and policy makers when planning for mine development in remote areas. It thus provides a human-focused framework that can be used to support decision making in planning and implementing workforce accommodation strategies in remote areas, and a tool to monitor the performance of these strategies. Both the evaluation framework and tool include quality of life domains and indicators that could be applied to a range of settlements and accommodations options.

Locally, this research also makes important contributions specific to the case study communities. It identifies factors that most impact the quality of life of mineworkers in each of the case study communities and examines the perspective of mineworkers to identify key areas of concern. Findings from this research are expected to provide for better-informed mining community development strategies to improve quality of life in these communities. The discussion of results provides some clear directions and identifies opportunities for specific interventions locally. It is also expected that findings will inform Brazilian policy makers and local governments that will

benefit from the identification of opportunities to address challenges related to quality of life in remote resource communities in the Amazon.

With specific regards to the context of the 3 case study communities, Vale needs to address the challenges of recruitment and accommodations in the Brazilian Amazon as the company prepares for the future development of up to 5 more mines[5] and one hydrometallurgical plant in the same geographical region (Vale, 2007b). The most recently established community, Canaã dos Carajás, is expected to serve as the major centre for the development of these upcoming mines. It is intended to serve as a locus for the housing, education and health care for the mining workforce for several decades to come. Moreover, since Vale has recently expanded into a major global mining company through the purchase of Inco, a major Canadian mining company, it needs to address similar challenges at varying levels and in very different geographical and cultural contexts, such as Canada, the Pacific island of New Caledonia, the United Kingdom, the United States and countries throughout Asia.

1.6. Academic Contribution of Research

Findings from this research complement the body of knowledge on resource communities and quality of life. This research contributes to the existing body of quality of life (QOL) literature by providing an evaluation of QOL in 3 case studies of resource communities in remote locations that were examined through a subjective wellbeing lens.

This research intends to demonstrate how the subjective wellbeing approach can be integrated into lifecycle planning of new natural resource operations in remote areas. The research also intends to identify opportunities for positive intervention in existing resource communities. According to a recent publication on the past, present and future of the QOL movement (Sirgy et al., 2006), one of the critical needs in QOL research is to improve the applications of its findings. Few interventions based on research findings have taken place because policy makers tend to rely on objective social indicators. Significant tasks that remain to be completed in subjective quality of life research is a systematic approach to the assessment, the translation of the findings

[5] Vermelho (Ni) expected start-up2008; Alvo 118 (Cu) expected start-up 2008, Cristalino (Cu/Au) expected start-up 2010, Salobo I (Cu/Au) expected start-up 2009, Salobo II expected start-up 2011, and Alemão (Cu/Au) expected start-up year 2011. A hydrometallurgical copper plant is also expected to process concentrate from Salobo II and Alemão (Vale, 2007b).

into practical applications and the development of an index of subjective quality of life indicators to compliment the existing social indicators already in use by policy makers (Sirgy et al., 2002).

This research used a qualitative case study approach. Findings are not expected to provide definitive answers or solutions to broad quality of life theoretical inquiry. Findings are, however, expected to contribute to an improved theoretical understanding of the quality of life and the subjective wellbeing concepts. Specifically, findings are expected to provide insights on quality of life domains and indicators and the distinction between related constructs widely used in the applied and theoretical research: quality of life and life satisfaction. The quality of life domains and indicators stemming from this research are expected to contribute to existing quality of life theory as well as provide new hypotheses to be tested in future research. A new quality of life measurement tool is also a contribution to the field.

This research also adds to the understanding of the implications of 3 distinct models and approaches to the development and management of resource communities to human wellbeing in remote locations worldwide. Results from this research also provide hypotheses for further research and investigation of the factors and circumstances that are most relevant to the improvement of quality of life in remote resource communities in Brazil and elsewhere. This study also provided evidence of some demographic factors that influence perceived quality of life in remote mining communities. Of broader application are the relationships between satisfaction with quality of life and age, gender, educational level, marital status and number of children.

This research is a multidisciplinary case study undertaking which includes the triangulation of different sources of evidence. Lessons learned from its unique methodological strategy and specific methods are also expected to be of value for researchers intending to take similar approaches to future research.

1.7. Limitations of Research

This research includes qualitative and quantitative methods. A comprehensive discussion of the methodological strategy, including the limitations of specific methods is presented in Chapter 4.

One of the limitations of this research relates to the study population. Given that only current employees were research subjects, the framing does not include ex-employees or ex-residents who have left their jobs or moved away for reasons related to the quality of life in these

communities. Moreover, the researcher examined quality of life aspects in the 3 communities mostly through the lenses of the Vale employees, largely excluding individuals working for other companies and the unemployed population.

Time constraints and limited resources to complete the research are also considered limitations. Given a limited time frame to complete Phase III of the research, which included cross-sectional data collection through questionnaire and qualitative interviews, both methods were used concurrently. The implication is that unexpected findings or new hypothesis that could be developed from questionnaire or interview results in Phase III could not be further explored in Phase III. Further investigation of hypotheses emerging from qualitative or quantitative results of this research is recommended as future research.

1.8. Thesis Structure

This thesis is organized in 9 chapters. Figure 1.1 is a summary diagram that presents a roadmap to this thesis and is provided to guide the reader through this document.

Chapter 2 aims to discuss the context in which the research was conducted. It includes a description of the historical development of the Carajás Mining Province as a whole, as well as the 3 individual case study communities—Núcleo Urbano de Carajás, Parauapebas and Canaã dos Carajás. This chapter also includes a summary of each community's socio-economic and physical characteristics. The development of these 3 communities is directly associated with the development of the mining sector in the southeast of the State of Pará and of Vale's Northern System mines, so general information about mining development in the region and the company is also included.

Chapter 3 discusses the specific elements of the approach to this research, including a discussion of the subjective wellbeing approach. This chapter also includes a summary of a literature review on quality of life and subjective wellbeing, and discusses the most relevant and current quality of life measurement approaches, including tools that are particularly relevant to the methodological strategy of this research.

Chapter 4 explains in detail the methodological strategy adopted in this research, including qualitative and quantitative methods, and discusses the specific choices of research methods. This discussion includes the details of the 3 research phases: preliminary research

(comprehensive literature review and quality of life domain development), quality of life model development (validation of domains and development of indicators and a questionnaire tool) and data collection (intensive data collection through interviews and a quality of life survey questionnaire).

Chapter 5 presents the results from both the quantitative and qualitative analyses of the data collected for the research. The quantitative analysis refers to the data from the quality of life questionnaire, which was examined through statistical analysis. The qualitative analysis included the analysis of qualitative interviews with mineworkers and other residents in the 3 communities and participant observation notes.

Chapter 6 presents a discussion of the results achieved with the qualitative and quantitative analysis of the data collected for this research. It also shows the triangulation of these results with participant observation notes taken during 3 fieldwork periods. In addition, this chapter includes a discussion of the opportunities for intervention identified with this research. This discussion is aimed at mining companies operating in remote areas, local governments, and policy makers involved in environmental and social impact assessments of mining operations in remote areas.

Chapter 7 is the conclusion of this thesis and provides a concise summary of the main findings of this research. It includes an overview of how mineworkers living in the 3 case studies perceive quality of life.

Chapter 8 discusses the original contributions of this research to scientific knowledge and professional practice. It includes a discussion on the local significance as well as the scope of other implications of its findings.

Chapter 9 presents a discussion on opportunities for future research.

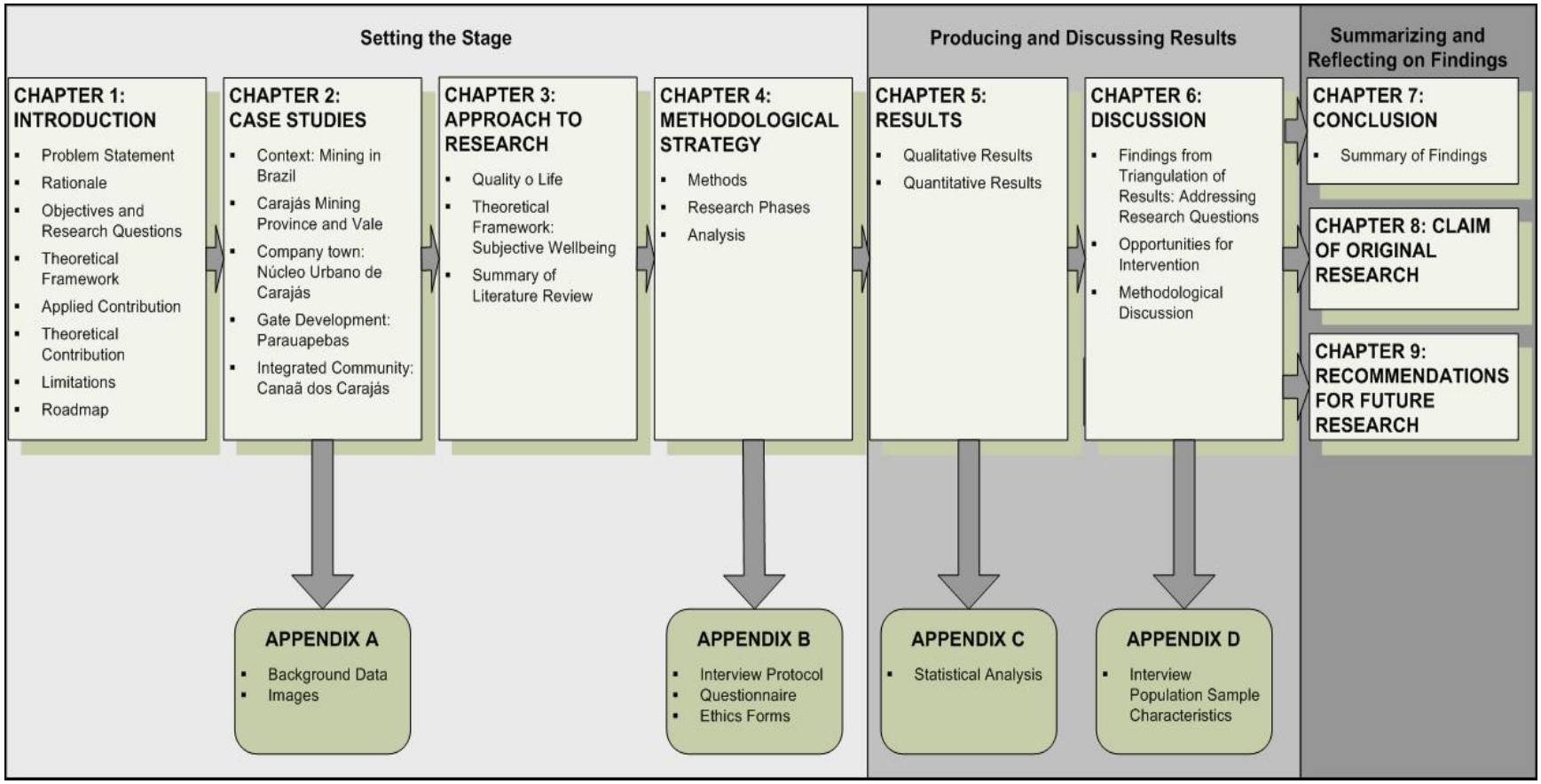

Figure 1.1: Thesis Roadmap

CHAPTER 2: CASE STUDIES

This chapter discusses the context in which this thesis research was conducted, providing an introduction to the historical development of the Carajás Mining Province as well as the 3 case study communities. Since the case studies are directly associated with the Vale mining operations, an overview of Vale and its significance in the Brazilian mining context is also included in this chapter.

The information in this chapter was compiled through a review of literature on the development of the southern State of Pará, particularly with regards to the Carajás Mining Province. Information in this chapter also reflects a comprehensive data-collection effort focused on statistical information available mostly through government-generated documents, such as census information and some Ministry-specific research and documentation. This data collection presented some challenges because of the limitations of the data. Specifically, because the Núcleo Urbano de Carajás is not an emancipated municipality, but part of the City of Parauapebas, statistical information specific to the Núcleo Urbano is fairly scarce. All data regarding population characteristics and services available in the community was supplied directly by Vale or through interviews with Vale personnel. Moreover, all census data obtained for Parauapebas include data from the Núcleo Urbano de Carajás.

Discrepancies also exist between data available for Parauapebas and Canaã dos Carajás. Until 1993, the village of Canaã dos Carajás was part of the Parauapebas municipality; therefore, census data available until 1993 aggregates Parauapebas and Canaã's information. Official demographic data for Canaã dos Carajás is only available starting at the 1996 census.

2.1. The Brazilian Mining Context

The great diversity of Brazil's landscapes and geological formations, partly attributed to the size of its territory—8.5 million km²—is one of the reasons why it has one the world's largest mineral potentials (Departamento Nacional de Produção Mineral, 2006).

Much like Canada, the mining industry in Brazil is responsible for significant development in remote regions and contributes considerably to the national economy. As in other parts of the world, the Brazilian minerals industry is experiencing substantial recent growth. From 2002 to

2005, the growth of the value of the Brazilian mineral production was of over 212%, from US$ 11.528.553 in 2002 to US$36.005.948 in 2005 (Departamento Nacional de Produção Mineral, 2006).

In spite of the large number of mining companies operating in Brazil, the sector is quite concentrated in most relevant segments, which has high levels of integration between the mines and the mineral processing industry (Departamento Nacional de Produção Mineral, 2006). In fact, an interesting feature of the Brazilian mining industry is the dominant presence of one large diversified mining company: Vale. This company has played a significant role in the regional development of its 2 major operational centers: the Southern System (including the states of Goiás, Minas Gerais, Espírito Santo and Rio de Janeiro) and the Northern System (including the states of Pará, Maranhão, Sergipe and Bahia), where Vale has large operations and a very complex and comprehensive logistics scheme and infrastructure.

In the Northern System, Vale operations include the largest iron-ore mining complex in the world. The Carajás Iron-ore Mining Complex, the Azul Manganese Mine, and the Sossego Copper Mine are all located in the south of the State of Pará. Appendix A includes a summary table with basic information, productivity and health and safety indicators for the 3 operations.

The Carajás Iron-ore Mining Complex began operating in 1984. The Azul Manganese Mine has been operating since 1985 (Vale, 2007b) and is not expected to operate for more than 30 years (Pinto, 2007). Both operations are located in the Carajás Mountain range, where the *Floresta Nacional de Carajás* (Carajás National Park) was established in 1988, within the boundaries of the Parauapebas municipality (Coelho et al., 2002).

The Sossego Copper Mine is the most recent mine in the Vale Northern System. It is also Vale's first copper project, and it is located about 75 kilometers from the Carajás National Park, in the City of Canaã dos Carajás. The expected mine life of the Sossego Mine is about 17 (Vale, 2005). Canaã dos Carajás is also where 3 of Vale's advanced exploration projects (copper, nickel and gold) are located (Vale, 2004).

In developing the comprehensive Northern System, Vale has taken different approaches to establishing the communities that support their operations in what used to be a vastly unexplored and undeveloped Amazon forest in the south of Pará. These communities were established in a context of extreme remoteness, with a lack of infrastructure and tremendous land disputes that

made the State of Pará notorious for violent land and access conflicts involving Aboriginal groups, small farming settlers, large property owners, timber and other forest resources harvesters, cattle ranchers and artisanal miners (Marín, 2003; Monteiro, 2003; Coelho et al. 2002).

2.2. The Development of the Carajás Mining Province

In the late 1960s, the world's largest mineral province was found in the Brazilian Amazon, in the south of the State of Pará. The detection of the various mineral deposits in the area followed intense oil exploration, manganese, tin and bauxite discoveries. American multinationals Union Carbide and US Steel were exploring for manganese in the Amazon rainforest and discovered what came to be one of the largest iron-ore deposits in the world. On July 31, 1967, Brazilian geologist Breno Augusto dos Santos, who was working for Companhia Meridional de Minerações (CMM) (a subsidiary of US Steel) was part of a team of geologists who landed in a clearing at the top of the Carajás Mountain range, where the ground had a visible overlay of iron-ore (Chadwick, 2005; Santos, 2006). Shortly after, the Brazilian government granted mineral rights to the then state-owned Companhia Vale do Rio Doce (CVRD). In 1970, CMM and CVRD became associated and started the exploitation of iron-ore, manganese and gold in the traditional territory of the *Xikrins do Cateté* Aboriginal peoples (Prefeitura Municipal de Parauapebas, 2005).

The discovery of the Mineral Province of Carajás was a milestone for the mining industry in Brazil. The estimated reserves in the Mineral Province of Carajás at the time of discovery were of 18 billion tonnes of iron-ore, 1 billion tonnes of copper, 40 million tonnes of bauxite, 60 million tonnes of manganese and 124 million tonnes of nickel (Chaves, 2004).

This massive mineral discovery started an exploration rush in the Central-West and Northeast regions of the Amazon which was supported by Australian, Peruvian and American technical expertise. By the 1970s, several federal organizations had been established to facilitate and regulate exploration and mining activity in Brazil while a multitude of national and international companies were implementing very aggressive exploration programs throughout the country.

The Carajás Iron-ore Project was a critical part of a large-scale federal development program that included mineral development as well as timber harvesting, agriculture, cattle ranching and the development of extensive infrastructure and logistics in a large area of the eastern Amazon, accounting for nearly 10% of Brazil's total land mass (Chaves, 2004). This program was

designed in the 1980s to develop and integrate the eastern Brazilian Amazon (Coelho et al., 2002) and was planned and partly implemented by the military government of Brazil.

The Carajás Iron-ore Project is one of the largest mining operations in the world. It is an integrated mail-railroad-port system, built and operated by Vale (Chadwick, 2005). It includes 5 open pits, and according to Chadwick (2005), it is expected to be in operation for over 4 centuries. The Carajás Iron-ore Project is situated in the heart of the Amazon rainforest—in the North region of Brazil—and is powered by the hydroelectric dam in Tucuruí (Chaves, 2004). The Project is located between the Tocantins and Xingu rivers, at an average altitude of 650 metres above sea level (Chadwick, 2005).

Figure 2.1 includes location maps that illustrate the geographical context of the case study communities.

2.3. The Mining Company: Vale

Vale originated in 1942 as the Companhia Vale do Rio Doce, a state-owned resource development company (Kury, 1992). As of early 2008, it is the largest mining company in Latin America and the dominant force in the Brazilian minerals industry. Throughout its 60-plus years of existence, Vale has expanded its operations in Brazil from the Southeast to the Northeast and Northern regions, always facing significant challenges regarding socio-economic and environmental impacts of its operations to the over 500 communities in Brazil where it operates (Coelho et al., 2002; Instituto Ethos, 2006).

Vale is present in 32 countries on 5 continents and operates in 13 of Brazil's 26 states (Vale, 2007a, 2007b). On October 24, 2006, Vale obtained control of Canadian nickel producer Inco Limited, the second-largest producer and the number one holder of nickel reserves in the world. On January 4, 2007, Inco Limited became a wholly-owned subsidiary of Vale (Vale, 2007b).

BRAZIL

SOUTHEAST PARÁ DETAIL: CARAJÁS AREA

Figure 2.1: Location Maps
Adapted from Governo do Estado do Pará (2007)

Vale is the largest producer of iron-ore and pellets (mostly used for steel production) and one of the largest producers of nickel. Vale also produces copper, manganese, bauxite, alumina, aluminum, coal, potassium and kaolin, products extensively used by the global industrial sector (Vale, 2007a). In the past, the company's Brazilian operations have produced significant amounts of gold.

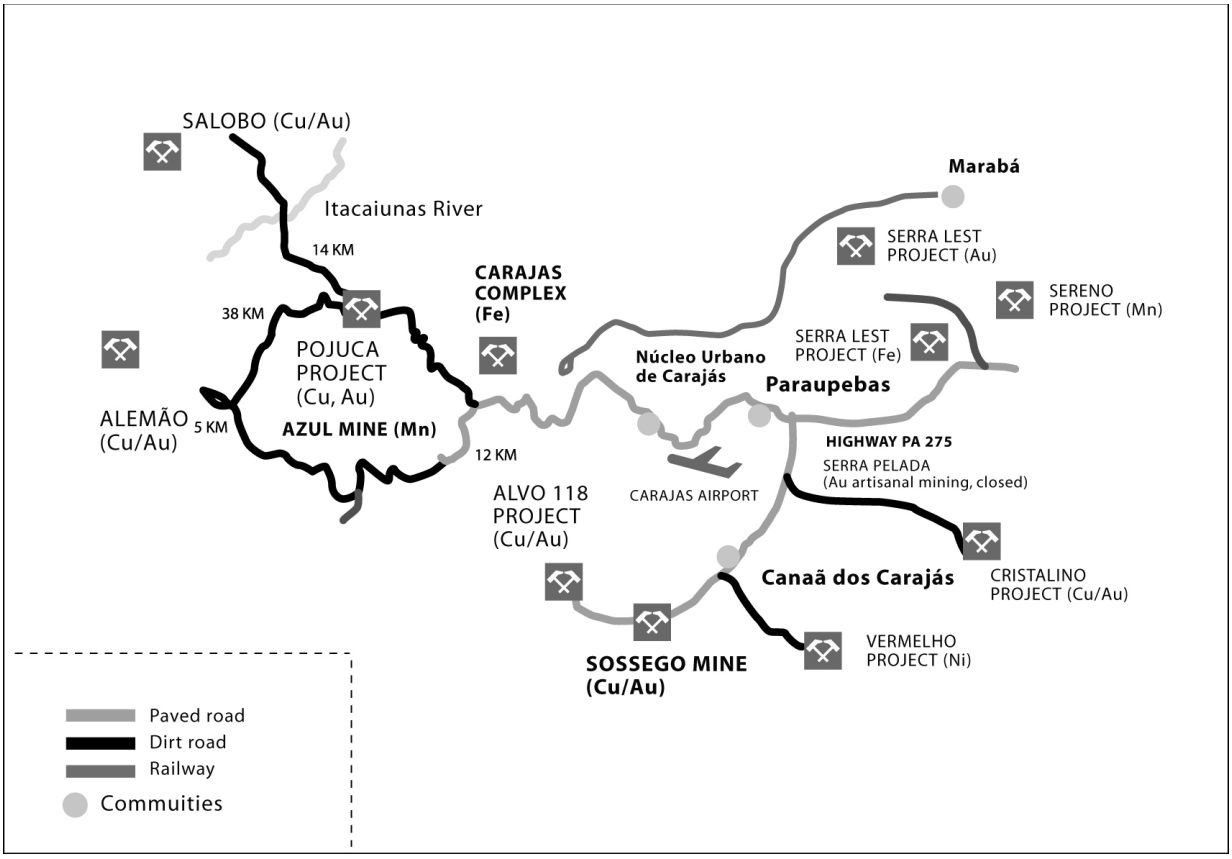

Figure 2.2: Operations in Vale's Northern System, in Relation to Case Study Communities
Source: Adapted from Ribeiro, E. (2006). (Not to scale.)

To support its activities, Vale created a complex integrated logistics system and became the greatest provider of logistic services in Brazil. The company operates over 9,000 kilometers of railroad and 10 proper port terminals. Vale is also one of the country's largest energy producers, with varying ownership of 6 hydroelectric plants. Along with its subsidiaries and joint ventures, Vale is the single biggest energy consumer in Brazil (Vale, 2007a). Figure 2.2 and Figure 2.3 illustrate the extent of Vale's operations in the Northern System.

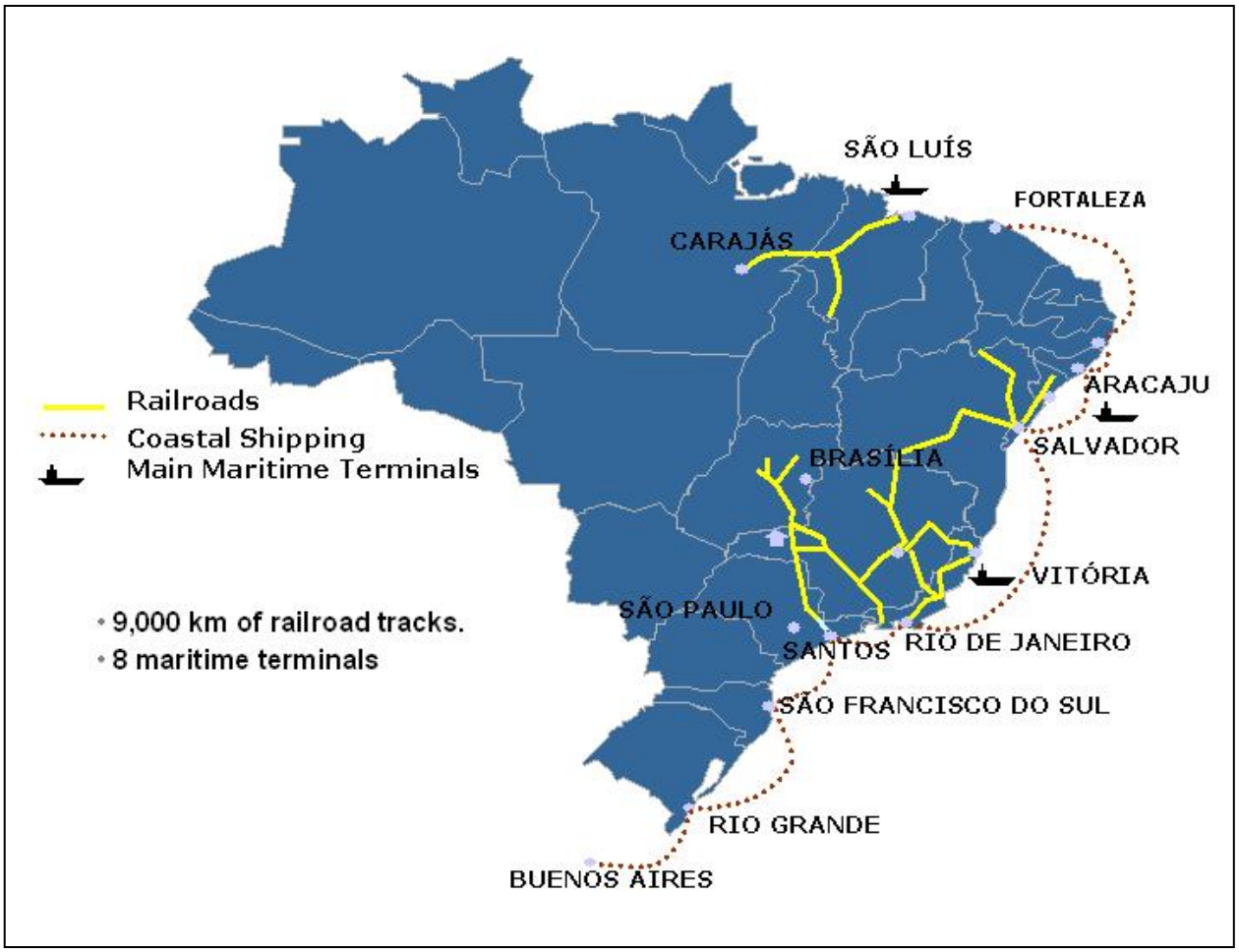

Figure 2.3: Logistics Infrastructure for Vale's Northern System
Source: Adapted from Ribeiro, E. (2006). (Not to scale.)

Vale is one of the wealthiest and largest Brazilian companies. At the time of the Carajás mineral discovery, Vale was a state-owned company, operating mostly in the Southeast of Brazil. It was privatized in the late 1990s. Vale's total market value in 2006 was approximately US $170 billion. According to recent corporate information, the company's third quarter gross income for 2007 was more than US $32 billion (Vale, 2007a).

Vale holds more than 30% of the iron-ore transoceanic market share. The company is the biggest private investor in Brazil, responsible for around 14% of all Brazilian foreign trade (Instituto Ethos, 2006). At the end of 2006, Vale had almost 44,000 direct employees, along with 12,000 at Vale-Inco.

Even though little occupational health and safety information from Vale is publicly available, the company's 2006 Annual Report highlights continuous performance improvement. In 2003, the

company reported 15.1 accidents not causing days off work (per million hours worked). In 2006, this number was reduced to 8.8. The frequency of accidents causing days off work declined from 4.7 in 2003 to 1.9 per million hours worked in 2006. From 2005 to 2006, there was a reduction of 34% in the number of accidents causing days off work (Vale, 2006).

2.4. Núcleo Urbano de Carajás: The Closed Company Town

The region of the Carajás has been explored by Vale since 1968, but 1979 marked the effective start of the development of the Carajás Iron-ore Project in the south of Pará. The Project became the primary goal of the corporate strategy (Vale, 2007a). In order to accommodate workers in the remote and isolated location, Vale built a mining camp in close proximity to the project site and began construction of its comprehensive logistical complex, including roads, rail and port facilities. The Núcleo Urbano de Carajás ("Núcleo") is a result of the evolution of this original mining camp.

The current Núcleo was built in 1986 and occupies an area of 308 hectares. The community provides all the conditions of comfort and security to accommodate a population of up to 7,000 inhabitants in 1,320 housing units. The Núcleo Urbano can be accessed by road (about 15 km from Parauapebas), or by plane. The airport is located within a national park, about 20 minutes by car from the Núcleo Urbano. The Carajás Airport is served by 2 airlines, with 5 daily weekday flights to a total of 14 destinations. The main destinations are Belém, Belo Horizonte, Brasília and Manaus. Each of the flights includes at least one stop in small towns in Pará, Tocantins and Minas Gerais[6].

The Núcleo Urbano de Carajás is therefore a *closed company town*—access is controlled and mostly limited to residents and mine employees. Residence in the community is controlled by Vale's local operations and is mostly a privilege and a benefit offered to higher-ranking employees. The Núcleo case study will allow for the description of a closed, controlled community established as a company town in the early 1980s, when Vale was a state-owned company and government policies supported the development of the eastern Amazon with little or no discussion of the social, economic and cultural implications of development and

[6] In December 2007, other destinations were: Altamira, Araguaína, Parintins, Porto Trombetas, Santarém, Tucuruí, Ourilândia do Norte, São Félix do Xingu, Uberaba, and Uberlândia. The costs of one-way flights varied from R$281.00 (Araguaina) to R$859.00 (Uberaba) each way (CAD $140.00 to CAD $430.00).

urbanization. The development approach here was paternalistic: the company provided all the facilities and services and imposed a code of conduct. This case also allows for the investigation of the rationale for the use of such a model, and of the ways Vale has attempted to facilitate quality of life (addressed in this context as part of the employee retention plan).

2.4.1. Development

The Núcleo Urbano de Carajás was developed in the early 1980s for Vale employees who came from diverse parts of Brazil to work for the company, generally in the Carajás Iron-ore Mining Complex, but also for the Azul Manganese Mine and Igarapé Bahia Gold Mine[7]. The community has undergone virtually no changes in terms of physical layout throughout the years. It remains a small community (5,500 persons) (Correa, 2006) where employees and families live in housing provided by the company. Most services and infrastructure are also provided free of charge[8], except for transportation, telephone and Internet access (Cota, 2006).

Figure 2.4: The Núcleo Urbano de Carajás: Aerial View and Typical Housing Units
© Silvana D. Costa. Photos taken in November 2006

Following construction of the Carajás Iron-ore Mine and the commencement of operations at the top of the Carajás Mountain Range, the *Floresta Nacional dos Carajás* (Carajás National Park) was established. The community and the large iron-ore reserves are located within this park, which was created in 1988 to "promote scientific research, sustainable exploitation of natural

[7] In 2006, Igarapé Bahia was under reclamation and closure procedures.
[8] For all homes, there is a limit to how much water and electricity consumption Vale will cover, but residents are free to go above that quota and pay the service fees for the extra usage (Cota, 2006).

resources, the study and conservation of biodiversity and bring social benefits to the local communities through the rational exploitation of its resources as well as tourism" (Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis, 1998).

Vale entered in an agreement with the Government of Brazil to assist the *Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis* (Brazilian Institute for Renewable Natural Resources—abbreviated as IBAMA), the federal environmental agency, in protecting and maintaining Carajás National Park. As a result, a large protective fence and several gates were erected around the Park, and have since also served as a means to control access to the Núcleo. Vale and IBAMA are responsible for the Park's 1.2 million hectares of forests. Of the Carajás Iron-ore Project's 412,000 hectares of land, only 1.6% is disturbed by the open pit mines (iron ore, manganese and, previously, gold), the mineral processing plants and the Núcleo itself.

A new mining camp, the current-day Núcleo, was built very close to the Carajás Iron-ore Project site to satisfy the needs (i.e., housing, health, education, food and recreation) of the mineworkers and their families. The original mining community was decommissioned when construction of the current community was completed in the mid-1980s, and the land on which the original camp was situated was then mined. The original mining community comprised wood houses and facilities and was mostly accessed by airplane. Employees worked on a fly-in-fly-out schedule (Coelho, 2006).

The Núcleo is known as the "city in the forest" because of its location on the top of a mountain in the *Serra dos Carajás* (Carajás Mountain Range), inside the Carajás National Park.

2.4.2. Urban Infrastructure

Development of the Núcleo was planned by Vale staff and included carefully designed houses, town squares and small parks, as well as water and power plants to service the community. The community is carefully maintained, and includes regular street cleaning, garbage collection, recycling and security services. It is also serviced by regular bus and passenger van transportation to and from Parauapebas.

Commercial venues in the Núcleo include grocery and general stores, 3 banks and a few bars and restaurants. Other public facilities in the Núcleo are the *Zoobotânico*—the Carajás Zoo,

which includes a botanical garden—a cinema/theatre and a recreation centre, the *Docenorte Clube*.

Figure 2.5: The Núcleo Urbano: Banks and Recreation Centre
© Silvana D. Costa. Photos taken in November 2006

2.4.3. Population

According to Kury (1992), by 1989, over 7,000 people, including Vale employees, contractors and their families, lived in the Núcleo. Current Vale employees living in the Núcleo today work at either the Carajás Iron-ore Mining Complex or the Azul Manganese Mine.

In 2006, the Núcleo was home to about 5,500 people, including Vale employees and their families (Jatay, 2006). The population also includes some key staff not directly employed by the mining company, such as the school principal, Yutaka Takeda hospital staff and *Docenorte* recreation centre program managers and staff, among others.

Demographically, the Núcleo is quite different from a regular community in Pará. Residents work directly or indirectly for Vale, or are employees' family members. The population is therefore made up of mostly working-age individuals (i.e., ranging from about 18 to 65 years old) and their children. Even though there are no demographic data available for the Núcleo (and resident turnover seems to be quite high), one can assume that this community has virtually no elderly permanent residents.

2.4.4. Education

The main educational facility in the Núcleo Urbano de Carajás is the community school (K–12). This school is a branch of the renowned Pitágoras School, which has branches in 5 other Brazilian states. The education offered by the Núcleo's community school is considered to be of a high quality, and this is recognized in evaluation reports prepared by the Pitágoras School Corporation, which annually compares performance amongst its various branches in Brazil. In August 2005, there were a total of 1,303 students attending all branches of the Pitágoras School: 130 students in the pre-school, 927 in the elementary school and 246 in the high school. In addition, the School had 106 staff.

The Núcleo also has a small day-care centre (available for employees' children free of charge) and a private English language school for children and adults (available for a fee).

2.4.5. Health

Information regarding the health of the population of the Núcleo Urbano de Carajás is not readily available through regular monitoring surveys implemented by health agencies. Municipal-level surveys aggregate data from the Núcleo with data from Parauapebas. However, some information from the private hospital (Yutaka Takeda) located in the community is available (Table 2.1).

Table 2.1: Yutaka Takeda Hospital, 2004 Data

Incidences and Procedures	Total	Tests	Monthly Average
Visits to Doctors	20,700	Endoscopies	31
Occupational Health–Related Visits*	75,000	Newborn Exams	11
Overnight Visits	1,000	Laboratory Exams	10,434
Emergency Room Visits	13,600	X-Rays	992
Surgeries	700	Ultrasounds	160
		Electrocardiograms	373

*Relates to the workers' health; most of these visits involved evaluation of fitness to work and deal with work hazards and requirements. This data does not include accidents.

Source: (Jatay, 2006). Note: Numbers are rounded.

The Yutaka Takeda Hospital has been in operation in the Núcleo since 1986. The hospital includes 50 beds, 12 examination offices and operating rooms for surgeries of average levels of complexity. In 2004, the hospital was the workplace of 13 doctors and 145 other employees. The following doctor specialties are available at the hospital: anesthesia, cardiology, general surgery, family medicine, gynecology, obstetrics, occupational health, orthopedy and pediatry. On a scheduled basis (once every month or 2), the following specialties are also available: neurology, otorrinolaringology and psychiatry (Jatay, 2006).

The hospital also includes a medical laboratory and a blood bank, as well as services of radiology, endoscopy, ultrasound, electrocardiograms, phonoaudiology, nutrition, physiotherapy, blood pressure monitoring and Holter 24h heart monitoring tests.

Figure 2.6: Kuarup Brazilian Culture Centre and Yutaka Takeda Hospital, Núcleo Urbano de Carajás
© Silvana D. Costa. Photos taken in November 2006

2.4.6. Culture, Recreation and Entertainment

The Núcleo was designed to provide for all the needs of Vale employees and their families. Therefore, some cultural, recreational and entertainment options are available in the Núcleo, such as a zoo and botanical garden complex, a cinema/theatre, a large recreation centre and a few bars and restaurants. The Núcleo also includes a small facility called the Kuarup Brazilian Culture Centre, which is dedicated to teaching traditional Brazilian dance.

2.5. Parauapebas: The Gate Development Community

A direct result of the Carajás mineral discoveries made at the end of the 1960s, Parauapebas originated from a small village built by Vale adjacent to the Carajás National Park gate (Secretaria Executiva de Estado de Planejamento, 2007b). When the Park boundaries were set, this area was largely untouched and used mostly for the harvest of *castanha* (Brazil nuts). Almost simultaneously, the region experienced a rapid increase in clear-cut timber extraction and the beginning of the cattle raising activity by large capitalist enterprises that take advantage of federal government policies and fiscal incentives for Northern development (Martins, 1984).

Parauapebas is located in the south of Pará, 547 km from Belém, the capital of the State. The city is situated in the Parauapebas River valley and shares borders with the cities of Marabá (north), Curionópolis (east), Canaã dos Carajás and Água Azul do Norte (south), and São Félix do Xingu (west) (Prefeitura Municipal de Parauapebas, 2005; Instituto Brasileiro de Geografia e Estatística, 2007).

Parauapebas is located in a relatively remote area. The city can be accessed by highway (Pará 275), aircraft (Carajás Airport) and train (company-controlled railroad). The airport is located at the top of the Carajás Mountain Range, within Carajás National Park, and mostly serves the workforce transportation needs.

Figure 2.7: Parauapebas Streetscapes
© Silvana D. Costa. Photos taken in November 2006

The community of Parauapebas is different from the 2 other communities in this study because here Vale has made only marginal efforts to facilitate the quality of life of resident employees. The city has developed adjacent to the Carajás National Park gate and access to the mining operations and the Núcleo Urbano de Carajás. Parauapebas is also important because with continuous expansion of the Carajás iron-ore mine and the need to increase the mine workforce, Vale needs to find workforce accommodation solutions. There is very limited opportunity to increase the population density of the Núcleo, and Parauapebas has become an undesirable place for higher-ranking or well-educated employees, who usually aspire to higher standards of living conditions and quality of life.

A community that grew spontaneously without addressing environmental or health concerns, the Parauapebas case allows for the examination of the implications of the "hands-off" approach to mining community development and planning for the quality of life of resident mineworkers.

2.5.1. Development

In the early 1980s, Vale built a small village—the *Vila de Parauapebas*—to accommodate contractors, municipal services and the workforce for the development of the Pará-Maranhão railway project (Prefeitura Municipal de Parauapebas, 2005). The original Parauapebas village was designed for 5,000 people and was built in about 1.5 years. It included treated water, sewer treatment, electricity, a hospital, a police station, an administration building and a school.

News of this development attracted large numbers of migrants to the area, and by the mid-1980s, the population had already reached 20,000 (Prefeitura Municipal de Parauapebas, 2005). The village of Parauapebas experienced rapid and uncontrolled growth as a consequence of high expectations of employment and business development in the region (Prefeitura Municipal de Parauapebas 2005). According to the municipal government, between 1981 and 2004, the population of Parauapebas increased tenfold (Prefeitura Municipal de Parauapebas, 2005).

Today, migrants continue to flock to Parauapebas from across the country, but they mostly come from the North and Northeastern states, where high unemployment rates and environmental challenges have created large poverty pockets. A municipality since 1988, Parauapebas has a highly transient population and very low economic, social and environmental standards, with several neighborhoods being established through squatter settlements. In 2007, it was estimated

that more than 100,000 people lived in this community (Instituto Brasileiro de Geografia e Estatística 2007).

2.5.2. Population

Between 2000 and 2007, Parauapebas' annual growth rate was 4.71%—almost double the annual growth rate of the State of Pará as a whole (2.28% from 2000–2007) (Instituto Brasileiro de Geografia e Estatística, 2007), and almost triple the annual growth rate of Brazil (1.67% from 2001–2005) (Ministério da Saúde, 2007). Urbanization of Parauapebas has also occurred at a phenomenal rate—82.8% in 2000 (Table 2.2).

According to the 1991 census carried out by the *Instituto Brasileiro de Geografia e Estatística* (the Brazilian Institute of Geography and Statistics—abbreviated as IBGE), the total Parauapebas population was 53,335 inhabitants distributed over 17,653.76 km² (including Canaã of the Carajás, which was considered part of Parauapebas until 1994). This averages to 3.02 inhabitants per square kilometre. In the 2000 census, Parauapebas' population size soared to 71,568, and density increased to over 10 inhabitants per square kilometre—this even though Canaã dos Carajás was no longer included in the Parauapebas figures. The 2006 census accounted for 95,225 inhabitants, and a population density of over 13 inhabitants per square kilometre (Instituto Brasileiro de Geografia e Estatística, 2007). The April 2007 municipal population count was 133,261 (Instituto Brasileiro de Geografia e Estatística, 2007)[9].

Table 2.2: Indicators of Growth and Urbanization, Pará and Parauapebas

Jurisdiction	Annual Growth, 2000–2007 (%)	Urbanization Rate*, 2000 (%)
Pará	2.28	66.55
Parauapebas	4.71	82.80

*Proportion of urban population in relation to total population.

Source: Instituto Brasileiro de Geografia e Estatística (IBGE) 2007

The majority of migrants looking for opportunities in Parauapebas arrive by road or train. The *Agência Nacional de Transportes Terrestres* (National Agency of Terrestrial Transportation)

[9] However, methodological changes in the data collection have resulted in the population of the Contestado village (about 30,000 people) being counted as part of Parauapebas. This village had traditionally been considered part of the municipality of Marabá (Santos, 2007). But even if the Contestado population is not included,, Parauapebas still have a population is of over 100,000 people.

estimates that between 500 and 600 people come to the city each month (by bus or train), while only about 200 people leave Parauapebas monthly (Agência Nacional de Transportes Terrestres, 2006).

According to IBGE, over 34% of the Parauapebas population is originally from the State of Maranhão—one of the poorest states in Brazil, where the Vale train makes its final stop to deliver mineral products at the Itaqui Port—while about 40% were born in the State of Pará.

According to the most recent census (2006), the population of Parauapebas is rather balanced in relation to gender. The male-female ratio has steadily declined throughout the years (Table 2.3), reflecting a population diversification since its origins as a mining village with a predominantly male population.

Table 2.3: Population Gender Distribution, Parauapebas

Population	1991	1996	2000	2006
Male	27,982	33,001	36,269	48,258
Female	25,353	30,562	35,299	46,967
Gender Ratio*	110.37	107.98	102.91	102.74

*Number of men per 100 women. 2006 gender ratio calculated by author.

Source: Secretaria Executiva de Estado de Planejamento, Orçamento e Finanças (SEPOF)/Diretoria de Estudos, Pesquisas e Informacoes Socio-economicas (DIEPI)/Gerência de base de Dados Estatísticos do Estado (GEDE) 2007. Data source: IBGE.

Parauapebas is a city of young people. More than 40% of the population is between 20 and 49 years of age, and over 66.5% is between 10 and 49 years of age. The community has a smaller percentage of older (i.e., over 50 years of age) people and higher percentages of people under 10 years of age than the State of Pará as a whole (Table 2.4).

Table 2.4: Age Distribution, Pará and Parauapebas (2007)

Jurisdiction	Less Than 1 Year Old	%*	1 – 9 Years Old	%*	10 – 19 Years Old	%*	20 – 49 Years Old	%*	50 Years Old or More	%*
Pará	177,596	2.45	1,629,035	22.47	1,743,795	24.06	2,894,304	39.93	804,430	11.10
Parauapebas	2,697	2.73	23,346	23.63	23,424	23.71	42,352	42.87	6,977	7.06

*Percentage of total population.

Source: Banco de dados do Sistema Único de Saúde (DATASUS)/IBGE 2007

2.5.3. Urban Infrastructure

According to IBGE (2007), in 2000 there were 26,000 housing units in Parauapebas. In the urban areas, 92% of the streets had lighting, and 70% were paved. Of the total urban housing units, 70.83% were being used by owners or owners' relatives and 20.14% by renters, 7.66% were company-provided housing and 1.33% were going through an acquisition process.

The urban services provided in Parauapebas have increased throughout the years (Table 2.5). However, these services tend to be distributed in the more established neighborhoods of Parauapebas, in the Núcleo Urbano and closer to the downtown area and Vale's gate. The urban areas that have experienced the most growth are situated along the railway, where the infrastructure is seriously lacking (Santos, 2006).

There are only 5 small banks (all of which are branches of large banking institutions) in Parauapebas (excluding the Núcleo Urbano) (Prefeitura Municipal de Parauapebas, 2005). This number is extremely low relative to the size of the city's population, and this in turn is a source of considerable disappointment and frustration for residents, particularly on paydays, when the demand for banking services is significantly higher than usual.

There are 4 mobile phone operators —TIM, Vivo, Oi and Amazônia Cellular—4 TV stations, and 1 official FM radio station in Parauapebas. According to the National Agency of Telecommunications (Anatel), in 2006 there were about 45,000 registered private cellular phones in Parauapebas, which means 1 cellular phone for every 2 inhabitants—almost 2 phones per housing unit (Santos, 2006).

Cable Internet is available in a limited area of the downtown core of Parauapebas, although Internet provision has been expanding in the last 5 years. In April 2007, Parauapebas celebrated the opening of the first computer lab in a public school; this lab houses 20 computers connected to the Internet and services 700 students of the Josias Leão School (Secretaria de Educação de Parauapebas, 2007).

Table 2.5: Household Access to Selected Goods and Services, Parauapebas

Household Goods and Services	1991		2000	
	Housing Units Total 10,962	%	Housing Units Total 16,433	%
Garbage Collection	5,459	49.80	13,598	82,75
Electricity	6,881	62.13	15,714	95.63
Phone line	452	4.12	2,429	14.78
Radio	6,429	58.65	9,435	57.42
Television	5,073	46,28	13,161	80.09
Computer	-	-	958	5.83
Private Vehicle	1,080	9.29	2,192	13.34

Source: Secretaria Executiva de Estado de Planejamento, Orçamento e Finanças (SEPOF)/Diretoria de Estudos, Pesquisas e Informacoes Socio-economicas (DIEPI)/Gerencia de base de Dados Estatísticos do Estado (GEDE) 2007. Data source: IBGE. .

2.5.4. Economy

Parauapebas' economy is heavily dependent on large-scale mining (Prefeitura de Parauapebas, 2005; da Silva, 1998). Most of the infrastructure of the city, including roads, was developed with funds generated by taxes collected from the mining operations in the Carajás Mountain Range. Except for forestry farming and cattle ranching, most industries in Parauapebas are directly or indirectly related to the mining sector.

In 2006, mining activity (ore extraction and transformation) was responsible for 70% of Parauapebas' Gross Domestic Product (GDP), followed by the services sector (25%), and by the farming sector (5%). Before its emancipation in 1998, Parauapebas was considered part of the municipality of Marabá and thus did not have direct access to economic benefits (royalties) from the mining development in the Carajás Mountain Range. In 2006, Parauapebas was the 6th richest municipality in Pará, after Belém, Barcarena, Tucuruí, Ananindeua and Marabá, and it has the 7th highest income per capita in the state (Instituto Brasileiro de Geografia e Estatística, 2007).

From 1991 to 1995, mining activity contributed to 23%–28% of Parauapebas' municipal revenue (da Silva, 1998; Barreto, 2001). In Brazil, mining royalties are shared by the municipal (65%), state (23%) and federal (12%) governments (da Silva, 1998). As an example of the magnitude of the mining royalties Parauapebas earns every year, in 2000, the municipal government received

US $12,051,604 from iron-ore mining alone (Barreto, 2001). Because the mineral production in the Carajás Iron-ore complex has steadily increased since 2002, it is certain that mining royalty revenues have also increased significantly.

Despite the economic growth and vibrancy of the city, the percentage of people living under the poverty line in Parauapebas is alarmingly high: 43.55% of the total population lives below the poverty line[10], and the poverty rate of the rural population is almost 50% (Table 2.6). When compared to the State of Pará as a whole, however, these rates indicate that Parauapebas is, in general, less poor than the general Pará population. The difference is most noticeable on the rural population poverty data.

Table 2.6: Poverty Indicators, Pará and Parauapebas (2000)

Jurisdiction	Population			Population Below the Poverty Line (1)			Population Below the Poverty Line (%)		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
Pará	6,195,974	4,122,105	2,073,869	3,246,882	1,784,787	1,462,095	52.40	43.30	70.50
Parauapebas	71,571	59,261	12,310	31,166	25,017	6,149	43.55	42.21	49.95

(1) Poverty Line: Proportion of people who live in a family with a monthly income of less than one-half of the minimum wage per capita.

Source: IBGE/SEPOF (2006)

Incomes in Parauapebas (Table 2.7) reflect the scale of the mining activity in Carajás and its direct and indirect impacts on employment and wages. Even though Vale has tended in the last few years to reduce its workforce and increase its use of contractors, these jobs still remain in the region and often with comparable wages. The mineral activity has facilitated the increased the income per capita in Parauapebas and the city's contribution to state revenues. Excluding Belém, the state capital, Parauapebas was the city that most contributed to Pará's revenues in 1995 (da Silva, 1998).

[10]The term "poverty line" is used here as it is defined by IBGE: The proportion of people who live in a family with a monthly income of less than one-half of the minimum wage per capita. In 2000, the minimum wage in Brazil was US $84.00 per month (considering 1 Brazilian Real = 0.56 American Dollar), or US $2.8 a day.

Table 2.7: Income Indicators, Parauapebas (2000 Data)

Jurisdictions	Income per capita (monthly in Brazilian Reais)	% income from work	% income from government transfers	% of population with > 50% of income from government transfers
Brazil	297.23	-	-	-
Pará	168.59	68.93	12.22	10.38
Parauapebas	221.48	73.39	6.73	5.02

Source: United Nations Development Program (UNDP).New Atlas of Human Development in Brazil (2000)

There is clearly income inequality in Parauapebas, which has intensified throughout the years: the Gini Index[11] for Parauapebas in 1991 was 0.58, and it increased by 15% to 0.67 in 2000.

2.5.5. Human Development

According to the most recent United Nations (UN) Human Development Index (HDI)[12] (based on 2000 census data), Parauapebas' HDI grew 12.8% from 0.657 in 1991 to 0.74 in 2000, putting the city in the 11th position among the 143 cities in the State of Pará and in 2,137th position (out of a total of 5,507 cities evaluated) in all of Brazil[13] (Santos, 2006). Table 2.8 shows the Parauapebas HDI in relation to other jurisdictions.

[11]The Gini coefficient is a measure of inequality of income distribution or inequality of wealth distribution. It is defined as a ratio with values between 0 and 1: 0 corresponds to perfect equality and 1 corresponds to perfect inequality (where one person has all the income, while everyone else has zero income). A low Gini coefficient indicates more equal income or wealth distribution, while a high Gini coefficient indicates more unequal distribution (United Nations Development Programme, 2000).

[12] Launched in 1990, the Human Development Index (HDI) is the measure of life expectancy, literacy, education, and standard of living for countries worldwide. The HDI measures the average achievements in three basic dimensions of human development: long and healthy life, as measured by life expectancy at birth, knowledge and education, as measured by the adult literacy rate and the combined primary, secondary, and tertiary gross enrollment ratio (with one-third weighting) and decent standard of living, as measured by the log of gross domestic product per capita at purchasing power parity in US$. In the 2005, the country with highest HDI was Iceland (0.968). Canada was third in the world, with an HDI of 0.961(United Nations Development Programme, 2000; United Nations Development Programme, 2007).

Table 2.8: Human Development Index (HDI) Indicators in the Carajás Region

Municipality	1991				2000			
	HDI	Education	Income	Life Expectancy	HDI	Education	Income	Life Expectancy
Canaã dos Carajás	-	-	-	-	0.699	0.792	0.627	0.679
Eldorado dos Carajás	0.542	0.472	0.556	0.598	0.663	0.725	0.551	0.712
Parauapebas	0.657	0.712	0.661	0.598	0.741	0.844	0.674	0.704

Source: United Nations Development Program (UNDP). New Atlas of Human Development in Brazil (2000). 1991 data is not available for Canaã dos Carajás.

2.5.6. Education

According to a 2006 school census carried out by the Brazilian Ministry of Education, Parauapebas has about 45,000 students (kindergarten to high school); almost 35,000 (78%) of these students were enrolled in municipal schools, while 22% were attending private schools. About 1,500 individuals were registered as university students in approximately 30 courses offered by 10 different (public and private) educational institutions in Parauapebas (Ministério da Educação, 2006).

The 2006 illiteracy rate (of people 15 years of age or older) of Brazil's North region was 12.7%, and that of the government of the State of Pará was 14.1%. At 12.23% (about 8,000 people), Parauapebas' 2006 illiteracy rate was lower than the region's average, but better than the state average, and was an improvement over the 2000 illiteracy rate, which was 16.3% (Instituto Brasileiro de Geografia e Estatística, 2007).

2.5.7. Health

Thousands of people from neighboring cities come to Parauapebas in search of health care. Because Parauapebas is the largest city between Marabá (north) and Redenção (south), it has more than half of the medical facilities in the North region (Santos, 2006). In 2005, Parauapebas had a total of 33 health care facilities, of which 19 were public and 14 were private facilities (Instituto Brasileiro de Geografia e Estatística, 2007).

In 2003, Parauapebas had 131 hospital beds, but only 28 of these were located in public hospitals. According to the State of Pará, this number had not changed since 1999 (Secretaria Executiva de Estado de Planejamento, 2007b). The 2003 average number of beds—1.61 per 1,000 people (Secretaria Executiva de Estado de Planejamento, 2007b)—is extremely low if compared to the World Health Organization (WHO) minimum standard of 2.5 beds per 1,000 people[14] (World Health Organization, 2007). The situation is in fact worse because these beds are serving not only Parauapebas' population, but also people living in neighboring towns with fewer health care facilities, such as Curionópolis and Canaã dos Carajás.

The health care facilities available are under-resourced regarding medical staff and equipment and are clearly not sufficient for the growing population of Parauapebas. Signs of the poor health care in this city are the poor performance on indicators of health displayed in Table 2.9, which includes data for Pará.

Table 2.9: Health Indicators, Parauapebas 2006

Jurisdiction	Infant Mortality Rate*	General Mortality Rate*
Pará	22.22	3.87
Parauapebas	30.06	4.60

Source: DATASUS/IBGE 2007
* Mortality rate expressed as number of deaths per 1,000 inhabitants per year

Considering that its economic performance in general is better than the state average, the health care challenges in Parauapebas can be seen as something of a paradox.

2.5.8. Culture, Recreation and Entertainment

The cultural, recreational and entertainment options in Parauapebas are fairly limited. The only theatre in Parauapebas is actually located in the Núcleo Urbano de Carajás. This theatre is accessed made through the Vale/Carajás National Park gate with the purchase of a movie ticket. The Zoobotânico Park (zoo and botanical garden) is also located in the Núcleo. Parauapebas recreation centers—City Park Club, *Juvenil* Club and *Docenorte* Club—are all privately owned. The best-equipped of these is the *Docenorte* recreation centre, which is located at the Núcleo Urbano de Carajás.

[14] In Brazil, the rate was 2.6 in 2002. Canada's rate was 3.6 (World Health Organization, 2007)

Figure 2.8: Parauapebas: Open Sewage.
© Silvana D. Costa. Photo taken in November 2006

One of most traditional recreation centers, the Asfep Club, was located next to the Carajás National Park gate (also Vale's security access gate) but recently closed down to make way for a private company parking lot. Public spaces for leisure and recreation include only a few sports fields spread throughout the city: the Rosenão Stadium, the Poliesportivo Gymnasium, the *Centro de Desenvolvimento Cultural* (CDC) (cultural centre), and 8 small municipal squares.

Sports events in Parauapebas are limited to school competitions and inter-municipal school games.

Very little cultural activity occurs in Parauapebas. The organization that most supports cultural programs in Parauapebas is the Vale do Rio Doce Foundation. Other organizations that promote cultural events are the KUARUP Dance Group (Brazilian dance classes located in the Núcleo Urbano) and folklore dance groups Palmares I and II (Noel, 2006; Santos, 2006).

2.6. Canaã dos Carajás: The Integrated Community

The third case study community, Canaã dos Carajás (Canaã) has its origins in the 1982 federal government resettlement program that brought migrant families, mostly from the States of Maranhão, Tocantins and Goiás to develop small scale agriculture in southern Pará (Lima,

2004). The Carajás Settlement Project was established to ease the violent land conflicts in the Araguaia–Tocantins region (Coelho et al., 2002; Martins, 1984).

The youngest Vale mine, the Sossego Copper Mine, has been in operation since 2004. During this time, Canaã has experienced rapid growth and both physical and social transformation. Similar to Parauapebas, Canaã is a boomtown that receives migrants from across the country, most of whom are looking for employment in the nearby mines. From a small village of just over 1,500 families in the early 1980s, Canaã has grown to be home to more than 20,000 people in 2007 (Instituto Brasileiro de Geografia e Estatística, 2007).

With advanced copper and nickel projects in the area and requirements from the Brazilian government associated with their development permits, Vale has engaged in a large-scale investment program in Canaã dos Carajás. In partnership with the municipal government, the company has invested in basic infrastructure, health, educational and cultural facilities and programs in Canaã. The company has also built houses for employees in 4 different neighborhoods, spatially dispersed throughout the city (Pavan, 2005). Thus Canaã can be designated the “integrated community”.

Figure 2.9: Canaã dos Carajás: Vale-Built Homes and an Existing Wood-Frame Home
© Silvana D. Costa. Photos taken in August 2006

The case of Canaã dos Carajás allows for the investigation of Vale’s revised approach to mineworkers’ settlements and accommodations about 25 years after the establishment of the closed-company town of the Núcleo Urbano de Carajás and the hands-off approach to the development of Parauapebas. This case provides the opportunity to illustrate a contemporary

approach, under contemporary environmental legislation and mine permitting process, which includes a more formalized relationship with the local municipal government. This case study also allows for the investigation of the implications of these factors on the quality of life of employees who reside in Canaã dos Carajás.

Canaã dos Carajás is located 760 km from Belém, the capital of the State of Pará. Canaã is in a fairly remote area, located 120 km from Marabá and 75 km from Parauapebas. The city shares borders with Parauapebas (north and west), Curionópolis and Sapucaia (east), Água Azul do Norte (south), and São Félix do Xingu (west) (Secretaria Executiva de Estado de Planejamento, 2007a).

Canaã dos Carajás includes a town centre as well as 7 rural villages: Mozartinópolis, Planalto, Ouro Verde, Serra Dourada, Bom Jesus, Feitosa and Nova Esperança (Lima, 2004). Most of the rural villages are accessible only by dirt roads that often flood during the rainy season. Vale has built a highway to facilitate the development of the Sossego Copper Mine, and this highway provides the only road access to and from the city. The closest airports are located in the Núcleo Urbano de Carajás and in Marabá. Bus service is only available in Parauapebas, Núcleo Urbano de Carajás or Marabá. Train service is only available in Parauapebas.

2.6.1. Development

Canaã dos Carajás originated from an agricultural settlement set by a federal government program. The Executive Group of Lands of the Araguaia and Tocantins (GETAT), established the Carajás Settlement Project in the Southeastern region of Pará, in 1982 (Lessa, 2007). The GETAT's purpose was to ease the land conflicts in the Araguaia –Tocantins region, mainly in the highly disputed area known as *Bico do Papagaio* ("Parrot's Beak") (Martins, 1984).

In 3 years, GETAT settled 1,551 families in the area that was known as a Regional Development Centre (CEDERE) in Canaã dos Carajás (Lessa, 2007). These families were mostly from the States of Maranhão, Tocantins and Goiás, and were settled in this area to develop small scale agriculture activity (Lima, 2004).

However, by 1985, only 816 families had received formal ownership of their lands. Economic activity was limited to agriculture, mainly the growth and harvest of corn, beans and rice. Also in

1985, the settlement activities were halted and GETAT was disbanded for political reasons. In October of 1994, the CEDERE was separated from Parauapebas and became a municipality—Canaã of the Carajás. The city's name was chosen through popular vote. The name "Canaã" has biblical origins and refers to the "Promised Land" (Lessa, 2007).

In 2002, Vale started work on the Sossego Copper project, located on Sossego Mountain, a few kilometers away from Canaã's town centre. A large migratory process was prompted by the company's announcement of expectations to employ around 3,000 people. This population growth was accompanied by a growth in Canaã's goods and services sector and a critical need to improve existing public services and urban infrastructure.

2.6.2. Population

Between 2000 and 2007, Canaã's population more than doubled (Figure 2.1). According to the 1996 census carried out by the *Instituto Brasileiro de Geografia e Estatística* (IBGE), Canaã was home to 11,139 inhabitants distributed over 3,161,50 km², which averages to 3.52 inhabitants per square kilometre.

The 2000 census indicated a decline in land area and population, probably reflecting a downturn in the agriculture sector and migration to other parts of the state, such as neighboring Parauapebas, where the economy was booming due to mining activity. Since the establishment of Vale's mineral development projects in 2002 and the opening of the Sossego Copper Mine in 2004, the population of Canaã has soared—the 2006 census counted 13,870 inhabitants, and the population density had increased to 4.41 inhabitants per square kilometre (Instituto Brasileiro de Geografia e Estatística, 2007). As of April 2007, the current municipal population count sits at 23,707, which would imply on a population density of 7.53 inhabitants per square kilometre (Instituto Brasileiro de Geografia e Estatística, 2007).

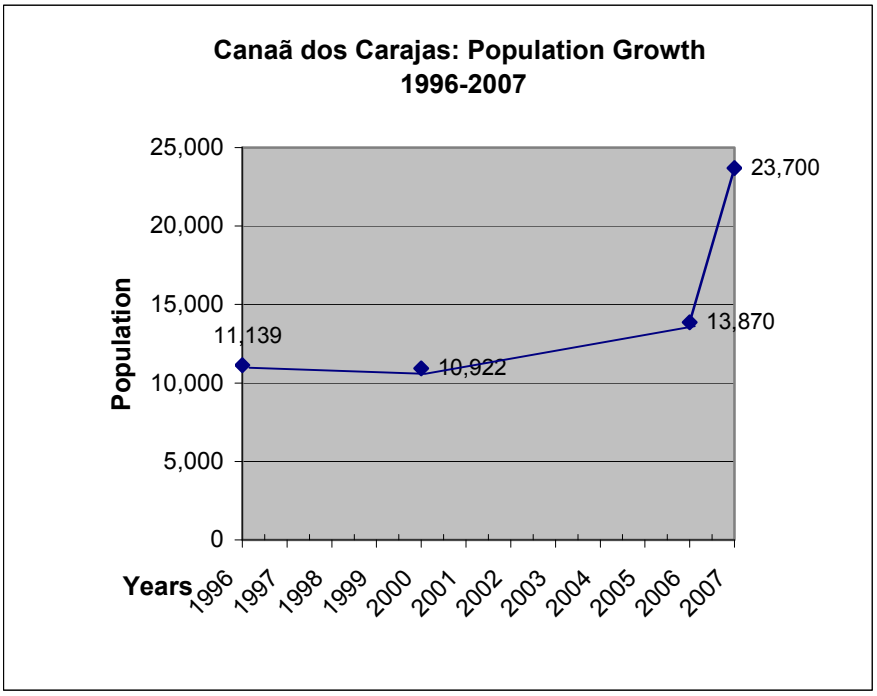

Figure 2.10: Population Growth in Canaã dos Carajás
Note: 1996, 2000 and 2006 figures are based on census data, while the 2007 population estimate is from a municipal government count.
Source: IBGE, Population Count 2007 and Population Estimates 2007

Table 2.10 exhibits the annual growth rate for Canaã, and the State of Pará as a whole. At 3.94%, Canaã's annual growth rate from 2000–2007 was smaller than Parauapebas' growth rate of 4.71 for the same period (Table 2.2), but still quite higher than that of the State of Pará. Urbanization in Canaã (Table 2.10) has not been as intense as it has been in Parauapebas (Table 2.2). However, it is expected that Canaã's urbanization rate will show a significant increase in the 2006 census results, reflecting the significant population growth.

Table 2.10: Indicators of Growth and Urbanization, Pará and Canaã dos Carajás

Jurisdiction	Annual Growth, 2000–2007 (%)	Urbanization Rate, 2000 (%)
Pará	2.28	66.55
Canaã dos Carajás	3.94	35.93

Source: IBGE 2007

In 2006, more than 60% of Canaã's population lived in rural areas (Table 2.11). This was almost double than the percentage for the State of Pará as a whole, and almost 4 times the percentage in Parauapebas.

Table 2.11: Urban and Rural Populations, Pará, Parauapebas and Canaã dos Carajás (2006)

Jurisdiction	Urban Population	Urban % of Population	Rural Population	Rural % of Population
Pará	4,811,305	63.37	2,437,855	33.63
Parauapebas	81,805	82.80	16,991	17.20
Canaã dos Carajás	5,143	35.93	9,171	64.07

Source: DATASUS/IBGE 2007

Similar to Parauapebas (Table 2.3), the male population in Canaã is slightly larger than the female population (Table 2.12). Statistical data shows, however, that unlike Parauapebas, this balance changed significantly between 1996 and 2000 and has since remained relatively stable. The recent increase in the proportion of males in Canaã is certainly a reflection of the mineral development boom brought about by the Sossego Copper project. Such upturns in mineral development activity in an area generally attract a larger percentage of males for its workforce.

Table 2.12: Population Gender Distribution, Canaã dos Carajás

Population	1996	2000	2006
Male	5,783	5,871	7,694
Female	5,356	5,051	6,620
Gender Ratio*	107.97	116.23	116.22

*Number of men per 100 women; 2006 gender ratio calculated by author.

Source: Secretaria Executiva de Estado de Planejamento, Orcamento e Financas (SEPOF)/Diretoria de Estudos, Pesquisas e Informacoes Socio-economicas (DIEPI)/ Gerencia de base de Dados Estatísticos do Estado (GEDE) 2007. Data source: IBGE.

In terms of its population's age distribution, Canaã dos Carajás is more similar to the State of Pará as a whole (Table 2.13) than it is to Parauapebas (Table 2.4). Canaã is a youthful community, with more than 65% of its population aged 10–49, and over 40% of its population aged 20–49.

Table 2.13: Age Distribution, Pará and Canaã dos Carajás (2007)

Jurisdiction	Less than 1 year old	%	1–9 years old	%	10–19 years old	%	20–49 years old	%	50 years old or more	%
Pará	177,596	2.45	1,629,035	22.47	1,743,795	24.06	2,894,304	39.93	804,430	11.10
Canaã dos Carajás	309	2.16	3,145	21.97	3,506	24.49	5,863	40.96	1491	10.42

Source: DATASUS/IBGE 2007

2.6.3. Urban Infrastructure

According to IBGE, in 2000 there were 2.521 housing units in Canaã dos Carajás, not including the 100 housing units built for the Sossego Copper Mine workforce (Secretaria Executiva de Estado de Planejamento, 2007a). It is evident that with the development of the Sossego Copper Mine the urban infrastructure and services available in Canaã have improved; however, census data is only available for the year 2000 (Table 2.14).

It is also clear that most improvements to Canaã's infrastructure were accomplished in the neighborhoods where the Vale housing units have been built. Even though these have been distributed around the city in different neighborhoods, infrastructure improvements by 2006 had been implemented only in these particular areas and at the city's main point of access, where the Sossego Mine Camp and some of the company offices are located. For example, before the Sossego Mine was developed, there were no paved roads in Canaã. In 2006 there were several roads paved with asphalt, including the main access road to city and the streets that lead to company housing units.

Table 2.14 depicts the deficient infrastructure and services in Canaã in 2000. Unfortunately, data for 2006 was not available at the time that research for this thesis was completed. However, it is notable that a significant problem of access to electricity and garbage collection existed in Canaã before the Sossego Mine began operating. It is expected that these numbers, as well as access to consumer goods such as radio and televisions, have improved since 2000.

Table 2.14: Permanent Housing Units and Selected Goods and Services, Canaã dos Carajás (2000)

Household Goods and Services	Housing Units*	(%)**
Garbage Collection	628	24.91
Electricity	1,569	62.24
Radio	1,425	56.53
Television	1,130	44.82
Computer	44	1.75
Private Vehicle	286	11.34

*Out of 2,521 total housing units.
**Percentage of housing units which use service/own household good.

Source: IBGE/SEPOF 2007

Communications systems in Canaã are fairly limited. Internet access is only available by radio, and there are very few establishments where Internet access is available for a fee. In 2001, the first 547 phone lines—for both residential and commercial uses—were installed (Secretaria Executiva de Estado de Planejamento, 2007a). Mobile phone services are only available through 2 service companies. There is only one post office and one banking institution in the city (not including a bank branch at the Sossego Mine).

2.6.4. Economy

Since the 1980s, the economic activity in Canaã has diversified slowly to include cattle ranching, timber extraction and goods and services. Because of the disbandment of GETAT, cattle ranching (mostly for meat production) had developed as the main economic activity before mineral exploration and mining were established with the Sossego Project in the late 1990s. Table 2.15 summarizes data on the economic activity in Canaã.

Even though the data in Table 2.15 does not depict exceptional economic performance from 1999–2000, the area has since experienced a significant boom. For example, the amount of taxes received annually has grown incredibly since 1997—from about one million Reais to eleven million Reais in 2006[15] (Secretaria Executiva de Estado de Planejamento, 2007a).

[15] Total taxes, including mining royalties.

Figure 2.11: Canaã dos Carajás City Centre
© Silvana D. Costa. Photos taken in November 2006

Table 2.15: Economic Indicators, Canaã dos Carajás (2000)

Indicators	2000 Numbers
Population aged 10 years or older	8,286
Economically active population (EAP)*	4,031
Working population	3,824
Activity rate (percentage of EAP that are working)	48.65%
Inactivity rate (percentage of unemployment in relation to EAP)	5.14%
Income per capita	$167,46* monthly
Income from work	66.19%
Income from government transfers	6.16%
Population with > 50% of income from government transfers	4.53%

Source: IBGE/SEPOF 2007

* Reais (Brazilian Currency). In August 2006, 1 R$ ~ CAD$ 0.50

From 1997–2001, the gross domestic product (GDP) value in Canaã remained roughly the same. With mining development, the GDP value started to grow, and in 2004, when the Sossego Mine opened, the GDP value in Canaã dos Carajás spiked significantly (Figure 2.2.). In 2004, Canaã's GDP per capita was 21,480.04, the third largest in the State of Pará (Secretaria Executiva de Estado de Planejamento, 2007a).

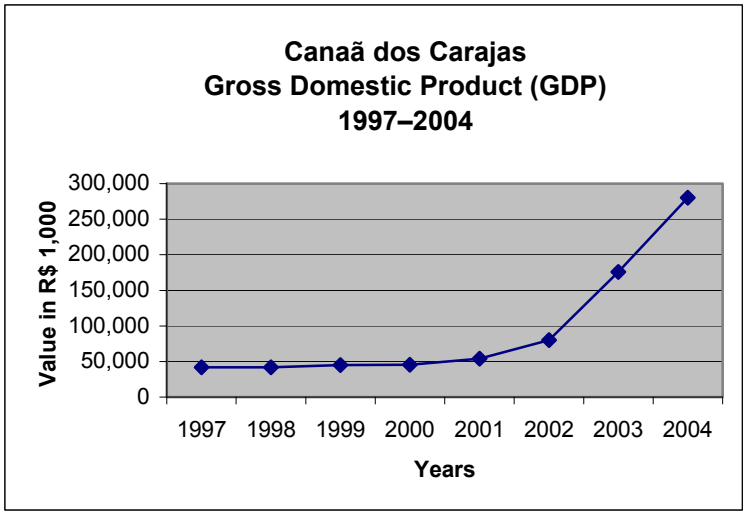

Figure 2.12: Canaã dos Carajás GDP (1997–2004)
Source: (Secretaria Executiva de Estado de Planejamento, 2007a)

Even though the percentage of people living in poverty in Canaã is smaller than that of the State of Pará, in 2000, almost half of the population in Canaã lived under the poverty line. The situation was even worse in the rural areas, where more the half of the population were living below the poverty line (Table 2.16).

Poverty in the urban areas of Canaã dos Carajás in 2000 (Table 2.16) was more acute than in the urban areas of Parauapebas, where the percentage of people living under the poverty line was higher in the rural areas (Table 2.6). Moreover, the inequality in Canaã dos Carajás has in fact increased, since the Gini Inequality Index for Canaã increased from 0.52 to 0.62—a 19.2% increase in 9 years.

Table 2.16: Poverty Indicators, Pará and Canaã dos Carajás (2000)

Jurisdiction	Population			Population Below the Poverty Line (1)			Population Below the Poverty Line (%)		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
Pará	6,195,974	4,122,105	2,073,869	3,246,882	1,784,787	1,462,095	52.40	43.30	70.50
Canaã dos Carajás	10,923	3,925	6,998	5,303	1,591	3,712	48.55	40.54	53.0

(1) Poverty line: Proportion of people that live in a family with monthly income of less than a ½ minimum wage per capita (US $2.8 dollars a day).

Source: IBGE/SEPOF 2007

2.6.5. Human Development

In 2000, the Human development Index (HDI) for Canaã dos Carajás was 0.699, well below the HDI for the State of Pará (0.723) and for Brazil (0.796).

2.6.6. Education

A 2006 school census carried out by the Brazilian Ministry of Education shows that the Canaã dos Carajás student population (kindergarten to elementary school) has more than doubled since 2000, from 3,504 to 7,630 students. In 2006, 6,804 (89%) students were registered in municipal or state schools, while 826 (11%) were attending private schools. However, there are no municipal or state high schools in Canaã dos Carajás.

In 2000, the literacy rate in Canaã dos Carajás was 81.5%, lower than Parauapebas (83.7%), the state average (83.2%) and Brazil's average (86.37%) (United Nations Development Programme, 2000).

2.6.7. Health

In 2005, there were only 9 health care facilities in Canaã dos Carajás, of which 6 were public and 3 were private (Instituto Brasileiro de Geografia e Estatística, 2007). The first and only municipal hospital in Canaã opened in the early 2000s (Secretaria Executiva de Estado de Planejamento, 2007a), and until 2006 was still the only one in town. A new private hospital, built by Vale, was under construction in 2006, and was designed to include some publicly accessible hospital beds (Pavan, 2005).

In 2003, Canaã dos Carajás still had only 26 hospital beds in the municipal hospital. The 2003 average number of beds—2.14 per 1,000 people (Table 2.17)—and the number of health units per 1,000 people were better than Parauapebas but still below the World Health Organization (WHO) minimum standard of 2.5 beds per 1,000 people (World Health Organization, 2007). The situation in 2006 was particularly dramatic since the population had increased to 13,870 without any increase in capacity at local hospitals, which implies on a rate of 1.87, well below the WHO standard of 2.5 beds per 1,000 inhabitants.

Table 2.17: Health Care Indicators, Canaã dos Carajás and Parauapebas (2003)

Cities	Units/10,000 Persons	Beds/1,000 Persons
Canaã dos Carajás	3.5	2.14
Parauapebas	3.4	1.61

Source: DATASUS/IBGE 2007

2.6.8. Culture, Recreation and Entertainment

Vale built the only cultural facility available in Canaã, the *Casa da Cultura,* through the Itakyra Association[16] (independent but heavily funded by Vale). This centre includes an open-air theatre, arts and crafts workshops and a small library.

In 2006, a company-owned recreation centre was being developed next to the Sossego Camp, at the entrance of the city. When completed, this centre will include sports fields, a gym and swimming pools. This facility will be a private enterprise available to the general public for a membership fee.

Figure 2.13: Canaã dos Carajás. Casa da Cultura
© Silvana D. Costa. Photo taken in November 2006

Entertainment options are also few and far between in Canaã. The first public municipal square[17] was only recently built by Vale, and there are no public sports fields or arenas (except for the

[16] The Itakyra Association is a not-for-profit organization, a partnership of the Vale Foundation and the Canaã dos Carajás municipal government. The Foundation manages investments in education, health and leisure/culture (Ethos Institute, 2006).

occasional open lot where soccer is played). Internet access is quite limited in private homes and available at only a few Internet cafés.

2.7. Reflecting on the Case Study Communities

The above descriptions of the 3 case study communities reveal a clear distinction among them. Table 2.18 summarizes each of the 3 case study communities in relation to its mining community model and approach, associated mining operation and the parameters discussed in this chapter.

Information in this chapter (highlighted in Table 2.18) reveals that the Núcleo Urbano de Carajás scenario is quite different from that of Parauapebas or Canaã dos Carajás. On-site observations support the obvious conclusion that the Núcleo provides better and more comfortable physical living conditions, services and resources for its residents.

Despite the clear differences between the models and approaches to mining community development used in Canaã and Parauapebas, and despite the limited data available for Canaã, it seems that Canaã is facing challenges that are somewhat similar to those faced by Parauapebas since its inception in the early 1980s. With the new integrated approach taken in Canaã dos Carajás, Vale is clearly more involved with the physical and social development of the town. Moreover, local government and social organizations are operating under a new paradigm, one of sustainable development and environmental management. In Parauapebas, however, mining activity does not seem to be contributing to sustainable development in the region, but it is providing for improved quality of life for thousands of people.

As observed in the historical development of Parauapebas, the most significant challenge for a booming small mining community is to be prepared to quickly adapt to the rapid and intense growth that accompanies increased industry activity. In Canaã, this adaptation does not seem to be happening at the pace necessary. Statistical measures presented in this chapter might indicate dramatic positive changes during this early phase of development but can be deceiving because of the limited ability to adequately account for the existing population.

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[17] In Brazil, city or neighbourhood plazas or squares are culturally important and historically have been the public space where residents meet and greet and where major civic or community events take place.

Table 2.18: Case Studies

Case Study	Associated Operations	Community Model	Approach	Population (2006)	Urban Infrastructure, Education and Health Facilities	Economy	Human Development Index (health, income and education)	Culture, Recreation and Entertainment
Núcleo (built by the company in the 1980s).	▪ Carajás Iron-ore Complex Azul Manganese Mine.	▪ A typical company town ▪ The entire infrastructure is owned by the company	Paternalistic—company controls physical and social environment	▪ Fairly constant at 5,500 ▪ Mostly mineworkers and their families	▪ Built/maintained by company ▪ High quality ▪ Relatively good health and education services and facilities	Activities revolve around the mines and supporting commercial services	Data included in Parauapebas' numbers	Limited facilities and options, but certainly best in the south of Pará
Parauapebas (started as supporting village for the mining operations in the early 1980s, emancipated municipality in 1998).	▪ Carajás Iron-ore Complex, ▪ Azul Manganese Mine, and ▪ Sossego Copper Mine.	▪ Gate development ▪ Chaotic development which has started at the gate to the mine /park boundaries	Company built first facilities and infrastructure but has since taken a "hands off' approach, with little intervention on social or physical environment	▪ Population boom since its beginnings ▪ From 53,335 in 1988 to 133,261 in 2007	▪ Clearly inadequate for population size ▪ Housing shortages ▪ Inadequate health and education services and facilities	Severely dependent on mining. Some services, agriculture and ranching	Grew 12.8% from 0.657 in 1991 to 0.74 in 2000, putting the city on the 11th position among the 143 cities in the state	Limited facilities and options
Canaã (started as a farming settlement in 1982, emancipated municipality in 1994)	▪ Sossego Copper Mine.	▪ Integrated community ▪ Company is extending infrastructure and building facilities and homes throughout the city (not in one specific neighborhood)	Collaborative, integrated development (extension) of independent existing community: company partnerships with foundations and government	▪ Population boom since the beginning of the Sossego Project ▪ From 11,139 in 1995 to 23,000 in 2006	▪ In development phase. ▪ Most isolated community case study ▪ Housing shortages ▪ Inadequate health and education services and facilities	Increasingly dependent on mining. Some family farms and large scale ranching	In 2000, the Human development Index (HDI) for Canaã dos Carajás was 0.699, below the HDI for the state (0.723) and Brazil (0.796)	Limited facilities and options

CHAPTER 3: APPROACH TO RESEARCH

This chapter discusses the approach to this research. It includes a summary of a literature review on Quality of Life and Subjective Wellbeing, and introduces and discusses the most relevant and most current QOL measurement studies, including tools that are particularly relevant to the methodology used in this research.

3.1. Quality of Life

The term Quality of Life (QOL) does not have an unambiguous and universally accepted definition; it has been used inconsistently and with diverse connotations (Cummins et al., 2002). Often, the term has been closely associated with the concept of wellbeing (Andrews and Withey, 1976; Diener, 1984; Glatzer, 1991; Eckermann, 2000; Noronha, 2001), happiness (Glatzer, 1991; Musschenga, 1997; Steel and Ones, 2002) and life satisfaction (Vittersø et al., 2002). For some authors, the term overlaps but is not synonymous with other terms, such as level of living, ways of life, and life satisfaction (Andrews and Withey, 1976).

In the western world, quality of life is a *terminal* societal value. Different from *instrumental* values, terminal values are life goals that are not means to an end, but end-states such as happiness, a comfortable life, peace, equality, freedom and wisdom (Sirgy, 2002). Instrumental values are those that need to be achieved if the terminal goals are to be experienced. Examples of instrumental values are hard work, respect for others, co-operation, loyalty, commitment and respect for the environment. Quality of life, as a terminal value, is often captured by common-language terms such as “happiness”, “a meaningful life” and “a comfortable life” (Sirgy, 2002). As a societal terminal value, governments and civil society organizations strive to attain a better quality of life for all. Recently, with the popularization of the notion of corporate social responsibility, corporations have also felt compelled to contribute, through their business, to the overall quality of life of the communities where they operate.

One of the key distinctions that have been made is the difference between the quality of life concept in health-related and non-health related fields. In the health-related fields, QOL has often been defined in a one-dimensional way (i.e., in terms of the absence of illness and symptoms of the disease under consideration, or health status) (Power et al., 2002), but

exceptions exist, such as the World Health Organization (WHO) quality of life definition, which includes the culture and context which influence an individual's perception of health (American Thoracic Society, 2002).

More recently, there has been wide agreement that quality of life is a multidimensional concept (e.g., Coffman and Adamek, 1999; Bowling and Gabriel, 2004) and needs to be understood in the context of culture and value systems in which individuals live and in relation to their goals, expectations, standards and concerns (Cummins et al., 2002; Power et al., 2002).

Quality of life is here understood as the external conditions of one's life—that is, what is available to individuals at a specific location and at a specific time of their lives. When making cognitive evaluations of one's quality of life, immediate and current conditions are examined.

3.2. Measuring Quality of Life

Quality of life (QOL) studies emerged during the social indicators movement of the late 1960s and early 1970s (Andrews and Withey, 1976), largely in response to dissatisfaction with traditional economic methods of measuring wellbeing. It was recognized that economic prosperity was often accompanied by degradation of the environment, increased poverty and inequality, and other social problems among some population groups (Beckley and Burkosky, 1999). Therefore economic measures such as growth in Gross Domestic Product (GDP) are often no longer considered enough for evaluating a nation's, region's or city's quality of life (Australian Centre on Quality of Life, 2005).

Historically, QOL measurement studies have been used for a number of purposes, including descriptive reporting of the state of a society or community; for the analysis of social change; for setting goals and priorities; and for developing a system of social accounts (Eyles 1994). According to Beckley and Burkosky (1999), there are 3 general types of quality of life studies: a) those conducted on a national or cross-national level to measure and compare social progress or "development" of nations; b) those that focus on the quality of life in local communities; and c) those that focus on the more subjective, individual view of quality of life.

The majority of the national, cross-national and community quality of life studies have trusted external judgments to define and measure quality of life.

3.2.1. Internal versus External Measurements of Quality of Life

The lack of clarity of the quality of life (QOL) concept and its inconsistent use is reflected in the variety of ways researchers have attempted to measure QOL. A critical discussion in QOL measurement, closely related to the QOL definition discussion, involves the objective versus the subjective way to define and measure QOL (Veenhoven, 2006). Externally measured indicators are usually referred to as "objective", although this work—including measures such as Human Development Index (HDI)[18], the Index of Social Progress (ISP)[19] and the Gross National Product (GDP)—inevitably requires subjective judgments by the analyst on the meaning and content of wellbeing (Sirgy et al., 2006). The term "objective measures" therefore refers to the degree a life meets explicit standards of what is "good" as assessed externally by an impartial outsider. The term "subjective measures" involves self-appraisals based on implicit, internally defined criteria (Veenhoven, 2006).

Traditionally, QOL studies have almost exclusively relied on external measures (e.g., the environment) and the external circumstances (based on outsiders' judgments) of an individual's life, such as pollution, traffic congestion, access to health care, quality of housing and aesthetic surroundings. External judgments might be perceived to be more manageable by decision makers when compared to attitudes or feelings (e.g., feelings of love or belonging), which can only be measured internally and at an individual level. However, it has been widely argued that subjective measures are necessary to properly evaluate a society, and that they add substantially to the external measures that are often favored by policy makers (Diener and Suh, 1997), given that external circumstances "form only a limited aspect of the sum of satisfactions that make life worthwhile" (Dalkey, 1972, p. 9).

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[18] The United Nations Development Project HDI has reported on the development and progress of the world's nations since 1990, combining indicators of life expectancy, educational attainment, and income (United Nations Development Programme, 2004).

[19] The ISP is a framework for measuring national and international social development and examines the sectors of education, status of women, demography, political participation, cultural diversity, and welfare effort (Estes, 1998; Beckley and Burkosky, 1999).

In the early 1970s, Dalkey (1972) proposed that a fundamental question is whether external measures "constitute a major share of an individual's wellbeing, or whether they are dominated by factors such as a sense of achievement, love and affection, perceived freedom and so on" (Dalkey, 1972, p.9). Dalkey defended a deeper and more holistic evaluation of quality of life as perceived and experienced by individuals. This proposition was supported by Bateson (1972), who strongly felt that quality of life is not adequately defined only by physical variables, and suggested that what human beings care about the most is not "episodes or things as such, but the patterns and setting of their personal relationships —how they stand in love, belonging, hate, respect, responsibility, dependency, trust, and other abstract but nonetheless real relations" (Bateson 1972 in Andrews and Withey, 1976, p. 5).

Diener and Suh (1997) point out that in the last decades, researchers have suggested different approaches to measuring quality of life, such as through social indicators (e.g., health and levels of crime) (Sirgy and Cornwell, 2002; Requena, 2003), subjective wellbeing measures (e.g., individuals' perceptions of their lives and societies) (Proshansky and Fabian, 1986; Sirgy, 1998; Zumbo and Michalos, 2000; Vittersø, 2004), and economic indices (Organization for Economic Co-operation and Development, 1971; Szalai and Andrews, 1980). According to Diener and Suh, these alternative measures appraise 3 philosophical approaches to wellbeing. These are based, respectively, on normative ideals, on subjective experiences, and on individuals' abilities to select goods and services respectively. Diener and Suh argue that social indicators and subjective wellbeing measures are crucial to evaluating a society, and significantly add to the widespread economic indicators that are currently favored by policy makers and analysts.

More recently, a significant number of studies involving QOL measurement efforts have focused on the subjective characteristics (Cummins et al., 2002). The rationale for the focus on subjectivity is twofold: a) objective and subjective measurement have been observed to be poorly related (Cummins et al., 2002; Rojas, 2006); and b) clarity and consistency within each measure tends to be lost when both objective and subjective measures are combined (Power et al., 2002).

Even though there is an overload of external measures that relate to quality of life and wellbeing, the same is not true for subjective measures. Although interest in subjective wellbeing has grown over time and resulted in significant academic investigations in the last few

decades, there are only a few subjective quality of life measures that have been proved to be rigorous, comprehensive and systematic (Cummins et al., 2002).

It is therefore the premise of this research that it is worthwhile to measure quality of life using rigorous, comprehensive and systematic subjective measurements that reflect how people feel about their quality of life and the material conditions under which they live. Even though one cannot deny the importance of externally measurable factors such as income and access to health services and drinking water, perceptions can often matter more than realities, and how people relate to one another can matter more than their material circumstances and assets. Based on this assumption, the literature reviewed for this research includes a relatively recent and innovative body of knowledge built on subjective measures of quality of life often described in the literature as “Subjective Wellbeing”.

3.3. Subjective Wellbeing

The approach to this research, including the definition of the methodology and analytical framework are based on the theory of subjective wellbeing (SWB). SWB has a relatively short history in Psychology. Starting in the 1960s, the research on SWB within the field of Psychology slowly gained momentum. In the 1970s, large-scale national QOL surveys, which included assessments of SWB, were conducted in North America (e.g., Andrews and Withey, 1976; Campbell et al., 1976). The 1990s witnessed a significant expansion in SWB research (Sirgy et al., 2006).

Subjective wellbeing—commonly referred to as “subjective quality of life” or ”perceived quality of life”—has become an increasingly popular research subject worldwide, and clear trends regarding this concept have emerged from the literature (Bramston, 2002). The literature demonstrates an evolution of the knowledge in the quality of life field resulting from the consideration of the implications of affect and cognition in measuring subjective quality of life, achieved through continuous research and theory development.

As it has been widely acknowledged since Campbell et al. (1976), SWB includes both *affect* and *cognition* aspects (Cummins et al., 2002). The definition of cognitive versus affective is very important in quality of life research, and many researchers have made this differentiation. While

cognitive aspects involve conscious, judgmental processes that are dependent on a comparison of one's circumstances with what is thought to be an "appropriate standard" (Diener et al., 1985), affective aspects involve immediate emotional reactions. For example, while happiness and sadness are affective concepts (positive affect and negative affect, respectively), satisfaction or dissatisfaction are cognitive concepts (Sirgy, 2002).

The definition of SWB that has emerged over time is that of a broad, multi-faceted construct, which includes the affective and cognitive components that are gradually identified by early research. Diener et al. (1984, p. 277) offered the definition of SWB as "a broad category of phenomena that includes people's emotional responses, domain satisfactions, and global judgments of life satisfaction".

According to Cummins et al. (2003), the single most important subjective wellbeing feature is that it is always positive—it is normal for individuals to feel good about themselves. This assertion is based on the Homeostasis[20] theory of subjective wellbeing, which suggests that each person has a "set-point" for subjective wellbeing that is internally maintained and defended. This internally regulated set-point is believed to be genetically determined (International Wellbeing Group, 2004). It has been established through extensive research that the normal level of individual set-point variation about 60–90% and that the provision of personal resources (e.g., money, material belongings, personal relationships) does not normally increase the set-point on a long-term basis, although such resources can strengthen personal defenses against negative experiences (International Wellbeing Group, 2004).

For individuals suffering from homeostatic defeat (when homeostasis fails and no longer controls the SWB level), the provision of additional resources such as wealth and personal relationships may allow the individual to regain control of his/her wellbeing, causing it to rise until the set-point is achieved. Low or reduced levels of personal resources (e.g., poverty, low income, problems with personal relationships or the absence of a partner) can weaken or defeat subjective wellbeing homeostasis. When personal challenges such as stress, sadness or pain exceed personal resources, homeostasis is defeated, and subjective wellbeing decreases to levels below its normal 60–90% range (International Wellbeing Group, 2004).

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[20] In Psychology, homeostasis is a state of psychological equilibrium obtained when tension or a drive has been reduced or eliminated (Random House, 2006).

The second most important feature of subjective wellbeing is its stability, which has been demonstrated by studies using 2 types of data: the mean scores from population surveys and data obtained from individuals. Studies conducted by Cummins (1995) first demonstrated the strength of the SWB stability and consequently the predictability of population mean scores[21]. When individual measures of satisfaction with SWB are used, the standard deviation is much larger, but is also very consistent.

Psychologists—particularly social, personality, and developmental psychologists—and quality of life researchers often refer to the *subjective aspects of quality of life* as happiness, life satisfaction, subjective wellbeing, and *perceived* quality of life (Sirgy, 2002). It is critical, however, to pause here to discuss the differentiation between happiness, life satisfaction and subjective quality of life. All 3 terms are often used interchangeably with subjective wellbeing, and imply a subjective and internally defined concept. However, the bulk of research and literature on wellbeing suggests that these terms are not necessarily synonymous. Even though "happiness" and "life satisfaction" are quite often used interchangeably in the literature and frequently defined as subjective wellbeing, "subjective quality of life" is here conceptualized as peoples' satisfaction with their *quality of life*—their perception of the external conditions of their lives; of what is available to them at a specific location and at a specific time of life. One's satisfaction with one's *quality of life* is thus conceptually different from one's satisfaction with one's *life*. When making cognitive evaluations of one's quality of life, immediate and current conditions are examined, while one's life is usually evaluated considering past events and accomplishments, current conditions, and often, future possibilities and opportunities. Perceived quality of life or subjective quality of life therefore is one the factors that impact one's overall life satisfaction, but certainly not the only factor (Sirgy, 2002).

[21] The first of these studies combined data from population surveys performed in different Western countries and were highly diverse, having been conducted by different researchers, using different scales of measurement, at different times over the decades 1970 to 1990. The disparate results were combined by converting all data to the standardized 0 – 100 range (Cummins, 1995).

3.4. Measuring Subjective Wellbeing

3.4.1. Health-Focused versus Holistic Measurements

According to Cummins et al. (2002), a great number of studies of subjective wellbeing have generated over 600 measurement instruments, many of which were developed for specific population subgroups. These instruments have been largely designed for relatively disadvantaged groups, such as people with a medical condition, low income or a congenital condition (Cummins et al., 2002, Michalos, 2004). Consequently, some instruments have a deficit orientation, such that a high score indicates a relative lack of disability or condition, rather than quality of life (Cummins et al., 2002).

Examples of these instruments are abundant in the medical literature examined, and are usually described as “Health-related Quality of Life” instruments. Depending on the scale chosen, the measures involve factors such as disease symptoms, patients’ perceptions of their health, functional status and standard of care, and are often combined in one single scale. As a result, these instruments are unsuitable for use with the healthy population. A well-established, reliable health-focused quality of life instrument is the SF-36 Health Survey (Jordan-Marsh, 2002; Roberts and Meletiche, 2001), which includes 36 health-related questions. The SF-36 is a multipurpose measure as opposed to instruments that target a specific group defined by age, disease, or treatment group (Ware, 2007).

This research examined key instruments for self-reported subjective quality of life that can be used with the general population, and are therefore defined here as “holistic”[22] (Cummins et al., 2002). Table 2.1 includes details on some of self-reported subjective quality of life instruments, including health-focused and holistic tools.

[22] Most holistic scales devised for use with the general population cannot be used with all population sub-groups, such as people with cognitive impairment and children. These are important limitations since it means that the quality of life experienced by minority groups cannot be norm-referenced back to the general population (Cummins et al., 2002).

Table 3.1: Recent Quality of Life Measurement Instruments

Instrument	Domains	# of Items	Scale	Test Locations	Comments
EuroQOL (EQ-5D), (1990)	▪ mobility ▪ self-care ▪ usual activities ▪ pain or discomfort anxiety or depression	15	Visual analogue scale of satisfaction (similar to a thermometer), from 0 to 100	England, The Netherlands and Sweden.	Focuses on health-related quality of life.
SF-36 Health Scale, (1988)	Physical Health: ▪ general health ▪ bodily pain ▪ physical functioning ▪ role-physical ▪ Mental Health: ▪ social functioning ▪ vitality ▪ role-physical ▪ role-emotional	36	Multiple-choice scales as well as yes-no questions	United States of America, Sweden, United Kingdom and other 9 countries.	Most SF-36 items have their roots in instruments that have been in use since the 1970s and 1980s.
WHOQOL (World Health Organization Quality of Life), (1995)	▪ physical ▪ psychological ▪ level of independence ▪ social relationships ▪ environment ▪ spirituality/religion/ personal beliefs	236	Likert scale 1–5 of satisfaction	Pilot study carried out in 15 field centres in Africa, Asia, Europe and Australia.	Focuses on health-related quality of life, but includes other areas besides physical, mental and social, such as environment and spiritual/religious aspects.
WHOQOL –100, (1998) (short form of WHOQOL)	Same as above.	100	Likert scale 1–5 of satisfaction	Analysis carried out in 15 field centres in Africa, Asia, Europe and Australia.	The WHOQOL –100 is a refinement of the WHOQOL; a shortened scale.

Table 3.1: Recent Quality of Life Measurement Instruments (CONTINUED)

Instrument	Domains	# of Items	Scale	Test Locations	Comments
WHOQOL-BREF, (1998) (short form of WHOQOL – 100)	▪ physical ▪ psychological ▪ social relationships ▪ environment	24	Likert scale 1–5 of satisfaction	Analysis carried out in 15 field centres in Africa, Asia, Europe and Australia.	It is a further shortened form of the WHOQOL-100, with summary scores for 4 domains rather than detailed scores at the facet (sub-domain level).
Comprehensive Quality of Life Scale (ComQOL), (1997)	▪ material wellbeing ▪ health ▪ productivity ▪ relationships ▪ safety ▪ community ▪ emotional wellbeing	7	Several non-scale questions, scales of importance (5-point) and satisfaction (7-point)	Australia.	Following investigation of validity and reliability of the ComQol instrument, changes were made in domain determination, metrics, and the response scale format, resulting in the International Wellbeing Index (IWI).
Personal Wellbeing Index (PWI), (2001)	▪ standard of living ▪ health ▪ achievement in life ▪ safety ▪ personal relationships ▪ future security ▪ community connectedness	7	Likert 0–10 scale of satisfaction	Australia.	The PWI is applied along with the National Wellbeing Index (NWI) to form the International Wellbeing Index (IWI).
Satisfaction with Life Scale (SWLS), (1985)	▪ life expectations ▪ living conditions ▪ life accomplishments	5	Likert 1–7 scale of agreement	41 countries in Africa, Latin America, North America, Asia and Europe.	This tool measures satisfaction with “life”, which is conceptually different from satisfaction with quality of life.

3.4.2. Self-Reported Levels of Satisfaction

Subjective wellbeing refers to wellbeing as declared by an individual; it is a self-reported measure based on a person's answer to either one question or several questions about their wellbeing (Rojas, 2006). An important concept that has been widely accepted is that the cognitive component of subjective quality of life involves some form of internal comparison process (with past conditions, other people, etc), and as a consequence, it is generally recognized that the cognitive component of subjective quality of life can be effectively measured through questions of "satisfaction" (Cummins, 2002b).

Levels of satisfaction can be measured through qualitative methods such as interviews or focus groups. Generally, however, studies of subjective quality of life have developed instruments for the measurement of self-reported satisfaction levels using psychometrics—the branch of Psychology that deals with the design, administration, and interpretation of quantitative tests for the measurement of psychological variables. Psychometric tools are quantitative measurement tools mostly used for the measurement of psychological variables such as intelligence, aptitude, and personality traits. These tools are widely used in Psychology, education, and the social sciences in general (The American Heritage Dictionary of English Language, n.d.). Psychometric scale development includes comprehensive processes of design and testing of questions and response scales for cognitive problems[23], and the testing of reliability and validity.

3.4.3. Reflective versus Formative Indicators

A relevant observation for the development of psychometric instruments to measure quality of life is the distinction between reflective and formative quality of life indicators and quality of life domains.

Reflective indicators are measures designed to capture the concept of quality of life directly, while formative indicators capture the concept of quality of life indirectly through other concepts

[23] Cognitive problems are those with comprehension or understanding of the questions, which implied that some respondents might not in fact understand what the concept means or different interpretations, were possible. If cognitive problems exist, it is difficult to guarantee that all respondents answered the question proposed or their interpretation of the question.

believed to play a significant role in the formation of this concept. Reflective indicators of subjective wellbeing, such as “Generally speaking, are you a happy person?", aim at capturing the behavioral phenomenon in a holistic and global manner (Sirgy, 2002). Examples of how reflective indicators are used in Subjective Wellbeing (SWB) measurements are the Measure of Life Satisfaction (Spreitzer and Snyder, 1974) and the Satisfaction with Life Scale (Diener et al, 1985). In these instruments, reflective questions are asked or statements are made and respondents rate satisfaction or happiness with an item or agreement with the statement. Table 3.2 presents examples of some of such questions and statements.

As described by Sirgy (2002), formative indicators aim at capturing subjective wellbeing by tapping its “causes”. For example, the Quality of Life Questionnaire (Greenley et al., 1997) is supported by the theory that overall life satisfaction can be understood by measuring and aggregating levels of satisfaction with 7 life domains: *financial life*, *leisure life*, *social life*, *health* and *health care*. Other examples of how formative indicators are used in SWB measurements are the Quality of Life Index survey (Ferrans and Powers, 1985), the Quality of Life Inventory (Frisch, 1993), the ComQol (Cummins et al. 1994), and the Personal Wellbeing Index (Cummins, 2002b). In these instruments, formative questions are asked or statements are made and respondents rate their satisfaction with an item or agreement with the statement. While reflective indicators are holistic, formative indicators are diagnostic—they provide an understanding of the causes of the levels of satisfaction. These causes are therefore critical to the definition and operationalization of what is being measured (Sirgy, 2002).

Instruments using a formative approach tend to include several items, often called quality of life *domains* or *dimensions*. Table 3.3 exhibits a few instruments identified by Sirgy (2002) in a comprehensive review of quality of life instruments. The Australian Centre on Quality of Life (ACQOL)[24] database of quality of life instruments, which includes over 600 instruments, was also used to complement information in Table 3.3.

[24] Located at the Deakin University, Melbourne, Australia (http://acqol.deakin.edu.au/instruments/instrument.php)

Table 3.2: Examples of SWB Measurements Using Reflective Approach

Instruments	Questions	Scale
Measure of Life Satisfaction (for the elderly) (Spreitzer and Snyder, 1974)	"Taking things all together, how would you say things are these days—would you say that you are very happy, pretty happy, or not too happy?	One (1) single item, scores from 1–3: 1) very happy 2) pretty happy 3) not too happy
Delighted –Terrible (D-T) Scale (Andrew and Withey, 1976)	"How do you feel about your life as a whole?	Coded scale: delighted, pleased, mostly satisfied, about equally satisfied and dissatisfied, mostly dissatisfied, unhappy and terrible.
Happy Person (O-HP) Scale (Veenhoven, 1974)	"Generally speaking are you a happy person?"	Open line scale, later coded in 7 categories, ranging from "very unhappy" (1) to "very happy" (7).
Satisfaction with Life one Leads (O-SLL) (Part of Euro-barometer surveys, in all EU member states, since 1973)	"On the whole how satisfied are you with the life you lead?"	Scale of satisfaction: 4) very satisfied 3) fairly satisfied 2) not very satisfied 1) not at all satisfied
Satisfaction with Life Scale (Diener et al., 1985)	"Below are 5 statements with which you may agree or disagree. Using the 1–7 scale below, indicate your agreement with each item by placing the appropriate number in the line preceding that item. Please be open and honest in your responding." Items: ▪ In most ways my life is close to ideal ▪ The conditions of my life are excellent ▪ I am satisfied with my life ▪ So far I have gotten the important things I want in life ▪ If I could live my life over, I would change almost nothing	7-point Likert scale of agreement: 7) Strongly agree 6) Agree, 5) Slightly agree, 4) Neither agree nor disagree, 3) Slightly disagree, 2) Disagree, and 1) Strongly disagree

This research adopted a combination of reflective and formative indicators as part of its methodology—more specifically, in the form of a quality of life questionnaire. Further discussion on the questionnaire design in presented in Chapter 4.

Table 3.3: SWB Measurements Using Formative Approach

Instruments	Domains	Scale
The Quality-of-life Index (Ferrans and Powers, 1985)	14 in total: ▪ Your relationship with your spouse ▪ Your friends ▪ Your standard of living ▪ Your ability to meet non-financial family responsibilities ▪ Your usefulness to others ▪ Amount of non-job stress or worries in your life ▪ Your financial independence ▪ Your leisure time activities ▪ Your achievements and personal goals ▪ Your happiness in general ▪ Your health ▪ Size of the city in which you live ▪ Your religious life ▪ Your family's happiness	Consists of 2 sections of 32 items each. One section measures satisfaction, and the other measures importance. 6-point scale of satisfaction, from "very dissatisfied" to "very satisfied".
The Quality-of-life Inventory (Frisch, 1993)	16 in total: ▪ Health ▪ Self-esteem ▪ Goals and values ▪ Money ▪ Work ▪ Play ▪ Learning ▪ Creativity ▪ Helping ▪ Love ▪ Friends ▪ Children ▪ Relatives ▪ Home ▪ Neighborhood ▪ Community	3-point rating scale for importance and 6-point rating scale for satisfaction. Overall life satisfaction is calculated as the sum of satisfactions with the 16 life domains.
The needs hierarchy measure of life satisfaction (Sirgy et al., 1995)	4 in total (based on Maslow's need-hierarchy theory): ▪ Survival needs ▪ Social needs ▪ Ego needs ▪ Self-actualization needs	"How much is there now?" "How much should there be?" Answer scales from 1 to 7. The overall score is calculated by taking the absolute difference score between the 2 questions.

Table 3.3: SWB Measurements Using Formative Approach (CONTINUED)

Instruments	Domains	Scale
The Quality of Life Questionnaire (Greenley et al., 1997)	7 in total: ▪ Living situation ▪ Finances ▪ Leisure ▪ Family ▪ Social life ▪ Health ▪ Access to medical care	24 items on 7-point scales.
Comprehensive Quality of Life Scale (ComQol), (Cummins, 1993)	7 in total: ▪ Material wellbeing ▪ Health ▪ Productivity ▪ Intimacy ▪ Safety ▪ Place in community ▪ Emotional wellbeing	Several non-scale questions, scales of importance (5-point) and satisfaction (7-point).
Personal Wellbeing Index (International Wellbeing Group, 2004)	7 in total: ▪ Standard of living ▪ Health ▪ Achievement in life ▪ Safety ▪ Personal relationships ▪ Future security ▪ Feeling part of the community	Likert 0–10 point scale of satisfaction: "How satisfied are you with…?" 0 = extremely dissatisfied 5 = not satisfied or dissatisfied 10 = extremely satisfied

3.4.4. Quality of Life Domains

A widely accepted concept is that life satisfaction can be divided into a number of domains representing areas of life experience, and that satisfaction with each domain, in aggregate, reflects overall life satisfaction (Campbell et al., 1976; Diener, 1994). The notion of general quality of life being defined by domains has also been broadly employed and validated in quality of life studies in Canada and abroad (Michalos, 1985; Cummins, 1996; Michalos, 1997; Hagerty et al., 2001; Sirgy et al., 2001; Bernhard et al., 2004; Hsieh, 2004).

Quality of life (QOL) domains can usually be determined through a logical process of "deconstructing" the general goal of quality of life. In subjective quality of life research, these domains would represent areas of life experience, and satisfaction with each domain, in aggregate, reflects overall life satisfaction (Campbell et al., 1976; Diener, 1994). Examples of domains used in subjective quality of life studies are presented in Table 3.1 and Table 3.3.

Advanced investigations of domains can be accomplished by further breaking those domains down into measurable elements—which have been defined as *facets* (e.g., WHOQOL 1995) and/or *indicators* (e.g., Smith Criteria 1973).

An early example of a study that used objective measures of quality of life, QOL domains and indicators can be found in Smith (1973). Using an urban social geography perspective, Smith identified 6 major domains of QOL: economic status, environment, health, education, social disorganization, and participation and equality (Table 3.4). Smith further subdivided these domains into more detailed aspects and finally developed 48 QOL indicators.

In a comprehensive literature review, Beesley and Russwurm (1989) draw from a broad variety of sources to identify a number of domains common to the majority of QOL studies. The literature that they referenced included the United Nations' "level of living", Drewnoski's development of "living index", Smith's "criteria", Harvey's "list of needs", Hagerstrand's notion on "liveability", and Shulman's study on quality of life medium-sized Canadian cities. The criteria/domains Beesley and Russwurm identified included education, leisure, health, employment, transportation, social environment, security, physical environment, and social opportunity/participation.

Table 3.4: Domains in Smith's Criteria (1973)

Economic Status	Environment	Health	Education	Social Disorganization	Participation and Equality
▪ Income ▪ Employment ▪ Welfare	▪ Housing ▪ Sewage ▪ Air pollution ▪ Open space	▪ General mortality ▪ Chronic diseases	▪ Duration	▪ Personal pathologies ▪ Family breakdown ▪ Overcrowding ▪ Public order and safety ▪ Delinquency	▪ Democratic participation ▪ Equality

Source: Knox (1987 p. 142)

However, the manner in which QOL domains are characterized has generated a variety of opinions. This problem has recently become less controversial, and several authors currently agree on the character of some central domains of quality of life, such as health, economic wealth, and social relationships. The consideration of these domains is important in this literature review because the approach for the methodology of this research is to examine these

domains from a subjective perspective. Therefore, domains examined and considered in the methodology and conceptual model for this study include those used in existing objective and subjective approaches.

Table 3.5 illustrates common quality of life domains adopted by recent instruments with formative measures of subjective quality of life domains.

Table 3.5: Quality of Life Domains in Selected Instruments

Domains	Instruments											
	Life Expectations	Happiness, Emotional Wellbeing, Psychological Wellbeing	Community Issues/ Social Conditions	Material Economic or Financial Situation, Future Security	Health	Productivity/Work	Social Relationships	Standard of Living/ Living Conditions	State of the Environment	Safety	Love	Achievements in Life, Self-Esteem
Satisfaction with Life Scale	X							X				X
Comprehensive Quality of Life Scale		X	X	X	X	X	X					
WHOQOL- BREF		X			X		X		X			
The Quality of Life Questionnaire				X	X		X	X				
The Quality of Life Index		X	X	X	X						X	X
The Quality-of-life Inventory	X		X	X	X	X	X					X
Personal Wellbeing Index			X	X	X		X	X		X		X

3.5. Reflecting on the Quality of Life Literature

The review of the literature on quality of life, subjective wellbeing and measurement instruments provides a strong methodological and theoretical basis for this research. It seems sensible to define domains and indicators of quality of life and to use self-appraisal instruments to measure satisfaction. Moreover, the literature supports the multi-methods approach to the research design in order to support findings from quantitative analysis of instruments' data.

The review of the literature also provides this research with tools to identify and validate quality of life domains, and indicators that can be used equally in evaluating each of the 3 communities focused on in this research. Further discussion of the development of quality of life domains and indicators for this research is presented in the next chapter.

CHAPTER 4: METHODOLOGICAL STRATEGY

This chapter discusses the methodological strategy chosen for this research. This research takes a case study approach and includes a combination of qualitative and quantitative sources of evidence, as well as the triangulation of findings.

Research was implemented in three phases: a preliminary research phase, a model and questionnaire development phase, and a comprehensive data collection phase (Figure 4.1). Phases II and III included fieldwork in the 3 case study communities.

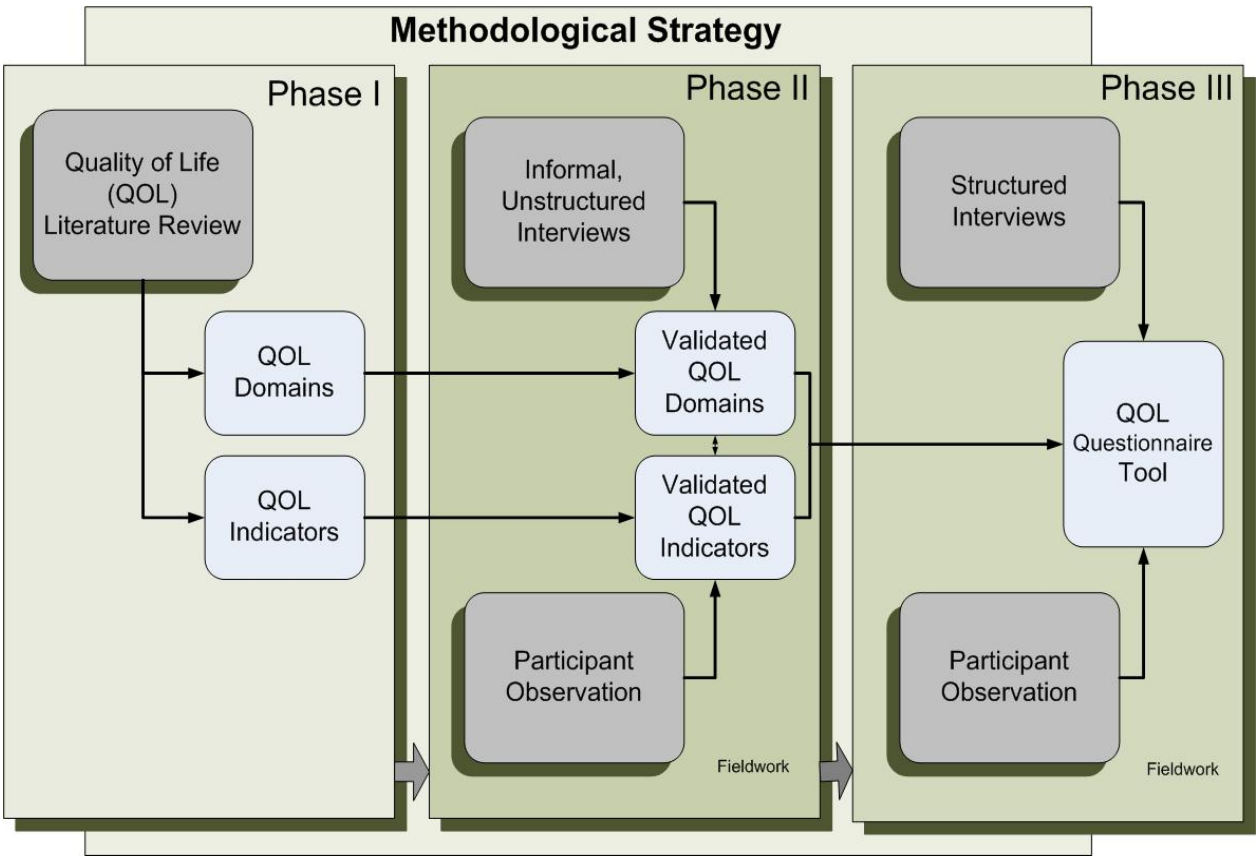

Figure 4.1: Research Phases and Methods

4.1 Methods Overview

This research project is an exploratory multiple case study. The case study is one of several approaches to conducting social science research[25]. Yin described the case study as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 1994). Since this research deliberately intends to cover contextual conditions—because these are believed to be pertinent to the phenomenon investigated—the case study strategy was deemed ideal.

Case study inquiry benefits from existing theoretical propositions to guide data collection and analysis. This method copes with a large number of variables of interests by relying on multiple sources of evidence (Jick, 1983; Yin, 1994). Therefore, case study data need to converge in triangulation[26] (Yin, 1994).

Denzin (1978, p. 291) described triangulation as "the combination of methodologies in the study of the same phenomenon". The use of triangulation as a means to achieve convergence of findings is widely used in research[27]. The cross validation achieved when two or more distinct methods are found to be congruent and yield comparable data enhances the validity of results (Jick, 1983). However, triangulation can achieve more than convergent validation: It can capture a more holistic and contextual description of the phenomena investigated. The triangulation of multiple measures may also illuminate elements of the context by eliciting data and suggesting conclusions that single methods might have neglected (Jick, 1983).

Scientists have widely advocated the viability and importance of the integration of quantitative and qualitative methods (Jick, 1983). By using complementary methods, triangulation claims to exploit their strengths and mitigate their limitations (Rohner, 1977; Jick, 1983). The combination

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[25] Other approaches are experiments, surveys, and the analysis of archival information (Yin, 1994).
[26] The triangulation metaphor has its origins in navigation and military strategies that use multiple reference points to locate the exact position of an object. Multiple viewpoints are expected to provide for greater accuracy. This same theory can be applied to researchers looking to improve the accuracy of their findings (Jick, 1983).
[27] Another conceptualization of triangulation is described by Denzin as the "within method", which uses multiple techniques within one method to collect and interpret data. An example is a survey that includes different scales or questions that address the same construct (Denzin, 1978).

of qualitative fieldwork and survey methods is one of the most prevalent attempts to use triangulation.

As sources of evidence, this research considers and triangulates data from the following:

- the existing literature on quality of life and subjective wellbeing and resource communities;
- context-relevant literature particularly related to the geographical location of the case studies, and the 3 case study communities and mining company associated with them;
- data collected from interviews and focus groups;
- data collected through a quality of life survey; and
- participant observation.

4.1.1. Literature Review

The literature review for this research included two main themes: quality of life and quality of life measurements (mostly in psychology and economic literature) as well as single-industry, resource communities, and mining communities' literature. This review included scientific journal articles, books as well as grey literature and was completed using the following sources:

- University of British Columbia Library (books, journals, and grey literature)
- University of British Columbia Library on-line journal database (urban, community and regional planning, mining engineering, psychology, economics, epidemiology and sociology databases)
- Government of British Columbia. Ministry of Community Services Bibliography on Local Government in British Columbia (single industry towns)
- World Wide Web (municipal, state and federal government sites, relevant blogs and news media)
- International Society for Quality of Life (ISQOL) publications database
- Australian Centre on Quality of Life (ACQOL) publications database
- Questia On-line Library (www.questia.com)
- HighBeam Research On-line Library (www.hghbean.com)

Other sources include Vale website and corporate materials, as well as online and print news associated with the case study communities and operations. Data collected through personal communication (interviews) were also used as reference throughout the thesis.

4.1.2. Participant Observation

Case studies may take a variety of forms, most of which include participant observation (Yin, 1994). The main goal of participant observation is to generate “practical and theoretical truths about human life grounded in the realities of daily existence” (Jorgensen, 1989, p. 13). This approach is appropriate for studying processes, relationships between events, human relationships and organizations, patterns, and the immediate socio-cultural contexts in which human life takes place (Jorgensen, 1989).

Participant observation may take place in a continuum that ranges from complete immersion in the setting as a full participant to spectator with a complete separation from the setting (Shipman, 1997; Patton, 2002). Participation can also be overt or covert (Jorgensen, 1989). For this research, the observer assumed overt yet varied roles. During the first fieldwork period (25 days), the researcher was an intern with the mining company. For the second fieldwork period (15 days) the researcher assumed a visitor role. During the third fieldwork period (30 days), the researcher assumed an academic researcher role.

According to Patton (2002), direct, personal contact with and observation of a setting have clear advantages. Firstly, through observation, the researcher is better able to understand and capture the context of a phenomenon that occurs and how people interact with each other, which is essential to a holistic perspective. Secondly, firsthand experience with a setting allows the researcher to be open and discovery-oriented because while in the field, the observer has less of a need to rely on prior documented or oral conceptualizations of the setting. The third strength of observational fieldwork is the opportunity to discover things that do not come up in interviews because no one else has ever paid attention to them. Participant observers may perceive routines that may be taken for granted and/or remain unnoticed by others in the setting (Patton, 2002).

“Questions regarding concept validity in participant observation revolve around whether or not the investigator has gained direct access to the insider’s world of meaning and action”

(Jorgensen, 1989 p. 36). Participant observation methodology requires the investigator to collect multiple forms of evidence regarding key concepts. It is therefore important to describe conflicts and disagreements over the meanings of basic concepts, and note differences among insiders. Thus actual use of the concept in the field while interacting with participants provides a powerful test of the validity of concepts (Jorgensen, 1989).

Since participant observation is rarely performed as a measurement, the conventional notion of reliability is unsuitable. Observation is very concerned with dependable and trustworthy findings, and is thus very much interrelated with validity. Validity and reliability of participant observation are therefore mostly checked through the use of several forms of evidence; the extent to which the investigator had direct access to the subject's world; and extensive discussion of procedures of data collection and analysis (Jorgensen, 1989).

Limitations of the participant observation method are closely associated with the concept of researcher bias—the effect of the individual's personal, professional and political views. Bias is, therefore, "part of any research, from design to implementation" (Shipman, 1997, p. 19). Since human beings construct their own knowledge of the world around them, a detached position for neutral observation is unattainable (Shipman, 1997).

4.1.3. Interviews

Interviewing refers to the range of strategies for formally asking questions. The qualitative research interview seeks to describe the meanings of central themes in the experience of the subjects. The main task in interviewing is therefore understanding the meaning of what the participants say (Kvale, 1996; Strauss and Corbin, 1998). Since the researcher works directly with the respondent in interviews, these are a far more personal form of research than questionnaires (Kvale, 1996).

Interviews are particularly useful for getting the story behind a participant's experiences. Individual interviews are the best approach when the purpose of the data collection is to have an individual, open-ended discussion on a range of issues and to obtain in-depth information on an individual basis about perceptions and concerns (Kvale, 1996). Individual interviews are particularly useful when:

- the topic is too sensitive for a group discussion;

- the target population differs in age, ethnicity, culture, or social background from investigators;
- participants may have a low reading ability; and/or
- it is difficult to gather people in groups due to conflicting schedules and/or geographic location.

In general, individual interviews can be classified as un*structured* or *structured* interviews. In unstructured interviews, the flow of conversation is more open and natural. This allows respondents to express their views about a topic, including good and bad points, without being prejudiced by the interviewer's own beliefs. It also allows participants to discuss points that are of importance to them and points that may not have occurred to the interviewer. Pre-determined questions are asked, but the interview remains as open and adaptable as possible to the interviewee's nature and priorities. An unstructured interview is conducted in a question-and-response format and may be free-flowing. However, it becomes structured in the sense that the interviewer has a purpose and requires skill to establish a relationship and ask well-structured questions to generate a conversational flow in which the participant offers information (factual, opinion, subjective and objective) about the matter under investigation (Kvale, 1996). Unstructured interviews were used in Phase II of this research.

In structured interviews, the interviewer decides what to ask and in what order. As a result, structured interviews can only get participants' perceptions of the issues the interviewer believes to be important (Institute of Education Technology, 1996). Structured interviews can include standardized, open-ended questions, when the same open-ended questions are asked to all interviewees (this approach facilitates faster interviews that can be more easily analyzed and compared); or closed, fixed-response questioning, when all interviewees are asked the same questions and asked to choose answers from among the same set of alternatives. Phase III of this research includes structured interviews with open-ended questions.

Interviewing requires a skilled researcher to make clear the meaning of questions, establish rapport with the respondent, and probe responses without leading the respondent to give certain answers (Strauss and Corbin, 1998). In the case of this research, the interviewer provided clarity regarding the purpose of the research and the particular focus of the investigation. In ensuring information received was properly heard and understood, listening, clarifying and reflective summarizing were important steps performed by the interviewer. To reduce the

uncertainty associated with the subjectivity of interview procedures, questions were tested on site. For the structured interviews in Phase III, the researcher closely followed a pre-defined interview protocol to reduce the interviewer bias (Groves et al., 2004).

4.1.4. Survey Questionnaire

A survey can be described as a systematic method for gathering information from a sample of people for the purposes of constructing quantitative descriptors of the larger population of which the respondents are members. Survey questionnaires are popular research tools because they collect data from large numbers of participants quickly and systematically (Groves et al., 2004). In sample survey questionnaires, standardized measurement and sampling procedures enhance the reliability of observation, facilitate the replication of studies and allow for statistical analysis of data and generalizations for larger populations (McClintock et al., 1983).

Questionnaire design is a meticulous and comprehensive process that implies careful question design to avoid cognitive problems and ensure accuracy of measurements (Shipman, 1997; Groves et al., 2004). Along with the definition of the population sampling approach, a critical issue in questionnaire design is the management of numerous potential errors[28] (Groves et al., 2004). Questionnaires are also evaluated for construct validity and reliability. In the case of this research, the questionnaire design also drew from existing validated psychometric quality of life and wellbeing instruments.

Some limitations of survey questionnaires are associated with the way questions are written by the researcher and understood by respondents (Patton, 2002). At both steps, there are chances for error. Another challenge with questionnaire design is that the researcher can never be absolutely certain that cognitive problems do not exist, or of the reasons why some questions are left unanswered. To mitigate these limitations, the questions and response scales were emulated from previously tested quality of life questionnaires. Questionnaires were also pre-tested in the field.

[28] Survey errors might include measurement errors, processing errors, coverage errors, sampling errors, nonresponse errors and adjustment errors (Groves et al., 2004).

A specific challenge of using questionnaires for measuring levels of satisfaction with quality of life in cross-sectional research designs is that participants respond only once. This is challenging because external transitory events might impact how individuals rate levels of satisfaction with domains or indicators. Longitudinal designs—when measurements are taken on multiple occasions—minimize the effects of the momentary contextual conditions (Sirgy et al., 2006). Given the time and resource limitations of this research, the methodology was strengthened by a multi-method strategy that included interviews and participant observation.

4.2. Phase I: Preliminary Research

This phase consisted of a comprehensive review of the literature and methodology and the first attempt to define a conceptual model for the study. The broad literature review conducted in Phase I is summarized in the first chapters of this thesis.

The literature on quality of life (QOL) measurement instruments provided information on which domain indicators have been tested in cross-cultural studies and proved to conform to validity and reliability expectations. Details on the major instruments and domains, and literature on quality of life and wellbeing studies also contributed to the initial definition of QOL domains for this research project (Tables 3.1, 3.2, 3.3 and 3.4).

The intention of this research was, similar to several studies found in the literature (e.g., Michalos, 1985; Cummins, 1996; Michalos, 1997; Hagerty et al., 2001; Sirgy et al., 2001; Bernhard et al., 2004; Hsieh, 2004), to define a list of domains and indicators for each of these domains. This task was completed in Phase II.

4.3. Phase II: Quality of Life Model

Phase II consisted of the validation of domains and definition of the indicators. This was accomplished through qualitative analysis of on-site interviews, supported by participant observation notes taken by the researcher, and the literature review on quality of life studies and subjective wellbeing.

The process of defining domains and indicators was an iterative one. Based on the literature review on mining/single industry/resource communities, quality of life (QOL) and QOL measurement tools, 4 initial domains were chosen: economic, social, environmental and health. With the content analysis of the initial exploratory interviews on site (Canaã dos Carajás, Parauapebas and Núcleo Urbano de Carajás), the initial four domains were validated, and one additional domain was added: the work domain.

The work domain was included in the QOL model for this research because of the unique nature of the communities studied (single-industry communities with populations largely composed of migrants from other towns or states). It is well documented that in life satisfaction studies, individuals living in single-industry or “occupational communities” such as mining towns usually consider work a very important part of their lives. For these individuals, work often influences their self-image, their choice of reference social groups and of friends (Near et al., 1980). Interviews in Phase II and the field observations support this theory. The literature on quality of life in the fields of organizational behaviour and mangement also provides discussions on what is referreed to as quality of work life (QWL) (e.g., O’brien, 1990; Tait et al., 1989). Quality of Work Life (QWL) has also been found to be significant predictor of life satisfaction (Sirgy et al., 2006).

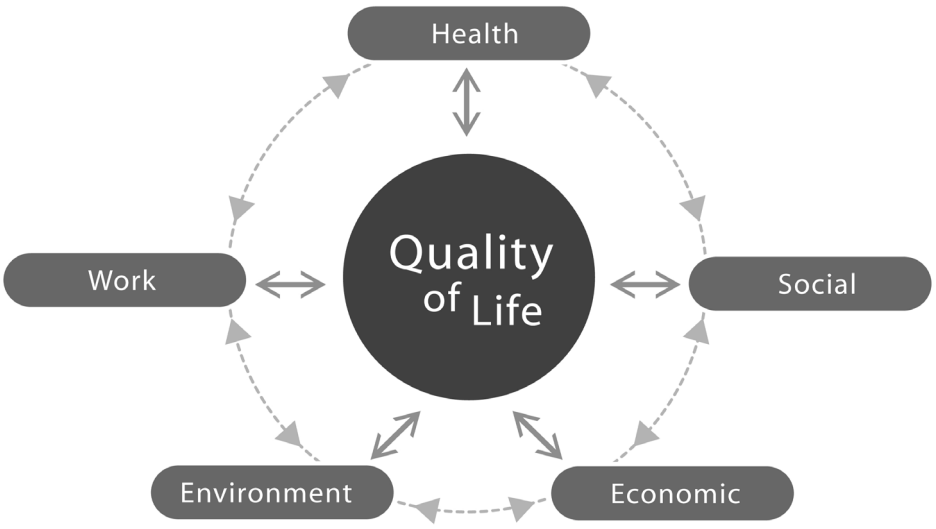

Figure 4.2: A Preliminary Quality of Life Conceptual Model

The work domain was therefore included in the conceptual model for this research and added to the quality of life questionnaire. This hypothesis was tested in Phase III.

Considering the five conceptual model domains, literature regarding indicators was reviewed once again. During the first fieldwork period (25 days), the researcher was able to visit all 3 case study communities and conduct unstructured interviews with employees and other residents.

Interview content analysis was also critical in the validation of indicators from the literature as well as in determining new indicators appropriate to the context of the 3 case study communities.

4.3.1. Phase II: Methods

Even though this research's sampled population is mostly composed of employee-residents, it was considered valuable to include subjects who did not work for Vale in order to increase the researcher's ability to identify as many local QOL issues as possible in a relatively short period of field work. These individuals were considered key informants and were mostly critical service providers (e.g., doctors, school teachers).

The initial unstructured interviews were conducted with key informants working in the 3 case study communities (Portuguese terms are explained in the Glossary at the beginning of this document):

- Community Affairs staff at the Non-ferrous Division (*Diretoria de Operações de Não-ferrosos de Carajás*—DIOC), and Ferrous Metals Division *(Diretoria de Ferrosos*—DIFN) in the Núcleo Urbano de Carajás and Canaã dos Carajás
- Coordinator of Health and Education Services, Núcleo Urbano de Carajás
- Coordinator and Transportation and Food Services, Núcleo Urbano de Carajás
- Head Nurse, Special Programs, Hospital Yutaka Takeda, Núcleo Urbano de Carajás
- Executive Director, Hospital Yutaka Takeda, Núcleo Urbano de Carajás
- Doctor, Hospital Yutaka Takeda, Núcleo Urbano de Carajás
- Social Worker, DIFN
- Director, *Agência de Desenvolvimento* (Sustainable Development Agency), Canaã dos Carajás
- Primary School Principal; Vila Bom Jesus, Canaã dos Carajás

- Elementary School Principal, Canaã dos Carajás
- Senior geologist, DIFN, Núcleo Urbano de Carajás
- Junior geologist, DIOC, Canaã dos Carajás

A convenience sample[29] of 17 residents was also interviewed. This sample included interns, Vale employees and other residents of the 3 case study communities. A group of 3 workers participated in a focus group regarding the Sossego Camp, located in Canaã dos Carajás. Participants from interviews and the focus group were contacted by the researcher and were interviewed in either their places of work or their homes.

The initial unstructured interviews were conducted to identify issues, likes and dislikes, concerns, and thoughts on quality of life in the 3 case study communities. Some interviews also aimed at understanding the company's approach, policies and programs, or at understanding the particularities of the 3 mining operations: Carajás Iron-ore Mine, Azul Manganese Mine and Sossego Copper Mine. The interviews and the focus group were tape recorded with informed consent from all participants; following the requirements of the University of British Columbia's Behavioural Research Ethics Board (confirmation of approval is available in Appendix B). .

Table 4.1: Phase II Data Collection

Focus of Research	Communities		
	Nucleo Urbano de Carajás	**Canaã dos Carajás**	**Parauapebas**
1. Investigating factors (domains and facets) of quality of life	11 interviews	4 interviews 1 focus group with 3 participants	2 interviews
2. Understanding the company approach, policies and programs	6 interviews	2 interviews	2 interviews

Coding of the initial interviews and the focus group (Table 4.1) provided an initial list of broad themes or concepts (i.e., factors affecting quality of life), which were categorized under broader themes (i.e., quality of life domains) and considered as indicators. This list was instrumental in

[29] A convenience sample is composed of easily accessible individuals and is not representative of the entire population (Shipman, 1997).

reaching the objectives of Phase II. Examples of the concepts are *difficult access to goods and services*, *lack of privacy*, and *difficult access to health services*.

While several interviews were completed with Núcleo Urbano de Carajás and Canaã dos Carajás residents, only 2 interviews were completed with Parauapebas residents. This was due to the initial research design and scope, which included only Núcleo Urbano de Carajás and Canaã dos Carajás as case studies. During interviews and researcher's observations on site, it became clear that the Núcleo Urbano de Carajás had physical growth constraints due to being located in a National Park and will, in the near future, accommodate exclusively higher-ranking Vale employees and their families. It will not be able to accommodate the growing influx of employees relocating to the region as mine operations expand. As a result, Vale employees are increasingly taking up residence in Parauapebas.

In Phase II, the direct observation data assisted with the interpretation of results from the qualitative data collected through interviews and the focus group. These results indicated that all of the conceptual domains identified—i.e., social, economic, environmental, work and health—seem to be relevant to the quality of life in the case study communities. Phase III included further qualitative data collection as well as a significant quantitative data collection effort and aims at validating both the domains and the indicators chosen in Phase II.

4.3.2. Quality of Life Domains and Indicators

Quality of life (QOL) indicators are standardized measures with which to monitor and compare the QOL of a group or population. The approach taken in this dissertation was to select a list of formative indicators from each of the selected domains and include them in a QOL questionnaire that will be described later in this chapter.

What follows is the list of concepts that were brought up during Phase II interviews, and therefore considered as indicators, organized by domains. For each domain, a short discussion follows on how these indicators are aligned with the current literature on QOL and subjective wellbeing research.

a. Social Domain

The social domain includes the social relationships and social aspects of life in a community. The following are the social issues identified during the Phase II interviews and focus group:

- Personal relationships:
    - relationships with friends
    - relationships with family and spouse
    - ability to form long-lasting friendships
- Community connectedness/participation:
    - identification with specific groups within a community (e.g., religious, cultural, ethnic)
    - community participation
- Freedom of expression
- Privacy levels
- Personal safety

In the QOL literature, the use of *personal relationships* and *community connectedness or participation* concepts as indicators are strongly supported (Pibernik-Okanovic et al., 1996; Michalos, 1997; Zumbo and Michalos, 2000; Bramston et al., 2002; Sirgy and Cornwell, 2002; Chen et al., 2006). *Freedom of expression*, *privacy* and *personal safety* have been considered of particular interest for studies of quality of life at work for mining and silviculture camps (White, 2004; Costa et al., 2005). These issues are also prominent in existing literature on resource communities and remote single-industry communities (e.g., Robinson, 1962; Lucas, 1971; Riffel, 1975; Barbedo, 2000).

b. Economic Domain

As is well articulated in the literature on resource communities and fly-in-fly-out mining camps (e.g., Robinson, 1962; Lucas, 1971; Riffel, 1975; Sibbel et al., 2006), economic issues such as income and wealth are significant in these settings. The prospect of a higher income has been identified as a major factor in motivating people to move to such communties (Riffel, 1975; Sibbel et al., 2006). The economic domain includes aspects of one's financial life and material wealth. What follows are economic issues identified during the interviews and focus groups in Phase II.

- Salary and benefits
- Cost of living
- Material belongings
- Financial security

All of the above concepts have been used as indicators in QOL research (Cummins, 1996; Michalos, 1997; Sirgy and Cornwell, 2001; Bowling and Gabriel, 2004).

c. Health Domain

Quality of life researchers extensively agree on the definition of health as a QOL domain. QOL and health care have been linked for centuries (Sirgy et al., 2006). The health domain in this research includes the aspects of one's physical and mental health status as well as the availability of health services. Health-related issues identified during the Phase II interviews and by the focus group were:

- Levels of stress
- Level of physical activity
- Food and nutrition
- Work-life balance
- Availability of recreation and entertainment options as a means to maintain mental health
- Access to good-quality health services and facilities

These indicators have also been identified as significant issues in remote resource communities, including fly-in-fly-out mining camps (e.g., Robinson, 1962; Lucas, 1971; Riffel, 1975; Sibbel et al., 2006). The indicators above have also been used as health indicators of quality of life, sustainability and community health (e.g. Michalos, 1997; Sirgy et al., 2001; Government of New Zealand, 2003; Bernhard et al., 2004).

d. Environment Domain

The environment domain can be defined as both natural and built environment and surroundings. Environment-related issues identified during the Phase II interviews and by the focus group were:

- Quality of one's home or residence

- Quality and integrity of the natural environment
- Order and safety
- Infrastructure (e.g., transportation, sewage, water, electricity, internet services) quality and availability
- Shopping, education and recreation facilities

These issues have all been identified as indicators of QOL in previous studies (e.g., Pibernik-Okanovic et al., 1996; Michalos, 1997; Cummins, 2000; Noronha, 2001; Sirgy and Cornwell, 2001) and have been widely identified as evalution factors for remote resource or single-industry communities (e.g., Robinson, 1962; Lucas, 1971; Riffel, 1975; Storey, 2001; Sibbel et al., 2006). For this research, ecreation facilities was included in the health domain because it addresses the physical need for exercise to maintain good health.

e. Work Domain

Phase II interviews and the focus group made it clear that work and their own perceptions of their work life are very significant for employees living in the 3 case study communities. Work-related issues identified as affecting QOL were:

- Number of hours of work per week
- Amount of time off
- Salary and benefits
- Relationships at the work place
- Safety of the workplace
- Opportunities for growth in the organization
- Empowerment and ability to make decisions at work

These indicators are prominent isses in the Work Satisfaction literature (Rodgers, 1977; Kim and Cho, 2003; Requena, 2003). QWL research has identified participation in decision making and compensation packages as strong factors that impact QWL (Sirgy et al., 2006). The indicators *number of hours of work per week*, *salary* and *amount of time off* were tested and validated by the Australian Centre on Quality of Life PWI Survey 7; “The Wellbeing of Australians—The Effects of Work” (Cummins et al., 2003).

4.3.3. Quality of Life Survey Questionnaire Development

The survey questionnaire developed for Phase III is divided into 3 parts. Part 1 includes an adaptation of an existing satisfaction measurement tool, the Personal Wellbeing Index (PWI). Part 2 includes questions organized under the life domains identified in Phase I: work, social, health, environment, and economic domains. Part 3 includes personal and demographic questions intended to characterize respondents. The questionnaire was applied in the local language, Portuguese. An English version of the questionnaire is available in Appendix B.

For the first two parts of the questionnaire, an end-defined, Likert-like scale was used. The sociologist Rensis Likert, who was concerned with measuring psychological attitudes scientifically, originally developed this scale. Likert sought a method that would produce attitude measures that could reasonably be interpreted as measurements on a proper metric scale (equally spaced), in the same sense that we consider inches or degrees Celsius true measurement scales (Uebersax, 2006). Sets of Likert items are often used to form indices which are expected to pass the Cronbach's alpha test[30] or some other test of inter-correlation to assure a common meaning of items comprising a latent variable.

Likert-like scales are commonly used in quality of life survey instruments (Table 3.1). Usual response categories are associated with levels of agreement: "strongly disagree," "disagree," "don't know," "agree," and "strongly agree" (e.g., Satisfaction with Life Scale) or levels of satisfaction: "extremely dissatisfied", "dissatisfied", "not satisfied nor satisfied", "satisfied" and extremely satisfied" (e.g., Personal Wellbeing Index). These values are ordinal within any given Likert item, but sets of items are not necessarily ordinal with respect to each other.
The 11-point scale provides five levels of satisfaction above the neutrality point of the scale. A detailed discussion that supports the use of a 0–10 point end-defined scale, with only 3 labels (at the ends and in the middle of the scale), for QOL tools is provided by Dr. Robert Cummins (2002) (Australian Centre for Quality of Life). In a discussion paper on the caveats of the Comprehensive Quality of Life Scale (ComQol), Cummins argues that while there is always uncertainty regarding the respondents' discriminative capacity, five degrees of choice is not likely to exceed this capacity. Cummins further asserts that responses to 0–10 scales demonstrate equivalent reliability to scales with fewer choice points and that a 0–10 scale is

[30] For the Cronbach Alpha test to be applicable, it is necessary to have at least four items (Uebersax, 2006).

intuitively meaningful. Moreover, Cummins argues that labeling each choice point on a Likert-like scale introduces error variance since individuals seem to often differ in their allocation of a numerical value to such labels (Cummins, 2002a).

Based on Cummins' observations, 11-point (0–10) end-defined scales were used in the quality of life questionnaire designed for this research. Similar to a Likert scale, the items were equally spaced. Only the two ends and the central items were defined with labels. The lowest end (0) was labeled as *not at all satisfied,* the middle point (5) was labeled as *neutral,* and the positive end of the scale (10) was labeled as *extremely satisfied.*

f. Questionnaire Part 1: The Subjective Wellbeing Index

The Subjective Wellbeing Index (SWI) tested in this research is a modified version of the Personal Wellbeing Index (PWI). This adaptation included a change in the list of items, but maintained the wording of the questions: "Thinking about your life and current situation, how satisfied are you with…?" To assure that questions were easily understood and therefore introduced few cognitive problems (Groves et al., 2004), the SWI questionnaire was first tested with a sample of 13 volunteers from diverse genders, job classes and communities of residence.

Testing results suggested that 3 of the PWI questions presented cognitive problems[31] on site. Thus, the following questions were excluded from the final version of the questionnaire:

- "How satisfied are you with your standard of living?"
- "How satisfied are you with your financial security?"
- "How satisfied are you with how safe you feel?"

Questions about satisfaction with health, achievements in life and personal relationships were maintained. Based on the literature review and preliminary interviews conducted on site during Phase II of this research, other items of satisfaction were added: *surrounding environment*, *economic situation*, *community* and *work* (Figure 4.2).

Through statistical analysis, a first attempt to validate the SWI construct included the seven SWI domains (Table 4.2). This was accomplished with linear regression. Validation of domains

[31] Testing of these questions determined that there were differences on how some respondents understood the meaning of the questions.

occurs when satisfaction with each domain (independent variables) contributes with unique variance when regressed against the satisfaction with QOL (dependent variable).

Table 4.2: Subjective Wellbeing Index and Personal Wellbeing Index

Subjective Wellbeing Index (SWI) Items	Personal Wellbeing Index (PWI) Items (2006)
Economic situation	Standard of living
Health	Health
Achievements in life	Achievements in life
Personal relationships	Personal relationships
Physical environment	How safe you feel
Community	Community connectedness
Work	Future security

The original PWI items are a first-level deconstruction of the global question about satisfaction with *Life as a Whole* (LAW). Therefore, PWI questionnaires also include this single question: "Thinking about your own life and personal circumstances, how satisfied are you with your life as a whole?" The SWI items are intended to represent a first-level deconstruction of the global question about satisfaction with *Quality of Life* (QOL).

Endeavouring to explore conceptual distinctions between LAW and QOL, the questionnaire used in this research included both reflective questions:

- "Thinking about your own current life and personal circumstances, how satisfied are you with your quality of life in general?"
- "Thinking about your own life and personal circumstances, how satisfied are you with your life as a whole?"

These questions were added as dependent variables to test the construct validity of both the SWI items and the second part of the questionnaire, which includes questions on the five QOL domains. These single questions were administered first to ensure that domains and indicators could not influence a global response (The International Wellbeing Group, 2006).

The distinction between the concepts of "life as a whole" (LAW) and "quality of life" (QOL) is acknowledged in the literature and yet is not clearly defined. The inclusion of the two single questions (about LAW and QOL) in the questionnaire allows for the investigation of the

suitability of the SWI items as a first-level deconstruction of both LAW and QOL. It also allows for the investigation of LAW and QOL predictors using the domains and indicators of the questionnaire. This investigation is intended to provide insights on the distinctions between these two constructs and contribute to the discussion about conceptual distinctions among wellbeing concepts such as quality of life, happiness, and life satisfaction.

A study by Zumbo and Michalos (2000) in Jasper, Alberta presented an interesting discussion on the distinctions between LAW and QOL. The researchers found that in 1997, Jasper residents' satisfaction with personal worth, interpersonal relations, finances, police protection and weather were predictors of life satisfaction, while personal worth, finances, Jasper as a place to live, sanitation/waste management and recycling were predictors of satisfaction with quality of life. Predictors of happiness were personal worth, finances, interpersonal relations, and recycling (Zumbo and Michalos, 2000), thus revealing differences in how the study population defined predictors of QOL, LAW and happiness. It is hoped that results from the analyses on the LAW data in this research will contribute to this discussion.

g. Questionnaire Part 2: QOL Domains

The second part of the questionnaire contains five sections, one for each domain, and includes questions about satisfaction with items in each domain (Table 4.3).

h. Questionnaire Part 3: Demographic Data

The third and final part of the questionnaire includes questions about the respondents and their families. These questions (e.g., *community of residence*, *gender*, *age*, and *job class*) were chosen to classify the respondents into groups of relevance to the research objectives. The variables and categories were initially defined by the researcher but were slightly modified, in collaboration with Vale personnel, once on site. A list of items addressed in Part 3 of the questionnaire is provided in Table 4.4.

Table 4.3: Questionnaire Items: QOL Domains and Indicators

Domains	Indicators
Economic	What you can buy and do with your money
	Material belongings
	Economic situation of surrounding community
	Ability to save for the future
	Financial stability
Work	Number of hours of work per week
	Relationships with co-workers
	Autonomy and decision-making ability
	Relationship with immediate supervisor
	Opportunities for professional growth
	Occupational safety at the workplace
	Job security
	Salary and benefits
Environment	Place of residence (house/apt/camp)
	Quality and integrity of the natural environment around you
	General order, cleanliness and security in the community
	Basic infrastructure in the community
	Availability of goods and services
	Transportation options and quality in your community
Health	Stress level in your life
	Physical activity level
	The food you eat
	Entertainment and recreation options in your community
	Health services and facilities in your community
	Work-life balance
Social	Relationship with family
	Love life
	Relationship with friends
	Privacy
	Participation in community events
	Participation in decision making in the community
	Educational opportunities available

Table 4.4: Questionnaire Items: Demographic Information

Domains	Indicators
Your Home and Community	Community of residence
	Length of residence in the community
	Housing status
	Region of origin
Your Work	Job class
	Area of work
	Length of employment with Vale
You and Your Family	Gender
	Age
	Education level
	Marital status
	Number of dependent children

4.4. Phase III: Interviews and Questionnaire

Phase III took place during the third site visit and consisted of two major data collection efforts: a) in-depth structured interviews, and b) a Quality of Life survey questionnaire.

Phase III began with the researcher participating in a planning and communication meeting with administrative co-ordinators working in several different Vale departments. These individuals were generally administrative assistants whose responsibilities included communicating with all employees about human resources, social events and other issues of broad interest. The support of these individuals for this research was effective because co-ordinators generally have wide access to all Vale employees in their respective departments, and they had the ability to access employees without the “boss-employee” relationship that could result in a feeling of coercion to participate in the research project and, consequently, biased responses to the questionnaire or during interviews. The meeting with the company support staff was facilitated and organized by a Corporate Communications Manager and a Human Resources Manager. Meeting participants included representatives of the Mining, Mineral Processing and Administration departments of the Carajás Iron-ore Mine, Azul Manganese Mine and Sossego Copper Mine.

4.4.1. Interviews

Employee co-ordinators were responsible for communicating with managers and other employees about the research and for inviting them to answer the questionnaire and participate in the interview process.

Reliability of information obtained though individual interviews can be assessed by asking for a confirmation of information later in the interview, or by re-interviewing the respondent about key points (Kvale, 1996). For this research, reliability was ensured by asking interviewees for agreement or confirmation of responses at the end of each interview. Interviewees therefore had the opportunity to confirm or clarify information.

a. Structure and Content

The interviews were designed to collect qualitative data regarding the 3 case study communities. Structured, in-depth interviews were conducted with a total of 32 workers residing in the 3 communities and 8 residents who at the time of the interview were not Vale employees (Table 4.5).

Interviews included structured, open-ended questions about quality of life and the most and least satisfying aspects of quality of life in each community. Participants were also asked to make suggestions for quality of life improvements or identify priorities for improvement in their communities. Other comments on quality of life in the communities were encouraged. The list of interview questions is available in Appendix B.

b. Sampling Frame

The sampling frame included all full-time Vale employees or interns who were residents in Parauapebas, Canaã dos Carajás or Núcleo Urbano de Carajás and were 18 years of age or older (age of majority in Brazil). The call for participants was also advertised on the company's printed and online newsletters. The invitation to participate indicated that the interviews were anonymous and confidential and were expected to last between 30 and 45 minutes. The sampling aimed at including subjects from the 3 different communities and with diversity in length of residence and employment. A balance of female and male subjects was also intended.

The interview population sample also included diverse job classes. The lowest job class was assistant mechanic, and the highest class was senior geologist.

During the interview process, some participants suggested consultation with key informants in their communities, people who were not Vale employees. These key informants were invited to participate in an interview, and those who accepted the invitation were asked the same questions prepared for Vale employees. Respondents had to be 18 years of age or older and a resident in one of the case study communities in order to participate.

The goals and objectives of the research project were explained to all interview participants, and everyone interviewed signed a consent form, following all requirements of the University of British Columbia Behavioral Research Ethics Board.

c. Population Sample

A total of 40 structured interviews were completed in Phase III. Interviews included participants from the 3 case study communities. Details of the total sampled population are illustrated in Table 4.5.

More than one-third of the interviews were conducted with females (15), and 25 interviews were conducted with males. A total of 18 interviews were conducted with residents of the Núcleo Urbano de Carajás, 13 interviews were conducted with Canaã residents and 9 with Parauapebas residents.

The population sample for interviews was fairly young—the mean age of participants was 30. The oldest participant was 56 years old, while the youngest was 19. Slightly more than half of the sampled population was married or living in common law (55%), while 44% of participants were single.

Because the researcher was interested in discussions with both newcomers and long-term residents, the variance in length of employment with Vale was wide, from 3 months to 25 years of service.

Table 4.5: Interview Population Sample

Variables	Mean	Median	Max.	Min.
Age	30.2 years	29 years	56 years	19 years
Length of Employment	5.85 years	2.5 years	25 years	About 3 months
	Frequency		**% of Total Sample**	
Community of Residence				
Núcleo Urbano de Carajás	18		45	
Canaã dos Carajás	13		32.5	
Parauapebas	9		22.5	
Gender				
Female	15		37.5	
Male	25		62.5	
Job Class				
Manager or supervisor	5		12.5	
Engineer, geologist or analyst	8		20	
Technicians	15		37.5	
Interns	4		10	
Not Vale employee	8		20	
Educational Level				
High school completed*	7		17.5	
Technical or trades training completed	20		50	
University level	13		32.5	
Marital Status				
Married or common law	22		55	
Single	18		45	
Children				
No children	23		57.5	
1 or 2 children	14		35	
3 or more children	3		7.5	
Region of Origin				
North	15		37.5	
Northeast	16		40	
Southeast	9		22.5	

*With no technical or trades training

The population sample also includes a variety of job classes—12.5% (5) were managers or supervisors, and 20% (8) were engineers, geologists or analysts. Technicians, who comprised 37.5% (15) of the sample, were the best-represented group. Only 4 interns (10% of the

population sample) participated in interviews, making them the least-represented group. A total of 20 interviews were conducted with local residents who did not work directly for Vale.

As illustrated in Table 4.5, half of the population sample had completed a technical degree at high school or Technical or trades training. Only 17.5% had only a high-school education, and 32.5% had completed a university degree.

The majority of the population sample (57.5%) did not have any dependent children, while 42.5% had one to two dependent children. Only 3 interview participants (7.5% of the population sample) had 3 or more children.

The population sample did not include any participants from the South or Central-West Regions of Brazil. 40% of participants were originally from the Northeast Region, while 37.5% were from the North Region and 22.5 % were from the Southeast Region.

d. Núcleo Urbano Population Sample

A total of 18 structured interviews were completed with Núcleo Urbano de Carajás residents. Details of the Núcleo population sample are illustrated in Table 4.6.

In the Núcleo Urbano, all employees live in company-provided accommodations, thus, all of the respondents who were Vale employees (83%) lived in a company house. The other 17% of the respondents lived in *repúblicas*[32]—shared company houses—in the Núcleo. All employees were associated with the Carajás Iron-ore Mine. Of the eighteen structured interviews completed with residents of the Núcleo Urbano de Carajás, 8 were conducted with females and 10 were conducted with males.

The average age of Núcleo respondents was 34.22 (median age = 32 years). The oldest participant was 56 years old and the youngest was 20 years old. While the Núcleo's population

[32] *Repúblicas* are shared living arrangements, usually owned by a third party. In the Núcleo Urbano de Carajás and Canaã dos Carajás, these are regular company houses that are shared among single employees. The density within the *repúblicas* varies between one person per bedroom to two persons sharing a bedroom, so the number of people living in a *república* will vary according to the number of bedrooms in the house and the need to accommodate singles.

sample was fairly young, the average ages of both the Parauapebas and Canaã dos Carajás population samples were lower.

Almost 2/3 of the Núcleo Urbano de Carajás population sample were married or living in common law (72.2%), while 27.8% of participants were single. 44% of the sampled population did not have any dependent children, while another 44.4% had one to two dependent children. Only 2 participants (11.2%) had 3 or more children.

Among the population samples for the 3 communities, the Núcleo's sampled population had the largest variance in length of employment with Vale, ranging from 6 months of employment to 25 years.

Of the total Núcleo population sample, 16.7% (3) were managers or supervisors, and 27% (5) were engineers, geologists or analysts. Technicians, who comprised 33.3% (6) of the sample population, were the best-represented group. The least-represented group were interns—only 2 interns (11.1% of the population sample) participated. An additional 2 interviews (11.1% of the population sample) were conducted with local residents who did not work directly for the company.

Among the population samples for the 3 case study communities, the Núcleo's had the highest levels of education. Half of the population sample had completed a technical degree at high school or Technical or trades training, and the other half had completed a university degree.

Of the Núcleo's population sample, 44.4% were originally from the Northern Region of Brazil, 27.8% were from the Northeast Region and 27.8% were from the Southeast Region.

Table 4.6: Interview Population Sample: Núcleo Urbano de Carajás

Variables	Mean	Median	Max.	Min.
Age	34.22 years	32 years	56 years	20 years
Length of Employment	9.7 years	6.5 years	25 years	6 months
	Frequency		**% of Total Sample**	
Gender				
Female	8		44.4	
Male	10		55.6	
Job Class				
Manager or supervisor	3		16.7	
Engineer, geologist or analyst	5		27.8	
Technician	6		33.3	
Interns	2		11.1	
Not Vale employee	2		11.1	
Educational Level				
Technical or training completed	9		50	
University level	9		50	
Marital Status				
Married or common law	13		72.2	
Single	5		27.8	
Children				
No children	8		44.4	
1 or 2 children	8		44.4	
3 or more children	2		11.2	
Region of Origin				
North	8		44.4	
Northeast	5		27.8	
Southeast	5		27.8	

*Refers only to Vale employees

e. Canaã dos Carajás Population Sample

A total of 13 structured interviews were completed with Canaã dos Carajás residents. At the time of the interviews, 5 respondents (38.5% of the population sample) lived in a company house with their families, 3 respondents (about 23%) lived in shared company homes, 3 lived in the Sossego Camp[33], and 2 respondents (15.4 %) lived in their own homes with their families.

[33] The Sossego Mine Camp is a temporary facility located in Canaã dos Carajás that accommodates company employees and business visitors.

Table 4.7: Interview Population Sample: Canaã dos Carajás

Variables	Mean	Median	Max.	Min.
Age	28.5 years	29 years	40 years	19 years
Length of Employment	1.8 years	1.8 years	3 years	About 3 months
	Frequency		**% of Total Sample**	
Gender				
Female	3		77	
Male	10		23	
Job Class				
Manager or supervisor	2		15.4	
Engineer, geologist or analyst	3		23.0	
Technicians	6		46.2	
Interns	1		7.7	
Not Vale employee	1		7.7	
Educational Level				
High school completed*	1		7.7	
Technical or trades training	8		61.5	
University level	4		30.8	
Marital Status				
Married of common law	6		46.2	
Single	7		53.8	
Children				
No children	8		61.5	
1-2 children	4		30.8	
3 or more children	1		7.7	
Region of Origin				
North	3		23.0	
Northeast	6		46.2	
Southeast	4		30.8	

*With no technical or trades training

Table 4.7 presents more details on Canaã's population sample. One participant from the Núcleo Urbano de Carajás, who had lived in Canaã for one year, was also able to answer questions about both of those communities.

Canaã's sample population was younger than the Núcleo's. The average age of respondents was 28.5, with the oldest participant being 40 years old and the youngest being 19 years old.

Regarding marital status, Canaã's population sample was quite balanced: 46.2% of the sampled population was married or living in common law, while 53.8% of participants were single.

Canaã's population sample had the smallest variance in length of employment with Vale, from about 3 months of employment to only 3 years of employment. All employees were associated with the Sossego Copper Mine, which has only been operating since 2004.

Only 15.4% of the Canaã population sample (2) were managers or supervisors, while 23.1% (3) were engineers, geologists or analysts. The best-represented group was also technicians (6), who made up almost half (46.2%) of the sample population. Only 1 intern was interviewed (representing 7.7% of the population sample), and 1 interview was conducted with a local resident who did not work directly for Vale.

The majority (61.5%) of participants from Canaã had completed a technical qualification program at high school or Technical or trades training, while 30.8% had a university degree; 1 participant (7.7%) had completed high school only.

Most (61.5%) of the Canaã population sample did not have any children, while 30.8% had one to two dependent children, only 1 participant (7.7%) had 3 or more children.

Different from the Núcleo's sampled population, almost half (46.2%) of the Canaã population sample was originally from the Northeast Region of Brazil. Surprisingly, 30.8% participants were from the Southeast Region, and only 23% were from the Northern Region.

f. Parauapebas Population Sample

A total of 9 structured interviews about Parauapebas were conducted. Five of these interviews were conducted with individuals residing in the city. Four participants from Núcleo Urbano and two from Canaã were also able to answer questions about Parauapebas.

While eight participants were renters at the time of the interview, only one was a homeowner. Table 4.8 presents the sampled population of respondents who resided in Parauapebas at the time of the interview.

Parauapebas' population sample was the youngest of the 3 sample populations. The average age of respondents was only 25, with the oldest participant being 35 years old and the youngest being 20 years old. Just under half of the interviews with Parauapebas residents were conducted with females (4), and 5 interviews were conducted with males.

Two-thirds of the Parauapebas population sample were married or living in common law, while one-third of participants were single. The vast majority of the participants from Parauapebas did not have any dependent children (77.8%), while 22.2% had one to two dependent children.

Regarding the average length of employment, Parauapebas' sampled population had the least variance. The average was 2.4 years, and participants' total length of employment ranged from 1.5 years to 4 years. All employees were associated with the Carajás Iron-ore Mine.

As indicated in Table 4.8, 2/3 of the Parauapebas population sample had had a high school degree only, and one-third had completed a technical degree at high school or Technical or trades training. None of the participants had completed a university degree at the time of the interviews. Most participants were not directly employed by Vale when they were interviewed. Of the Vale employees interviewed, 3 were technicians (33.3% of the population sample), and one (11.1%) was an intern.

More than half of the Parauapebas population sample was originally from the Northeast Region (55.6%) of Brazil, while the remaining 44.4% were from the Northern Region.

Table 4.8: Sampled Population for Interviews: Parauapebas Residents

Variables	Mean	Median	Max.	Min.
Age	25 years	23 years	35 years	20 years
Length of Employment	2.4	2	4 years	1.5 years
	Frequency		**% of Total Sample**	
Gender				
Female	4		44.4	
Male	5		55.6	
Job Class				
Technician	3		33.3	
Interns	1		11.1	
Not Vale employee	5		55.6	
Educational Level				
High school completed*	6		66.7	
Technical or trades training	3		33.3	
Marital Status				
Married of common law	3		33.3	
Single	6		66.7	
Children				
No children	7		77.8	
1-2 children	2		22.2	
Region of Origin				
North	4		44.4	
Northeast	5		55.6	

*Does not include respondents who do not work for Vale

4.4.2. Administration of the Quality of Life Survey Questionnaire

a. Sampling Frame and Technique

The sampling frame for the quality of life (QOL) questionnaire included all full-time Vale employees or interns who resided in the Núcleo Urbano de Carajás, Parauapebas or Canaã dos Carajás and were 18 years of age or older at the time they completed the questionnaire. Vale employees from other parts of the country working on short-term projects in Carajás were excluded from the sample.

As with the interviews, communications/HR liaison persons were responsible for communicating with employees about the QOL questionnaire. A schedule for the survey implementation was set, and rooms were reserved for employees to come and answer the survey questionnaire. The questionnaire was administered in all 3 mines in the following areas:

- Carajás Iron-ore Mine—mine, processing plant, maintenance/mechanical shop, and administrative offices
- Azul Manganese Mine—mining, maintenance/mechanical shop and administrative offices
- Sossego Copper Mine—mine and engineering/administration office

The areas/shifts were chosen at the convenience of department co-ordinators or managers, or at specific times of high traffic, such as the beginning or end of a shift.

The approach used to administer the questionnaire was efficient and adequate since the researcher was able to personally introduce the idea of the research project, speak about the objectives and methods used, give instructions on how to fill out the questionnaire, answer any questions and address any concerns. It was also made clear to employees that the surveys were collected directly by the researcher; this was done to mitigate fears associated with issues of confidentiality and the anonymity of responses. A total of 455 paper questionnaires were collected in 4 days.

The questionnaire was also made available to employees with access to the Internet through Survey Monkey, an online survey tool (www.surveymonkey.com). Vale's Human Resources department advertised the online questionnaire via email notices advising employees that they had two weeks to complete the questionnaire online. One week after receiving the first email message about the online questionnaire, employees were reminded by another email of the deadline for completing the online survey. Unfortunately, even after the above efforts to encourage online participation, only six questionnaires were completed online; this is believed to have been due to a lack of familiarity with online questionnaire tools, as well as the extremely limited access Vale workers in the Carajás region have to the Internet.

b. Population Sample

A total of 461 completed questionnaires were collected. Only 2 questionnaires were eliminated because of a high rate of non-response items (questions not answered)[34]. Of the remaining questionnaire respondents, 168 were from the Núcleo Urbano de Carajás (36.7%), 75 were from Canaã dos Carajás (16.4%), and 215 were from Parauapebas (46.9%)[35].

Not surprisingly, the majority (83.2%) of the population sample were males. Only 16.8% of the respondents were female.

The majority (59.4%) of the questionnaire respondents were had moved to their communities of residence quite recently (5 years or less of residency). Only 8.3 % of respondents had lived in their communities between 5 and 10 years, but 32.5% of the respondents were long term residents who had lived in their communities for more than 10 years. Almost half (48%) of the sampled population resided in company-provided accommodations (house, shared house, camp, hotel). Homeowners made up 23.6 % of the sampled population, while 28.4 % were renters. Details of the questionnaire population sample are presented in Table 4.9.

The population sample illustrates the cultural diversity of the Vale workforce in the Carajás region: there were questionnaire respondents came from each of Brazil's five major regions. However, the population sample also highlights that a significant contingent (47.2%, or almost half, of the population sample) of Vale's Carajás workforce is from the Northeast Region. 32.5% of the sampled population were from the North Region, 12.7% were from the Southeast, and employees from the Central and South Regions represented only 4.4 % and 3.3%, respectively.

[34] In 2 of the 461 questionnaires, entire pages of answers were missed, resulting in a high rate of non-response items (questions not answered). This is probably due to the fact that the questionnaire booklet was printed double sided (the pages missed were the back pages). In order to address this risk, instructions were given to all respondents highlighting the need to answer questions on both sides of each page. Only 2 respondents (0.4%) did not follow this particular instruction to a point that made their questionnaires unusable.

[35] One respondent did not identify a community of residence.

Table 4.9: Frequencies of Demographic Variables

Variables	Frequency	Valid %*
Community of Residence		
Núcleo Urbano	168	36.7
Canaã dos Carajás	75	16.4
Parauapebas	215	46.9
Total	**458**	**100.0**
Missing**	1	-
Length of Residence		
Less than 1 year	81	17.7
More than 1 and less than 6 years	191	41.7
More than 6 and less than 10 years	38	8.3
More than 10 years	148	32.3
Total	**458**	**100.0**
Missing	1	-
Housing Status		
Rental	130	28.4
Ownership	108	23.6
Company-provided	220	48.0
Total	**458**	**100.0**
Missing	1	-
Region of Origin		
North	149	32.5
Northeast	216	47.2
Southeast	58	12.7
Central	20	4.4
South	15	3.3
Total	**458**	**100.0**
Missing	1	-
Area of Work		
Mine operations	327	72.3
Support	109	24.1
Other	16	3.5
Total	**452**	**100.0**
Missing	7	-

*Valid % excludes missing values (number of non-response items).
**Missing = number of respondents who did no answer the item
***Does not include any trades or technical program. Technical and trades training might be a high school degree with a trades/technical program or a certificate from a post-high school technical/trades institution. Graduate level includes all university education.
Note: For *Housing Status*, categories that had low frequencies were grouped with others in order to simplify analysis.

Table 4.9: Frequencies of Demographic Variables (CONTINUED)

Variables	Frequency	Valid %*
Length of Employment		
Six months or less	105	23.2
More than 6 months and less than 1 year	106	23.2
More than 1 and less than 3 years	97	21.4
More than 3 years and less than 8 years	61	13.5
More than 8 and less than 15 years	21	4.6
More than 15 and less than 20 years	35	7.7
20 years or more	28	6.2
Total	**453**	**100**
Missing	6	-
Job Class		
Manager or Supervisor	26	5.7
Engineer/geologist/analyst	30	6.6
Technicians/trades people/other	399	87.7
Total	**455**	**100.0**
Missing	4	-
Age		
18-30 years of age	288	63.6
31-40 years of age	101	22.3
Over 40 years of age	64	14.1
Total	**453**	**100.0**
Missing	6	**-**
Gender		
Female	76	16.8
Male	377	83.2
Total	**453**	**100.0**
Missing	6	-
Educational Level		
Elementary to high school***	256	56.5
Technical or trades training	129	28.5
University level	68	15.0
Total	**453**	**100**
Missing	6	-

*Valid % excludes missing values (number of non-response items).
**Missing = number of respondents who did no answer the item
*** Does not include any trades or technical program. Technical and trades training might be a high school degree with a trades/technical program or a certificate from a post-high school technical/trades institution. Graduate level includes all university education.
Note: For *Job Class, Age,* and *Educational Level* categories that had low frequencies were grouped with others in order to simplify analysis.

Table 4.9: Frequencies of Demographic Variables (CONTINUED)

Variables	Frequency	Valid %*
Marital Status		
Single	168	37.1
Married /common law	274	60.5
Divorced/separated	11	2.4
Total	**453**	**100**
Missing	6	-
Number of Dependent Children		
No children	199	43.9
1 to 2 children	204	45.0
3 or more children	50	11.0
Total	**453**	**100**
Missing	6	-

*Valid % excludes missing values (number of non-response items).
**Missing = number of respondents who did no answer the item
*** Does not include any trades or technical program. Technical and trades training might be a high school degree with a trades/technical program or a certificate from a post-high school technical/trades institution. Graduate level includes all university education.
Note: For *Marital Status*, categories that had low frequencies were grouped with others in order to simplify analysis.

The population sample also suggests a young workforce: more than half of respondents (63.6%) were 30 years old or younger, while 22.3% were middle-aged (31 to 40 years of age), and 14.1 % were over 40. No minors (i.e., persons younger than 18 years of age) answered the questionnaire[36].

Despite their youth, most employees were married or living in common law (60.5 %—includes those who had re-married), while 37.1% were single (never married) and only 2.4% was divorced or separated. The majority of the sampled population (56%) had at least one dependent child at the time they answered the questionnaire; 11% had 3 or more dependent children, and 43.9 % had no dependent children.

A large majority of respondents (87.7%) were technicians (e.g., OHS technicians, IT technicians, mechanics, and electricians) or other workers (e.g., machine operators, drillers,

[36] Vale workforce includes only adults (18 years of age or older).

blasters). Most respondents (72.3%) were working in operations, while 27.6% were working in professional, administrative or other leadership and support roles in company offices.

The population sample included a significant number of recently employed individuals—the great majority of respondents had been working for Vale for 3 years or less. While 18.1% of respondents had been with the company between 4 and 8 years, 13.9 % had been a Vale employee for 15 years or more.

While only 15% of the respondents had a university degree, the majority (56.5%) had a high school diploma or less. A significant number of respondents (129, representing 28.5%) had a Technical or trades training/high school degree or had been exposed to some kind of trades training.

4.5 Analytical Strategy

The analytical strategy consists of the triangulation of quantitative and qualitative results. The quantitative analysis includes the statistical analysis of the questionnaire. The qualitative analysis includes the coding of qualitative interviews in Phase III and the consideration of participant observation notes taken in the field.

4.5.1. Quantitative Analysis

The statistical analysis of the questionnaire data was mostly performed using the Statistics Package for Social Sciences (SPSS) for Windows Software (Version 12, SPSS Inc.). The objectives of the statistical analysis are summarized in Table 4.10.

a. Investigating Questionnaire Reliability

The first step in the statistical analysis of the questionnaire data was the internal reliability test. The test used was the calculation of the Cronbach alpha, also known as the coefficient alpha. Introduced by Cronbach (1951), the Cronbach alpha is a frequently used statistical parameter in

empirical research involving tests with numerous items. The Cronbach alpha tests whether items are sufficiently interrelated to justify their combination in an index or a scale[37].

Cronbach alphas were calculated to estimate reliability of the correlation among quality of life (QOL) items and domains and thus investigate the adequacy of the questions chosen for each domain. The use of this statistical test allows for the confirmation that the indicators (questions) chosen under each domain indeed collectively tapped into the same concept. These factors were a result of a comprehensive literature review and interviews with Vale's employees and community members. The Cronbach Alpha (α) is calculated as:

$$\alpha = \frac{N \times \overline{R}}{\left[1 + (N-1) \times \overline{R}\right]}$$

Where N is the number of factors and $\overline{R}$ is the average inter-item correlation among the factors(Garson, 2006).

For social sciences research, the widely accepted cut-off for Cronbach alpha values is 0.70 or higher for a set of items to be considered a coherent scale. This is because when the alpha is 0.70, the standard error of measurement will be slightly over half (0.55) of a standard deviation (Garson, 2006). All the Cronbach alphas were calculated using SPSS for Windows *Reliability Analysis* Tool.

b. Calculating Mean Scores

Once reliability of the domains was established, the mean scores for each of the QOL Domains —economic, social, work, health and environment—as well as the Subjective Wellbeing Index (SWI) were obtained. The mean is the simple measure of average level of satisfaction:

$$M = \sum \frac{Yi}{n}$$

[37] Under the assumption that the items are parallel, measurements have identical true scores and uncorrelated errors have equal variances (Cronbach, 1951; Lord and Novick, 1968; Cortina, 1993; Miller, 1995).

Where n is the sample size, Yi is the score for the i^{th} item. The scores in the questionnaire vary from 0 to 10.

The QOL means considered were the average scores with quality of life calculated using all the questions under every domain—an average score of the 31 QOL Domain questions in the questionnaire.

c. Comparing Mean Scores

Another important outcome of this research is the comparison of the questionnaire results of each of the 3 case study communities with one another, as well as comparisons among sub-populations (characterized by demographic variables such as age, job class, region of origin, etc.) of respondents. These comparisons were mostly achieved by comparing means using analysis of variance (ANOVA) or the Welch's F Test (used when Levene's test indicates that there are unequal variances among groups). For the variable *gender* —the only variable with only two categories—independent *t* tests were used to determine statistical significance of mean differences. A detailed discussion of these results, indicating when Welch F tests were needed, is presented in Chapter 5: Results.

ANOVA is a statistical technique for comparing means of more than two variables. ANOVA results indicate if the null hypothesis—that there are no statistically significant differences between the variables' mean scores (p values < alpha)—should be rejected. The confidence level desired for each test defines alpha values. The choice of the confidence level is discussed further in this chapter.

The 3 assumptions on which ANOVA is based are *independence*, *normality* and *homogeneity of variance* (HOV) (Sirkin, 2006). For this specific questionnaire, *independence* is guaranteed by the fact that each questionnaire was answered individually, and *normality*[38] was assumed. The *homogeneity of variance* assumption deals with the population variance, not with the population

[38] Normality is the assumption that all variables and all combinations of the variables are normally distributed. When the assumption is met, the residuals (the difference between an observed value of the response variable and the value predicted by the model) are normally distributed and independent, the differences between predicted and obtained scores (the errors) are symmetrically distributed around a mean of 0 and there is no pattern to the errors. Screening for normality may be undertaken in either statistical or graphical methods (Moore and McCabe, 1993).

sample, but because there are unequal numbers of subjects in each group (e.g., different number of respondents from each community of residence), this assumption needs to be tested (Sirkin, 2006).

In order to assess the applicability of ANOVA or of the Independent *t* tests, Levene's tests of Equality of Error Variances were run along with ANOVA. Levene's tests are used to determine if variances among groups are homogeneous. Unlike ANOVA, Levene's test is a "retain support hypothesis", which means that significance (p values < alpha) indicates a significant difference among variances, and therefore the *homogeneity of variance* assumption is not satisfied[39]. If the variance of means among groups is significantly different, ANOVA is not applicable. Therefore, when Levene's tests indicated p values larger than alpha values, the Welch's F Test was used.

Welch's Tests is a multiple group version of the Welch-Satterthwaite *t* test[40], and because it does not assume variance equality, it is more robust than ANOVA when variances are not equal among groups (Hayes, 2005).

The *t* test (independent or dependent) is the most commonly used method to evaluate the differences in means between two groups (Sirkin, 2006). The groups can be independent (e.g., different individuals answering each question) or dependent (e.g., the same individual answering a question before and after an event). For the variable *gender*, the independent *t* test was used since a different individual answered each questionnaire.

This study is of an exploratory nature, and therefore hypotheses on the way different categories in each variable would potentially affect responses were not established. However, decisions were made regarding which variables would be tested with each demographic variable; it was important to do this in order to reduce the number of tests, since the larger the number of tests, the less reliable results are. Relevance of tests was heuristically[41] ascertained through assumptions based on participant observation and common sense. For instance, *region of origin* was considered of relevance to the *environment domain* because one's previous experience of residence can impact one's perception of the current surrounding environment.

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[39] For this reason, confidence levels for Levene's test were set at 95%, not at 97.5%.
[40] The Welch-Satterthwaite *t* test is an alternative to the two sample t-test with equal variance, and is used when one cannot assume that the two populations have equal variances (Chung, 2004)
[41] The term "heuristic" refers to a set of common-sense rules. "Heuristically" then means it is based on common sense or previous experience.

For the comparison of means in this research, the confidence level for ANOVA was established at 97.5% (alpha = 0.025), to minimize the incidence of Type I errors, since even though tests were not run for every possible combination of variables, the number of tests run was still quite high. The level of significance denoted by alpha is the probability of a Type I error. Type I errors occur when the null hypothesis is rejected when it is in fact true (Jaisingh, 2000).

Table 4.11 exhibits the variables that were deemed of interest for each domain. Most variables were considered of interest or relevance to 2 or more quality of life (QOL) domains. The variable *area of work* was considered of relevance only for the *work domain*. Four variables—*community of residence*, *gender*, *educational level* and *dependent children*—were considered of interest for all of the domains.

The importance of investigating the variable *community of residence* is directly related to one of the main objectives of this research: to investigate if the mining community model impacted perceptions of quality of life, and if so, how. *Gender* and *age* were considered of importance because these are critical variables for human resources management, and any corporate policy needs to address differences and design strategies to reach and retain diversity. *Educational level* was considered of importance because it is directly related to the quality of the workforce. The *number of dependent children* variable was chosen because it can be interpreted as “having a family”, which is expected to change one’s perception of most domains of quality of life.

Both ANOVA and Welch’s F Tests can determine if there is at least one inequality among sample mean scores, but they do not indicate where the difference or differences lie, since only one inequality is enough to negate the null hypothesis. This is because these tests examine all sample mean scores at once, and it is possible that some pairs of mean scores may not be significantly different from one another. In order to establish inequalities, it is necessary to complete a follow-up step—a post-hoc procedure. Only post-hoc tests of multiple comparisons can determine where inequalities lie (Sirkin, 2006).

Table 4.10: Quality of Life Questionnaire Statistical Analysis

Analysis Goals	Statistical Analyses	Interpretation and Comments
Establishing reliability: Are the domains and facets chosen at the conceptual level adequate?	Calculate Cronbach's Alpha (α) values for domains and facets.	Cronbach's α is the common test of whether items are internally consistent, and sufficiently interrelated to justify their combination in an index. Alphas of .7 or higher would be satisfactory to confirm if domains defined in this proposal's conceptual framework are indeed "contributors" to overall QOL.
Comparing domains' mean scores: What appear to be the most and the least satisfying aspects of QOL in the case study communities? How do these vary in sub-groups by gender, age, etc.?	ANOVA, Welch F tests or independent *t* tests were run for mean scores for satisfaction level regarding the domains of quality of life: social, economic, health, environment, and work.	These tests will determine if there are statistically significant differences among the different communities and other variables.
Comparing QOL and LAW scores: In which of the 3 communities do employees report higher satisfaction with general QOL and LAW?	ANOVA, Welch F tests or independent *t* tests for satisfaction level with overall quality of life.	Tests will determine if there are statistically significant differences among the mean scores for QOL and LAW in the different communities.
Defining LAW and QOL predictors: What appear to be the most important factors—the predictors—of satisfaction with overall QOL/ LAW?	Calculate standardized regression coefficients (Betas) for mean scores for satisfaction various domains and facets.	The domains associated with significant Betas ($p < 0.05$ for confidence level at 95%) are determined to uniquely predict QOL.
Comparing predictors within populations: How differently do the 3 communities define the predictors of overall QOL?	Comparison of standardized regression coefficients (Betas).	The domains associated with significant Betas ($p<0.05$ for confidence level at 95%) are determined to uniquely predict QOL.
Investigating possibility of using SWI as a proxy for the QOL questionnaire	Determine the correlation between SWI and Average QOL as a way to test the adapted SWI scale's ability to measure quality of life as compared to the 31-item QOL survey.	A high correlation would mean that there is an overlap in measures, and therefore a justification to use the shorter scale in case there is a need for a short instrument.

Table 4.11: Variables of Interest for QOL Domains

Variables	Domains				
	Economic	**Environment**	**Work**	**Social**	**Health**
Community of Residence	**X**	**X**	**X**	**X**	**X**
Length of Residence		**X**		**X**	
Housing Status		**X**			
Region of Origin		**X**		**X**	**X**
Job Class	**X**		**X**		
Length of Employment	**X**		**X**		
Area of Work			**X**		
Age	**X**	**X**	**X**	**X**	**X**
Gender	**X**	**X**	**X**	**X**	**X**
Educational Level	**X**	**X**	**X**	**X**	**X**
Marital Status	**X**		**X**	**X**	
Dependent Children	**X**	**X**	**X**	**X**	**X**

Note: **Bold variables** indicate indicators that were tested for all categories.

For variables with 3 categories, such as *community of residence* (Núcleo Urbano de Carajás, Parauapebas or Canaã dos Carajás), the Fisher Least Significant Difference (LSD) post-hoc test was chosen. The LSD test is simply based on the rationale that if an omnibus test is conducted and is significant, the null hypothesis is incorrect (If the omnibus test is non-significant, no post-hoc tests are conducted).

For sub-groups with more than 3 categories, Tukey's post-hoc tests were preferred. Also known as Tukey's HSD for "honest significant difference", Tukey's test calculates a new critical value that can be used to evaluate whether differences between any two pairs of means are significant. The critical value is somewhat different because it involves the mean difference that has to be exceeded to achieve significance. So it is necessary to calculate one critical value and then the difference between all possible pairs of means. Each difference is then compared to the Tukey critical value. If the difference is larger than the Tukey value, the comparison is significant (Newsom, 2006).

The critical value ($\overline{d_T}$) is as follows:

$$\overline{d_T} = q_T \sqrt{\frac{MS_{s/A}}{n}}$$

Where q_T is the standardized range statistic, similar to the t-critical values. $MS_{s/A}$ is the mean square error from the overall F-test, and n is the sample size for each group. Studies have shown that Tukey's test has greater power than the other tests under most circumstances when group sizes (n) are unequal (Newsom, 2006).

d. Identifying QOL Predictors

One of the most important outcomes of the quantitative analysis in this research is the identification of predictors of quality of life for each community: the Núcleo Urbano de Carajás, Parauapebas and Canaã dos Carajás.

In the social and natural sciences, multiple regression procedures are widely used in research (Wonnacott and Wonnacott, 1985; Levin and Fox, 2000). The general purpose of multiple regression is to learn more about the relationship between several independent or "predictor" variables and a dependent or criterion variable. Generally, multiple regression allows for the establishment of the best predictor (dependent variable) of an independent variable. However, it is important to note that a major conceptual limitation of all regression techniques is that one can ascertain relationships, but never be sure about the underlying causal mechanism.

In order to define predictors, multiple linear regression analysis is used to define the coefficient of determination while analyzing the separate and the combined influences of two or more independent variables on a dependent variable. Tests of the assumption of correctly specified form (linearity) were completed with the use of ARC software and are available in Appendix C.

Generally, multiple linear regression procedures estimate a linear equation of the weighted sum:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i + \varepsilon$$

Where Y is the predicted score on the dependent variable, each X is one of the independent variables, β is the value of Y when X = 0 (the intercept), and each β_i is a standardized regression coefficient and is interpreted as the change in outcome for each standard deviation unit[42], and ε is error. The standardized regression coefficients β are the Beta weights, and these indicate the relative importance of the corresponding independent variable in determining the predicted value of the dependent variable (Colman and Pulford, 2006).

Statistically significant values of Betas indicate that the independent variable uniquely predicts variation of the dependent variable. However, interpretation is not complete when standardized regression coefficients (Betas) are calculated. Interpretation needs to take into consideration the coefficient of multiple determination—the R squared. The R squared indicates how much the regression equation can predict the dependent variable as it determines the proportion of variation in Y that is explained by the independent variable X in the regression model (Krehbiel, 2004). The coefficient of determination is equal to the regression sum of squares (explained variation) divided by the total sum of squares (total variation):

$$R^2 = \frac{SSR}{SST}$$

Where SSR is the regression of sum squares and SST is the total sum of squares. SST is the sum of the squared differences between each observed Y and the average value of Y:

$$SST = \sum_{i=1}^{n} \left(Y_1 - \overline{Y}\right)^2$$

Where $\overline{Y}$ is the average value of Y (Krehbiel, 2004).

[42] The standardized regression coefficients (Betas) are often used instead of the regression coefficients (b) in an attempt to solve the problem of units of measurement. All variables (response and predictors) are standardized by subtracting the mean and dividing by the standard deviation. The standardized regression coefficients then represent the change in response for a change of 1 standard deviation in a predictor.

The regression sum of squares (explained variation) is equal to the sum of the squared differences between the predicted value of Y and the average value of Y:

$$SSR = \sum_{i=1}^{n} \left(\widehat{Y}_1 = \overline{Y}\right)^2$$

Where $\widehat{Y}$ is the predicted value of Y and $\bar{Y}$ is the average value of Y (Krehbiel, 2004).

In this research, to define predictors of the dependent variable satisfaction with quality of life, linear regression was used to define the coefficients of determination while analyzing the separate and the combined influences of the independent variables (satisfaction with quality of life domains) on the dependent variable (satisfaction with quality of life).

A multiple regression equation was defined for the total sampled population (all QOL questionnaire respondents) to determine how satisfaction with each domain predicts satisfaction with quality of life in the sampled population[43]. The regression equation therefore would be:

$$Y_{QOL} = \beta_{social} X_{social} + \beta_{health} X_{health} + \ldots + \beta_{env.} X_{env.} + \beta_{econ.} X_{econ.} + \beta_{work} X_{work} + \varepsilon$$

Where Y_{QOL} is satisfaction with quality of life, β_{social} is the standardized b coefficient (beta) for the social domain, X_{social} is the mean score for social domain (the same is applicable to other domains), and ε is error. Even though the equation above suggests a specific order of independent variables, the predictors in the regression equation have no order, and one cannot be said to enter before the other.

Regression equations were also defined for 3 different sampled populations: residents of the Núcleo Urbano de Carajás, Parauapebas residents and Canaã dos Carajás residents.

[43] Once reliability is confirmed with the calculation of Cronbach alphas, domain mean scores will be calculated as the average of means for domain indicators. Standardized b Coefficients (Betas) will be defined for each QOL domain.

Calculated R^2 of each regression equation determine the proportion of variation in satisfaction with QOL that is explained by satisfaction with each of the 5 domains: social, economic, environment, health and work.

The standardized regression coefficients and regressions equations' coefficients of determination were calculated using the SPSS Linear Regression tool.

e. Investigating Life as Whole (LAW)

Similar to QOL, in order to compare Life as a Whole (LAW) scores from the 3 case study communities, analysis of variance (ANOVA) was performed only for the variable *community of residence.*

Similar to the method to identify satisfaction of quality of life predictors, multiple regression equations were established for LAW as the dependent variable, with the independent variables being the scores for the 5 QOL domains.

4.5.2. Qualitative Analysis

Analysis of qualitative data is not a structured, static or rigid process. Indeed, it is a free-flowing and creative one in which researchers need to move back and forth between types of coding, using analytic techniques and procedures freely and in response to the data being analyzed (Strauss and Corbin, 1998b). The qualitative analyses in this research include the coding of interview data as well as the use of participant observation field notes.

Analysis of observational data required the researcher to code and label field notes, while these are examined for patterns and relationships (Jorgensen, 1989). Based on the conceptual model for this research, the researcher used field notes to support the interpretation or explanation of quality of life (QOL) factors in the case study communities through the participants' as well as the researcher's perspectives.

The qualitative data from interviews were also analyzed with open coding, "the analytic process through which concepts are identified and their properties are discovered in data" (Strauss and Corbin, 1998). Coding of the first question about QOL classified data in the categories

(domains) established in the conceptual model developed for this study: environmental, social, health, work, and economic.

Coding of the answers to the 2nd, 3rd and 4th questions about the best and worst things about the communities and the priorities for intervention resulted in data being classified in concepts within more fluid categories, since answers usually presented concepts that could fall under more than one of the 5 categories (i.e., environmental, social, health, work, and economic).

When coding, the researcher looked for answers to questions such as “Why?”, “Where?”, “When?”, and “With what results?”, in order to uncover relationships among categories. Extra content volunteered by the interview participants (i.e., information not related to the 4 interview questions) was also coded and considered in the qualitative analysis.

CHAPTER 5: RESULTS

This chapter presents the results of the quantitative and qualitative analyses of the data collected in Phase III of this research. In the first section of this chapter, the quantitative results obtained with the statistical analysis of the Quality of Life (QOL) questionnaire are presented. In the second section, the results from the qualitative interviews are presented and supported with participant observation data. A detailed discussion and the triangulation of results from both quantitative and qualitative data analyses are presented in Chapter 6: Discussion.

5.1. Quantitative Analysis Results

The quantitative analysis refers to the data from the Quality of Life (QOL) questionnaire, which was examined through statistical analysis using the software Statistical Package for the Social Sciences (SPSS).

5.1.1. Establishing Reliability

The first level of statistical analysis in this research was the investigation of the reliability of the items in the QOL questionnaire. This was a logical first step since it ascertained if the indicators —i.e., the questions chosen for each QOL domain—tapped into the same concept and could therefore be considered as part of the same domain. Reliability was also established for Part 1: Subjective Wellbeing Index (SWI) and for Part 2: QOL questionnaire.

Reliability was tested with the calculation of Cronbach alphas. The Cronbach alphas calculated for the QOL domains in the survey were between 0.73 and 0.83. The Cronbach alpha for Part 2 (31 items) was 0.82, and the alpha for the SWI (7 items) was 0.71[44]. These results confirm that a) the items identified and questions for the domains indeed are cohesive enough to justify their use in an index; and b) the questions chosen for the first part of the questionnaire—the SWI adequately represent a single concept. The results achieved for the Cronbach alphas are illustrated in Table 5.1.

[44] Since an acceptable minimum value for Cronbach alphas in the social sciences in 0.70 (Garson, 2006).

Table 5.1: Domain Reliability Tests – Cronbach Alphas

Section	Item	Indicators	Cronbach Alpha
Part 1	Subjective Wellbeing Index (SWI)	Economic situation	0.71
		Health	
		Achievements in life	
		Personal relationships	
		Physical environment	
		Community	
		Work	
Part 2	Work Domain	Number of hours of work per week	0.83
		Relationship with co-workers	
		Autonomy and decision making ability	
		Relationship with immediate supervisor	
		Opportunities for professional growth	
		Occupational safety at the workplace	
		Job security	
	Economic Domain	What you can buy and do with your money	0.83
		Material belongings	
		Economic situation of surrounding community	
		Ability to save for the future	
		Financial stability	
	Environment Domain	Place of residence (house/apartment/camp)	0.82
		Quality and integrity of the natural environment around you	
		General order, cleanliness and security in the community	
		Basic infrastructure in the community	
		Availability of goods and services	
		Transportation options and quality in your community	
	Health Domain	Stress level in your life	0.74
		Physical activity level	
		The food you eat	
		Entertainment and recreation options in your community	
		Health services and facilities in your community	
		Work-life balance	
	Social Domain	Relationship with family	0.73
		Love life	
		Relationship with friends	
		Privacy	
		Participation in community events	
		Participation in community decision making	
		Educational opportunities	

5.1.2. Calculating Mean Scores

Once reliability of the domains was established, mean scores for all items in each of the QOL domains—i.e., economic, social, work, health and environment—as well as the SWI items were calculated. Scores were from 0 to 10, with 0 being “completely dissatisfied”, 5 being “neutral”, and 10 being “completely satisfied”. Table 5.2 presents all means and standard deviations for each of the 31 domain items.

Table 5.2: Indicators’ Mean Scores

Item	Núcleo Urbano de Carajás		Canaã dos Carajás		Parauapebas	
	Mean	Std. Dv.	Mean	Std. Dv.	Mean	Std. Dv.
Economic Domain						
What you can do and buy with your money	5.58	2.47	5.55	2.19	5.90	2.46
Material belongings	6.42	2.31	5.93	2.20	6.02	2.47
Your community's economic situation	5.94	2.29	4.61	2.14	5.08	2.65
Your ability to save for the future	5.50	2.44	5.85	2.65	5.69	2.97
Your financial stability	5.35	2.42	5.28	2.40	5.27	2.48
Work Domain						
The number of hours you work per week	6.12	2.75	7.01	2.55	7.09	2.78
Relationship with co-workers	8.07	1.70	8.34	1.72	8.77	1.75
Relationship with supervisors	7.57	2.25	8.15	2.09	8.25	2.17
Opportunities to grow professionally	6.25	2.80	7.14	2.74	7.47	2.59
Safety at work	7.93	2.25	8.57	1.76	8.46	2.15
Ability to make decisions on your own	6.82	2.41	6.70	2.51	7.55	2.14
Job stability	6.42	2.37	6.26	2.31	6.86	2.76
Salary and benefits	5.60	2.47	5.70	2.49	6.00	2.92
Environment Domain						
Your home	7.78	2.18	5.80	3.03	5.87	3.20
Access to nature	7.95	2.08	5.52	2.94	6.26	2.82
Order, cleanliness and security	8.40	1.94	5.15	2.67	5.86	3.19
Basic infrastructure	9.02	1.56	3.69	2.81	4.55	3.05
Services and goods available	5.46	2.77	3.88	2.34	5.40	2.71
Transportation options	6.03	2.70	4.12	2.75	5.05	3.08

Table 5.2: Indicators' Mean Scores (CONTINUED)

Item	Núcleo Urbano de Carajás		Canaã dos Carajás		Parauapebas	
	Mean	Std. Dv.	Mean	Std. Dv.	Mean	Std. Dv.
Health Domain						
Stress levels	5.60	2.43	5.47	2.50	6.22	2.57
Physical activity level	4.83	2.89	5.22	2.84	5.43	3.08
The food you eat	6.70	2.28	6.57	2.44	6.97	2.58
Entertainment options in your community	5.27	2.85	3.64	2.77	3.99	2.85
Health services in your community	5.29	2.77	3.24	2.49	4.36	2.92
Ability to balance life/work	6.71	2.39	7.10	2.52	7.81	2.12
Social Domain						
Relationship with your family	8.66	1.50	8.77	1.79	9.20	1.61
Love life	8.35	1.96	7.89	2.74	7.98	2.79
Relationship with friends	8.37	1.52	8.18	2.04	8.91	1.53
Privacy	6.93	2.52	7.50	2.56	7.96	2.13
Participation in community events	6.36	2.29	5.84	2.58	5.88	2.64
Participation in community decision-making	4.73	2.44	4.31	2.52	4.69	2.69
Educational opportunities	6.49	2.89	4.16	2.92	5.50	2.89

The means are a simple average measure—the sum of all scores divided by the number of scores. Comparisons of the domain mean scores by community of residence were completed for each domain individually. Comparisons of mean scores for individual indicators were only investigated in specific cases and will be discussed further in this chapter. However, it is noted that residents from the 3 communities consistently rated 2 items of the SWI scale similarly: personal relationships with the highest scores and economic situation with the lowest scores (Table 5.2).

Because Cronbach alpha results confirm that all the indicators in each domain are cohesive enough to represent one concept, the average mean scores for each domain were calculated as the average of the means for the indicators listed under each domain.

The means for average quality of life (AQOL) were calculated as the average scores of all of the 31 questions under every QOL domain. All of the mean scores for all 5 domains, AQOL, the

Subjective Wellbeing Index (SWI), the single question of QOL, and the single question on life as a whole (LAW) are displayed in Table 5.3.

The results in Table 5.3 highlight the most and least satisfying domains in each community and are only the first step in comparing the perceptions of quality of life in the 3 sample populations: the Núcleo Urbano de Carajás, Parauapebas and Canaã dos Carajás. The examination of significant differences among mean scores required a variety of tests.

5.1.3. Comparing Means

As discussed in detail in Chapter 4, when deciding which tests to run, 5 variables were considered of relevance for all of the QOL domains, for the AQOL and for the Subjective Wellbeing Index (SWI): *community of residence, age, gender, educational level,* and *number of dependent children* (Table 4.10). These variables were heuristically ascertained through assumptions based on participant observation and common sense.

Therefore, when running *t* tests, analysis of variance (ANOVA) or Welch Tests for AQOL, SWI and each of the 5 domains, the 5 chosen variables were tested, as well as other variables that were considered of specific interest for each domain. These variables are listed and discussed under each domain. Only the variables that proved, through post-hoc tests, to have significant mean score differences within categories are discussed. Because a large number of tests were necessary (all 5 domains, life as a whole—LAW—and SWI in relation to 13 demographic variables), the confidence level was set at 97.5 % (alpha = 0.025) to minimize Type I errors.

The variable *gender* was the only variable with only 2 categories: male and female. For this reason, a simple independent sample *t* test was run for gender for all domains, SWI, AQOL and LAW. Results indicate that there were no significant differences between mean scores for satisfaction of males and females for any of the domains, SWI, AQOL or LAW. Results of the independent sample *t* tests (also at confidence level 97.5 %) are available in Appendix C.

Table 5.3: Mean Scores

Items	Núcleo Urbano	Std Dv.	Canaã dos Carajás	Std Dv.	Parauapebas	Std. Dv.	All	Std Dv.
Life as a Whole								
Single Question Life as a Whole (LAW)	7.88	1.62	7.59	1.65	7.79	1.95	7.79	1.78
Quality of Life								
Single question Quality of Life (QOL)	7.28	1.80	6.93	1.90	7.03	2.08	7.11	1.95
Average Quality of Life (AQOL)	5.84	1.16	5.33	1.21	5.73	1.26	5.72	1.23
Economic Domain (5 items)	5.76	1.99	5.44	1.73	5.59	1.93	5.63	1.92
Work Domain (8 items)	6.85	1.63	7.23	1.58	7.56	1.59	7.24	1.63
Environment Domain (6 items)	5.58	1.12	3.52	1.43	4.12	1.61	4.56	1.63
Social Domain (7 items)	6.24	1.25	5.83	1.37	6.26	1.30	6.19	1.30
Health Domain (7 items)	4.86	1.49	4.60	1.50	5.13	1.41	4.95	1.47
Subjective Wellbeing								
Subjective Wellbeing Index (SWI)	7.30	1.26	6.84	1.46	7.21	1.28	7.18	1.31
Personal Relationships	8.12	1.52	8.00	1.71	8.40	1.79	8.23	1.69
Environment	7.70	1.94	6.29	2.38	6.68	2.31	6.99	2.26
Work	7.20	2.04	7.73	2.35	8.13	1.96	7.72	2.10
Economic Situation	6.04	2.37	5.59	2.19	6.08	2.31	5.98	2.32
Accomplishments in Life	7.41	1.81	7.64	2.07	7.85	1.71	7.65	1.82
Community	6.96	2.20	5.60	2.09	5.75	2.69	6.17	2.50
Health	7.62	1.98	6.96	2.74	7.57	2.63	7.49	2.43

5.1.4. Comparing Means: Average Quality of Life (AQOL)

In addition to the 5 variables considered of interest for all domains (i.e., *community of residence, age*, *gender*, *educational level* and *number of dependent children*), the following variables were also tested: *length of residence, region of origin, job class*, and *marital status*. Tests determined that inequalities exist only among the variables *community of residence* [ANOVA: F (2, 447) = 4.537, p = 0.011] and *educational level* [Welch's Test: F (2,442) = 4.27, p =0.014].

Tukey post-hoc tests indicate where these inequalities lie: residents of the Núcleo Urbano de Carajás and Parauapebas rated their satisfaction with quality of life similarly, while Canaã residents rated their quality of life slightly lower.

Table 5.4: Statistical Tests for AQOL

Category	Mean	Std. Deviation	n
Community of Residence			
ANOVA: F (2, 447) = 4.537, p = 0.011			
Canaã dos Carajás[a]	5.33	1.21	72
Parauapebas[b]	5.73	1.26	212
Núcleo Urbano de Carajás[b]	5.85	1.16	166
Educational Level			
Levene's test: F (2, 442) = 5.63, p = 0.004. Welch's test F (2,442) = 4.45, p = 0.012			
Technical or trades training[a]	*5.47*	1.19	126
University level[a]	5.59	0.98	67
Elementary to high school[b]	*5.85*	1.29	252

[a, b]Groups in each row that share a superscript are not significantly different from each other. Confidence level: 97.5%.

As illustrated in Table 5.4, respondents with a high school degree or less rated their satisfaction with quality of life slightly higher than respondents with higher educational levels.

5.1.5. Comparing Means: Economic Domain

Besides *community of residence*, *age*, *gender*, *educational level* and *number of dependent children*, the variables *job class* and *length of employment* were also tested for the economic

domain because of the direct relationship between salary and benefits and the ability to accumulate wealth while working towards economic wellbeing.

Table 5.5: Satisfaction with Economic Domain by Education Level

Educational Level	Mean	Std. Deviation	n
Technical or trades training[a]	5.23	1.85	129
Elementary to high school[b]	5.71	1.96	256
University level[b]	5.99	1.80	68

ANOVA: F (2,450) = 4.32, p=0.014

[a, b]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: Fisher Least Significant Difference (LSD). Confidence level: 97.5%

Analysis of variance (ANOVA) suggested that in fact these variables do not significantly impact responses about satisfaction with the economic domain. At a confidence level of 97.5%, ANOVA indicate that differences exist only within the educational levels categories ($p < 0.025$). Fisher Least Significant Difference (LSD) post-hoc tests indicate that respondents with an elementary school education or high school degree and respondents with a university education reported higher levels of satisfaction than respondents with technical or trades training (Table 5.5).

5.1.6. Comparing Means: Work Domain

In addition to the 5 variables considered of interest for all domains (i.e., *community of residence*, *age*, *gende*r, *educational level* and *number of dependent children*), other variables investigated for the work domain were *job class*, *length of employment*, and *area of work*. These additional variables were investigated because they are related to the respondents' type of work, experience and professional accomplishments.

At a confidence level of 97.5%, the ANOVA showed that differences exist within categories of the following variables: *community of residence* [$F (2,452) = 9.172$, $p < 0.001$], *educational level* [$F (2,447) = 6.708$, $p < 0.001$] and length of employment [$F (6, 444) = 7.831$, $p < 0.001$]. Results of post-hoc tests for the work domain are discussed below in relation to each of these variables.

a. Satisfaction with Work Domain by Community of Residence

Fisher Least Significant Difference (LSD) post-hoc tests indicate that significant differences in satisfaction with the work domain exist between the respondents that live in the Núcleo Urbano de Carajás and Parauapebas. Statistically, the mean score for Canaã dos Carajás respondents is not significantly different from the Núcleo Urbano de Carajás or Parauapebas sample populations.

Table 5.6: Satisfaction with Work Domain by Community of Residence

Community	Mean	Std. Deviation	n
Núcleo Urbano de Carajás[a]	6.85	1.64	167
Canaã dos Carajás[a,b]	7.23	1.58	74
Parauapebas[b]	7.56	1.59	214

ANOVA: F (2,452) = 9.17, p < 0.001

[a, b]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: Fisher Least Significant Difference (LSD). Confidence level: 97.5%

As depicted in Table 5.6, results show that Parauapebas residents reported higher satisfaction with the work domain than residents of the Núcleo.

b. Satisfaction with Work Domain by Educational Level

LSD post-hoc tests determined that statistically significant differences in reported satisfaction with the work domain exist between the respondents that have technical or trades training or a university-level education, and those who have an elementary-level education or a high school diploma. Respondents without any post-secondary education reported the highest levels of satisfaction with the work domain (Table 5.7).

Table 5.7: Satisfaction with Work Domain by Job Class

Job Class	Mean	Std. Deviation	n
Technical or trades training[a]	6.92	1.66	128
University level[a]	6.94	1.44	68
Elementary to high school[b]	7.49	1.62	254

ANOVA: F (2,447) = 6.708, p < 0.001

[a, b]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%

c. Satisfaction with Work Domain by Length of Employment

Table 5.8 shows the means of satisfaction with the work domain by length of employment.

Table 5.8: Satisfaction with Work Domain by Length of Employment

Length of Employment	Mean	Std. Deviation	n
Between 8 and 15 years[a]	6.57	1.81	21
More than 3 years and less than 8 years[a]	6.70	2.29	61
Between 1 and 3 years[a,b]	7.40	2.13	97
More than 15 years and less than 20 years[a,b]	7.46	2.24	35
20 years or more[a,b]	7.61	1.77	28
More than 6 months and less than 1 year[b]	8.21	1.94	105
6 months or less[b]	8.48	1.79	104

ANOVA: F (6, 444) = 7.831, p < 0.001

[a, b]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: Tukey HSD. Confidence level: 97.5%.

According to Tukey post-hoc tests, the significant differences in satisfaction with work exist among the respondents who had been with Vale for less than 1 year and employees who had been with the company for more than 3 but less than 15 years at the time they completed the questionnaire. Newer employees (i.e., those who had been working for the company for less than 1 year) reported higher satisfaction with the work domain than employees who had been working for Vale for longer periods of time.

5.1.7. Comparing Means: Environment Domain

In addition to the 5 variables considered of interest for all domains (i.e., *community of residence, age, gender, educational level and number of dependent children*), other variables tested for the environment domain were *housing status*, *length of residence* and *region of origin*.

The Analysis of Variance (ANOVA) showed that differences exist within several variables: *housing status* [F (2, 455) = 36.24, p < 0.001], *job class* [F (2, 452) = 3.52, p = 0.03], *age* [F (2, 450) = 13.554, p = 0.005], and *number of dependent children* [F (2,450) = 5.427, p = 0.005]. The Welch test indicates that differences exist within the *community of residence* variable [F (2.445) = 59.22, p < 0.001]. Results of post-hoc tests for the environment domain are discussed in relation to each of these variables.

a. Satisfaction with Environment Domain by Community of Residence

Welch's F test was used to examine the effect of the *community of residence* variable on satisfaction with the environment domain[45]. The test indicates that the mean scores for satisfaction with the environment for residents of the 3 case study communities are statistically significantly different from one another (Table 5.9).

The highest reported level of satisfaction is associated with residents of the Núcleo Urbano de Carajás. Parauapebas residents' mean scores follow, while the lowest level of satisfaction is associated with Canaã dos Carajás residents.

Table 5.9: Satisfaction with Environment Domain by Community of Residence

Community	Mean	Std. Deviation	n
Canaã dos Carajás[a]	3.52	1.43	75
Parauapebas[b]	4.12	1.61	215
Núcleo Urbano de Carajás[c]	5.58	1.12	168

Levene's test: F (2, 445) = 12.94, p< 0.001. Welch's test F (2, 445) = 73.78, p < 0.001

[a,b,c]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%.

b. Satisfaction with Environment Domain by Housing Status

According to the Fisher Least Significant Difference (LSD) post-hoc tests, respondents within all 3 housing status categories (i.e., *rental*, *ownership* and *company-provided accommodations*) reported different levels of satisfaction with the surrounding environment (Table 5.10). Overall, respondents were most satisfied with accommodations provided by Vale and least satisfied with rental housing.

[45]The Welch F Test was used here because Levene's test indicated that ANOVA was not a robust test in this case. Levene's tests are used to determine if variances among groups are homogeneous. In this case, F (2, 445) = 12.94, p< 0.001, indicating that the differences of homogeneity of variance were significant among groups.

Table 5.10: Satisfaction with Environment Domain by Housing Status

Housing Status	Mean	Std. Deviation	n
Rental[a]	3.76	1.62	130
Ownership[b]	4.32	1.56	108
Company-provided accommodations[c]	5.15	1.43	220

ANOVA: F (2, 455) = 36.24, p < 0.001

[a,b,c]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%.

c. Satisfaction with Environment Domain by Job Class

The LSD post-hoc tests indicate that managers and supervisors reported statistically significantly higher levels of satisfaction than respondents who were technicians or working in trades.

The levels of satisfaction reported by engineers, geologists and analysts were not statistically different from the other respondents, as showed in Table 5.11.

Table 5.11: Satisfaction with Environment Domain by Job Class

Job Class	Mean	Std. Deviation	n
Technicians or trades[a]	4.50	1.31	399
Engineer/geologist /analyst[a,b]	4.56	1.37	30
Manager or supervisor[b]	5.38	1.66	26

ANOVA: F (2, 452) = 3.52, p = 0.030

[a, b]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%

d. Satisfaction with Environment Domain by Age

The LSD post-hoc tests determined that all the 3 different age groups reported statistically different levels of satisfaction with the environment domain. As illustrated in Table 5.12, levels of satisfaction with the environment domain steadily increased with respondents' age groups.

Table 5.12: Satisfaction with Environment Domain by Age Groups (Estimated Marginal Means)

Age Group	Mean	Std. Deviation	n
18-30 years old[a]	4.30	1.59	288
31-40 years old[b]	4.69	1.64	101
More than 40 years old[c]	5.42	1.50	64

ANOVA: F (2, 450) = 13.554, p = 0.005

[a,b,c]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%.

e. Satisfaction with Environment Domain by Number of Dependent Children

According to LSD tests, all 3 categories (i.e., *no children*, *1–2 children* and *3 or more children*) demonstrated statistically different means for satisfaction with the environment domain.

As illustrated in Table 5.13, reported levels of satisfaction increased slightly with the number of dependent children respondents had.

Table 5.13: Satisfaction with Environment Domain by Number of Dependent Children

Number of Dependent Children	Mean	Std. Deviation	n
No children[a]	4.27	1.60	199
1 to 2 children[b]	4.76	1.59	204
3 or more children[c]	4.83	1.76	50

ANOVA: F (2,450) = 5.427, p = .005

[a,b,c]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%.

5.1.8. Comparing Means: Social Domain

In addition to the 5 variables considered of interest for all domains (i.e., *community of residence*, *age, gender, educational level* and *number of dependent children*), the only other variable investigated for the social domain was *length of residence.* The analyses of variance showed that differences exist within categories of several variables: *educational level* [F (2,449) = 7.726, p = 0. 001], *number of dependent children* [F (2,449) = 10.002, p < 0.001] and *community of residence* [F (2,449) = 4.064 p < 0.001]. Results of post-hoc tests for the social domain are discussed below in relation to each of these variables

a. Satisfaction with Social Domain by Educational Level

Fisher Least Significant Difference (LSD) post-hoc tests results suggest that there are statistically significant differences between the mean of satisfaction with the social domain reported by respondents with a high-school diploma or less and by those who have a technical or trades school diploma or a university degree, as illustrated in Table 5.14.

Table 5.14: Satisfaction with Social Domain by Educational Level

Educational Level	Mean	Std. Deviation	n
Elementary to high school[a]	6.38	1.28	255
Technical or trades training[b]	5.90	1.35	129
University level or graduate school[b]	5.91	1.18	68

ANOVA: F (2,449) = 7.726, p = 0.001

[a,b,c]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%.

Respondents with a high-school degree or less seem to be more satisfied with the social domain than respondents with higher educational levels.

b. Satisfaction with Social Domain by Number of Dependent Children

According to LSD post-hoc tests, significant differences in social domain exist between respondents who have at least one child and those who do not have any children. As shown in Table 5.15, respondents with at least one dependent child reported slightly higher satisfaction with the social domain when compared to those who did not have children.

Table 5.15: Satisfaction with Social Domain by Number of Dependent Children

Number of Dependent Children	Mean	Std. Deviation	n
No children[a]	5.88	1.27	198
1 to 2 children[b]	6.35	1.24	204
3 or more children[b]	6.63	1.49	50

ANOVA: F (2,449) = 10.002, p < 0.001

[a,b,c]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%.

5.1.9. Comparing Means: Health Domain

For the health domain, analyses of variance were run only for the *community of residence*, *age*, *gender*, *educational level*, and *dependent children* variables. Results show that differences exist within the categories of the variables *community of residence* [F (2,449) = 4.064 p < 0.001] and *educational level* [F (2,444) = 14.328 p < 0.001]. Results of post-hoc tests for the health domain are discussed below in relation to each of these variables

a. Satisfaction with Health and Community of Residence

According to LSD post-hoc tests, there are no statistically significant differences in the health domain between mean scores of respondents from the Núcleo and mean scores of respondents from Parauapebas.

The mean for satisfaction with the health domain for the Parauapebas sample population is slightly higher than the mean from the sample populations of Canaã dos Carajás. Statistically, the mean for the Núcleo sample populations are not significantly different from the other 2 communities (Table 5.16).

Table 5.16: Satisfaction with Health Domain by Community of Residence

Community	Mean	Std. Deviation	n
Núcleo Urbano de Carajás[a,b]	4.86	1.49	167
Canaã dos Carajás[a]	4.60	1.50	72
Parauapebas[b]	5.13	1.42	213

ANOVA: F (2,449) = 4.064 p < 0.001

[a, b]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%

b. Satisfaction with Health Domain by Educational Level

The LSD post-hoc tests suggest that the statistically significant difference in levels of satisfaction within different educational level groups lies between the group of respondents with an elementary education or high-school diploma and the group of respondents who have technical training or a university-level education.

Table 5.17: Satisfaction with Health Domain by Educational Level

Educational Level	Mean	Std. Deviation	n
Technical or trades training[a]	4.46	1.45	126
University level[a]	4.94	1.35	67
Elementary to high school[b]	5.25	1.43	254

ANOVA: F (2,444) = 14.328 p < 0.001

[a, b]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%

Even though the differences are not large, results suggest that individuals with basic education—elementary to high-school level —are the most satisfied with the health domain.

5.1.10. Defining QOL Satisfaction Predictors

One of the important outcomes of this research is the identification of quality of life (QOL) predictors—those domains that seem to impact the perceptions of QOL in each community and for the respondents as a whole.

Regression analysis was used to define predictors. The independent variables were defined as the QOL domains: social, economic, environment, work and health. These were entered concurrently in the equation using SPSS Regression Analysis Tool. Table 5.18 presents the regression model coefficients for the QOL domains. Table 5.19 illustrates how each community defines QOL predictors.

Table 5.18: Model Coefficients: Regression against QOL, all communities

QOL Domain	Unstandardized Coefficients		Standardized Coefficients	Significance (p)
	B	Std. Error	Beta (β)	
Economic	0.29	0.05	0.29	0.00
Work	0.03	0.06	0.02	0.66
Environment	0.12	0.05	0.10	0.03
Social	0.16	0.07	0.10	0.03
Health	0.34	0.07	0.26	0.00

Note: $R^2 = 0.38$.

Confidence level: 95%.

The simplified regression equation for the entire sample population would therefore be:

$$Y_{QOL-all} = 0.29\,X_{economic} + 0.26\,X_{health} + 0.10\,X_{social} + 0.10\,X_{environment} + \varepsilon$$

Because the p value for the standardized coefficient (β) for the variable *work* was larger than 0.05[46] (β = .024, p = 0.66), it can be inferred that the variance in satisfaction levels with the work domain does not uniquely predict variance in satisfaction with QOL in the sample population. The economic (β = 0.29, p < 0. 001), health (β = 0.26, p < 0. 001), social (β = 0.10, p = 0. 03), and environment (β = 0.10, p = 0. 03) domains were identified as predictors of QOL in the sample population. This equation predicts 38% of the variance in satisfaction with QOL scores (R^2 = 0.38).

The simplified regression equation for the Núcleo Urbano de Carajás sample population would be:

$$Y_{QOL-Nucleo} = 0.17\,X_{social} + 0.23\,X_{economic} + \varepsilon$$

This equation indicates that QOL predictors in this community are the social (β = 0.17, p = 0.028) and economic (β = 0.23, p = 0.004) domains. Beta values for the other domains were not statistically significant (p values were above 0.05), and therefore these domains were not considered in the equation above. This equation predicts 42% of the variance in QOL scores (R^2 = 0.42).

[46] If the *p* value is larger than the alpha value (0.05 since the confidence level is 95%), the standardized coefficient (beta) is not considered statistically significant.

Table 5.19: QOL Model Coefficients per Community

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	Significance (p)	R^2
	B	Std. Error	Beta (β)		
Núcleo Urbano de Carajás					
Economic	0.21	0.07	0.23	0.004	0.42
Work	0.19	0.10	0.17	0.053	
Environment	0.20	0.12	0.13	0.101	
Social	0.25	0.11	0.17	0.028	
Health	0.17	0.10	0.14	0.090	
Parauapebas					
Economic	0.34	0.09	0.31	0.000	0.35
Work	-0.05	0.11	-0.04	0.643	
Environment	0.96	0.10	0.08	0.323	
Social	0.06	0.12	0.04	0.582	
Health	0.45	0.12	0.31	0.000	
Canaã dos Carajás					
Economic	0.21	0.13	0.23	0.096	0.46
Work	-0.11	0.15	0.17	0.466	
Environment	0.32	0.15	0.13	0.832	
Social	0.37	0.17	0.17	0.030	
Health	0.50	0.16	0.14	0.002	

Confidence level: 95% (alpha = 0.05)

The regression equation for Canaã dos Carajás is:

$$Y_{QOL\ -Canaa} = 0.14\ X_{health} + 0.17\ X_{social} + \varepsilon$$

This equation indicates that QOL predictors in this community are the health (ß = 0.14, p = 0.03) and social (ß = 0.17, p = 0.002) domains. Beta values for the other domains were not statistically significant (p values were higher than 0.05). and therefore these domains were not considered in the equation above. This equation predicts 46% of the variance in satisfaction with QOL scores (R^2 = 0.46).

The regression equation for Parauapebas is:

$$Y_{QOL\ -\ Parauapebas} = 0.31\,X_{health} + 0.31\,X_{economic} + \varepsilon$$

This equation indicates that QOL predictors in this community are the health (β = 0.31, p < 0.001) and economic (β = 0.309, p < 0.001) domains. Beta values for the other domains were not statistically significant (p values were higher than 0.05), and therefore these domains were not considered in the equation above. This equation predicts 35% of the variance in QOL scores (R^2 = 0.35).

5.1.11. Defining LAW Satisfaction Predictors

Life as a whole (LAW) was analyzed as a separate variable. The purpose of investigating LAW was to contribute to the subjective wellbeing literature by analyzing the predictors of LAW in the sample population.

To identify predictors of LAW in the sample population, an approach similar that taken in determining predictors of quality of life (QOL) for this research was taken. Table 5.20 presents the LAW regression model coefficients for the QOL domains.

The LAW regression equation for the entire sample population is:

$$Y_{LAW\ -\ all} = 0.27\ X_{work} + 0.36\ X_{economic} + \varepsilon$$

The work domain (β = 0.27, p = 0.004) and the economic domain (β = 0.363, p <. 0.001) are the predictors of satisfaction with life as a whole (LAW) in the sample population. The other domains did not prove to uniquely predict variance in satisfaction scores with LAW (β values for the other domains were not statistically significant if p values were above 0.05), and therefore were not considered in the equation above. This equation predicts 22% of the variance in satisfaction with LAW scores (R^2 = 0.22).

Table 5.20: LAW Model Coefficients per Community

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	Significance (p)	R^2
	B	Std. Error	Beta (β)		
Núcleo Urbano de Carajás					
Economic	0.158	0.075	0.194	0.037	0.22
Work	0.122	0.101	0.123	0.231	
Environment	0.433	0.128	0.300	0.001	
Social	-0.036	0.117	-0.028	0.756	
Health	-0.052	0.101	-0.048	0.609	
Canaã dos Carajás					
Economic	0.178	0.121	0.187	0.146	0.38
Work	0.145	0.147	0.140	0.326	
Environment	-0.239	0.145	-0.207	0.104	
Social	0.123	0.161	0.097	0.449	
Health	0.480	0.152	0.433	0.002	
Parauapebas					
Economic	0.373	0.087	0.363	0.000	0.26
Work	0.332	0.115	0.271	0.004	
Environment	-0.171	0.098	-0.141	0.082	
Social	-0.118	0.116	-0.080	0.312	
Health	0.124	0.117	0.090	0.288	
All 3 Communities					
Economic	0.373	0.087	0.363	0.000	0.22
Work	0.332	0.115	0.271	0.004	
Environment	-0.171	0.098	-0.141	0.082	
Social	-.0118	0.116	-0.080	0.312	
Health	0.124	0.117	0.090	0.288	

Confidence level: 95% (alpha = 0.05)

The life as a whole (LAW) regression equation for the Núcleo Urbano de Carajás is:

$$Y_{LAW\ -\ Nucleo} = 0.30\ X_{environmen\ t} + 0.19\ X_{economic} + \varepsilon$$

This equation indicates that QOL predictors in this community are the environment (β = 0.30, p = 0.001) and economic (β = 0.194, p = 0.037) domains. Beta values for the other domains were not statistically significant (p values were above 0.05), and therefore these domains were not considered in the equation above. This equation predicts 22% of the variance in LAW scores (R^2 = 0.22).

The LAW regression equation for Canaã dos Carajás would be:

$$Y_{LAW\ -\ Canaa} = 0.43\ X_{health} + \varepsilon$$

This equation indicates that the health domain is the only domain that uniquely predicts variation in satisfaction with LAW in this population (β = 0.433, p = 0.002). Beta values for the other domains were not statistically significant (p values were above 0.05), and therefore these domains were not considered in the equation above. This equation predicts 38% of the variance in LAW scores (R^2 = 0.38).

The LAW regression equation for Parauapebas would be:

$$Y_{LAW\ -\ Parauapebas} = 0.27\ X_{work} + 0.36\ X_{economic} + \varepsilon$$

This equation indicates that LAW predictors in this community are the work (β = 0.27, p = 0.004) and economic (β = 0.363, p < 0.001) domains. Beta values for the other domains were not statistically significant (p values were above 0.05), and therefore these domains were not considered in the equation above. This equation predicts 26% of the variance in satisfaction with LAW scores (R^2 = 0.26)

5.1.12. Subjective Wellbeing Index

The purpose of pursuing a pilot test of a Subjective Wellbeing Index (SWI) with 7 questions in Part 1 of the quality of life (QOL) questionnaire was to investigate the possibility of using a smaller questionnaire instrument as an alternative to the 31-item QOL scale.

The first step of this investigation was involved confirming that the items defined as part of the SWI (Table 5.21) were cohesive enough to be part of one index. These items were presented in the first page of the questionnaire as single items. Confirmation was obtained with an internal reliability test by calculating the Cronbach alpha. The Cronbach alpha obtained for the SWI is 0.71 (Table 5.1), which is considered acceptable and confirms the cohesion of the items.

Table 5.21: QOL Model Coefficients for SWI

SWI Items	Unstandardized Coefficients		Standardized Coefficients	Sig. (p)	R^2
	B	Std. Error	β (Beta)		
Personal relationships	0.09	0.02	0.13	0.000	
Surrounding Environment	0.05	0.02	0.10	0.003	
Work	0.10	0.02	0.17	0.000	
Economic situation	0.14	0.02	0.28	0.000	0. 64
Accomplishments in life	0.05	0.02	0.08	0.031	
Community	0.14	0.02	0.29	0.000	
Health	0.14	0.02	0.27	0.000	

Notes: R^2 indicates that the percentage of the variance in QOL scores that the regression equation predicts is 64%. Confidence level 95%.

The second step was the confirmation that the items in the SWI could be collectively interpreted as a measurement of satisfaction with quality of life. Multiple regression analysis was employed and all SWI items were expected to contribute unique variance to confirm that these items uniquely predict variance in scores of the single question on satisfaction with quality of life.

Table 5.20 shows that all the SWI items (independent variables) are predictors of QOL [47]since p values are smaller than 0.05 when the confidence level is 95%, indicating statistically significant standardized coefficients. Moreover, the complete regression equation (including all 7 items) predicts 64% (R^2 = 0.64) of the variance in scores for the single question, “How satisfied are you with your quality of life in general?”

The correlation between the scores for the SWI and for average quality of life (AQOL) was calculated as a way to test the ability of the SWI to measure quality of life as compared to the 31

[47] The dependent variable is the single question of satisfaction with quality of life.

items in the QOL domains. A high positive correlation indicates an overlap in measures and provides a rationale for the further investigation of the SWI instrument as a shorter alternative to the 31-item QOL instrument.

Table 5.22: Pearson Correlations for SWI and Average QOL

Pearson Correlations	SWI	AQOL
SWI (7 items)	1	0.79*
AQOL (31 items in 5 domains)	0.79*	1

*Correlation is significant at the 0.01 level.

Table 5.22 displays the correlations values for the adapted SWI and QOL, indicating a strong positive correlation. A detailed discussion on the implications of the results of this pilot test is presented in Chapter 6: Discussion.

5.2. Qualitative Analysis Results

Phase III of this research included structured qualitative interviews with mine employees residing in the Núcleo Urbano de Carajás, Parauapebas and Canaã dos Carajás and. This Phase also included participant observation during 2 site visits.

Concepts were defined through coding of the interviews and supported by participant observation notes. Through this analytic process, concepts were identified and their properties discovered in the qualitative data. Categories were identified from the conceptual framework defined for this project: social, environmental, economic, health and work domains of quality of life. With the coding process, it was also observed that some issues were brought up outside of the frame of positive and negative nature. These issues are presented in this section, under sub-sections called “Other Major Themes”. As with the quantitative data, the qualitative findings presented in this chapter are further interpreted and discussed in Chapter 6.

5.2.1. Interview Results: Defining Quality of Life

The first question, “What is quality of life for you?”, was analyzed at the broader level, with all interviews considered together, independent of community of residence. The following questions, about the best and worst aspects of each of the 3 case study communities, as well

as priorities and suggestions for improvement, were coded and analyzed with each individual community considered separately.

Quality of life (QOL) concepts were identified in open coding responses to the question "What is quality of life for you?" The following are quotes that illustrate the variety of views of QOL within the sample population:

> *"Quality of life is about doing what you enjoy, be it at work or within the community; for me, it also includes helping others*." (Male employee living in Canaã dos Carajás)

> *"Quality of life is peace and knowing you have access to good health services, to live well with family and to be able to improve yourself*." (Male employee living in Canaã dos Carajás)

The main themes extracted from open coding of the interviews were then classified into categories following the framework of the conceptual model for this study. The categories and corresponding concepts obtained in interviews are illustrated in Table 5.23.

Table 5.23: Major Concepts – How Do You Define Quality of Life?

Category (Domain)	Concepts
Environmental Aspects	▪ Adequate access to good housing ▪ Adequate access to services and facilities for: o Health care o Entertainment and recreation o Community interaction ▪ Basic infrastructure (water, sanitation, power) ▪ Security ▪ Quietness
Economic Aspects	▪ Having financial ability to meet basic needs
Health Aspects	▪ Life-work balance ▪ Spiritual wellbeing ▪ Mental wellbeing ▪ Physical health ▪ Access to good health care services ▪ Hygiene: water, sewage infrastructure, garbage collection ▪ Access to exercise facilities or space ▪ Access to entertainment and recreational options ▪ Freedom from stress and fatigue

Table 5.23: Major Concepts – How Do You Define Quality of Life? (CONTINUED)

Category (Domain)	Concepts
Work Aspects	▪ Professional achievements ▪ Employment opportunities ▪ Good relationships at work ▪ Good compensation
Social Aspects	▪ Family: o Family relationships, o Proximity to family members ▪ Good friendships ▪ Community involvement ▪ Access to education ▪ Access to social spaces

5.2.2. Núcleo Urbano de Carajás

a. Most Satisfying Things about the Núcleo Urbano de Carajás

> *"Sometimes I feel like I am part of a big family—in many places in the Núcleo I feel at home. It is a weird relationship we end up having with the place."* (Female employee living in the Núcleo Urbano de Carajás)
>
> *"I think that because you live inside the company, you don't stress too much—this is quality of life. It's really convenient."* (Female employee living in the Núcleo Urbano de Carajás)

The positive aspects of the Núcleo Urbano de Carajás were identified through a structured and open-ended question. Participants were asked to list the 3 "best things" about living in the Núcleo. Table 5.24 depicts the concepts identified during interviews and classified in the QOL domains, as well as the frequency with which each concept was mentioned during the interview process (all Phase III interviews).

Environmental qualities were the most frequently identified as the best things about living in the Núcleo Urbano de Carajás (51). Social aspects were also often mentioned as best things about the Núcleo (9), as well as work-related issues (6) like employee benefits (e.g., housing, health care, school for children, etc).

Table 5.24: Best Things about Living in the Núcleo Urbano de Carajás

QOL Domain	Concept	Frequency*
Environment	Access to nature	13
	Good security	12
	Quietness	10
	Convenience of facilities and work close by	9
	Quality of the urban space	5
	Quality of basic infrastructure	2
	Total	**51**
Social	Ease to socialize and make friends	4
	Cultural and socio-economic diversity	3
	Educational opportunities close by	1
	Sense of community	1
	Total	**9**
Work	Work related benefits	4
	Opportunities for professional growth	2
	Total	**6**

*Refers to number of times a concept was mentioned during interview process

b. Least Satisfying Things about living in the Núcleo Urbano de Carajás

> *"This feels like* Big Brother[48]*—people are watching you all the time, everybody is watching you, judging. Lots of silly gossip comes up from nothing, really."*
> (Female employee living in the Núcleo Urbano de Carajás)

The negative aspects of the Núcleo Urbano de Carajás were also identified through a structured and open-ended question in the interview: Participants were asked to list the 3 "worst things" about living in the Núcleo. Table 5.25 depicts the concepts identified during the interviews, classified into the QOL domains (i.e., social, health, economic and environment), as well as the frequency with which each concept was mentioned during the interview process.

As indicated in Table 5.25, the majority of negative issues identified by participants are fall under the social (38) and health domains (29), and it is interesting to note that these issues are

[48]*Big Brother* is a popular television show in which a group of people lives in a house with cameras in every room that operate 24 hours a day.

closely related. Some of the negative aspects offal under the economic (04) and environment (03) domains, but these were mentioned significantly fewer times than the social and health challenges encountered in the Núcleo.

Table 5.25: Worst Things about Living in the Núcleo Urbano de Carajás

QOL Domain	Concept	Frequency*
Social	Lack of privacy	12
	Blurred boundaries between personal and professional lives	8
	Lack of entertainment options	6
	Perceived over-regulation and control	5
	Isolation and disconnection from the world, services and resources	2
	High turnover of people	2
	Limited educational opportunities after K–12	2
	Social stigmatization: elite	1
	Total	**38**
Health	No work-life balance	12
	Monotony and boredom	12
	Work related-stress	3
	High incidence of depression and unhappiness	2
	Total	**29**
Economic	High cost of living	4
	Total	**4**
Environment	Problems with housing	2
	Transportation challenges	1
	Total	**3**

*Refers to number of times a concept was mentioned during interview process

c. Priorities for the Núcleo Urbano de Carajás

> *"Sometimes I am frustrated with the isolation… Even the Internet does not work half the time, so I feel isolated and as I have been denied [certain] things… And I feel powerless to do anything about it."* (Male employee living in Núcleo)

At the end of each interview, participants were asked to identify priorities for improvement and to make suggestions for improving the quality of life in the Núcleo Urbano de Carajás. Table 5.26 depicts the priority issues and suggestions identified during interviews, as well as the frequency with which suggestions were mentioned during the interview process.

Table 5.26: Areas of Priority: Núcleo Urbano de Carajás

Priority Issues to be Addressed	Suggestions	Frequency*
Boredom and depression	Increase entertainment and recreational opportunities and variety	5
	Create more professional development and training opportunities for family members who are not Vale employees	3
	Improve access to culture	1
	Total	**9**
Feelings of isolation	Improve access and ability to come and go	2
	Improve communication systems for residents	2
	Increase transportation and access to/from Parauapebas to increase access to education, services and goods, and a larger part of the community	1
	Promote social integration with Parauapebas	1
	Total	**6**
Privacy and freedom	Increase range of modifications one can make to company houses to address privacy issues	2
	Reduce control (resident rules and regulations, bylaws)	2
	Total	**4**
High cost of living	Improve salary and benefits for employees to mitigate costs	1
	Establish strategy to increase competition between local businesses in order to increase quality of goods and services and reduce prices	1
	Total	**2**
Social inequality	Eliminate housing inequalities within the community	1
	Total	**1**

*Refers to number of times a concept was mentioned during interview process

It is clear from the issues and frequencies listed in Table 5.25 that the majority of participants feel that intervention efforts should focus on the types of social and psychological issues, such as feelings of isolation and boredom, which often result from living in a remote, difficult-to-access location. Lack of privacy and freedom, the perceived social segregation within the community, and the high cost of living are other issues that seem to warrant intervention.

Through the interview coding process, other relevant concepts outside of the discussion of the best and worst aspects of the community were identified. The recurring concepts are regarded as “other major themes”.

d. Other Major Themes

- **Social Segregation between the Núcleo Urbano de Carajás and Parauapebas**

There is a perceived social segregation between the Núcleo Urbano de Carajás and Parauapebas, which causes discomfort for some Núcleo residents, and perceived social discrimination against Parauapebas residents. As stated by a male employee who had been a resident of the Núcleo for 6 years:

> *"I worry about getting more benefits from Vale—it sounds nice, but I am afraid that more benefits would only increase the disparity between the 2 communities (the Núcleo and Parauapebas). Our privileges—urban services, basic infrastructure—should be available to everybody in this region."*

For residents of the Núcleo, the disparities that exist between their community and Parauapebas create a certain level of fear; many residents of the company-controlled town feel that if they do not dedicate themselves to their work, they will lose their jobs and residence benefits. This fear seems to have resulted in further stress, pressure to work overtime and a lack of work-life balance for residents of the Núcleo. As stated by a male resident living in Parauapebas, who previously lived in the Núcleo for 14 years:

> *"These great inequalities only increase the fear of job loss and reinforce the belief that you need to dedicate your life to your job."*

Because some residents of the Núcleo regard Parauapebas as an undesirable place to live, the prospect of losing a job with Vale and having to work for contractors and live in Parauapebas may sound terrifying.

The fear of job loss is in fact a very serious concern in the Núcleo. Because employees have benefits that include housing, schooling for their children and health care, the fear of loosing a job is amplified because of the consequences for the individual and his/her family. Job loss means more than the loss of a paycheque from Vale—it also potentially means the loss of decent housing, quality schooling for children, social networks and friends, and possibly also the loss of the spouse's job.

- **Raising Children in a Company Town**

Generally, participants regard the Núcleo Urbano de Carajás as a great place to raise young children. Residents appreciate the tranquility and security of the Núcleo and the fact that children can play on the streets without direct supervision. However, it appears that life in this community poses challenges for pre-teens and teenagers, who often need more variety and discovery not available in small communities like the Núcleo Urbano. Some participants expressed fear that this might increase the risks of teen pregnancy and drug use among the youths of the company-controlled town. As discussed by a female employee who had lived in the Núcleo for 22 years:

> *"This place is beautiful and quiet, great for raising small children. But there is an age limit—about 15 or 16 years old. At this age they are looking for something they can't find here anymore, and what happens is that their sexual life starts too early. There's little to do, so they start dating too early, at 10, 11, 12 [years old]"*

Because children in the Núcleo generally grow up with such high levels of security and protection, they are often not "street smart" and have a hard time when they need to face the reality of a larger community. When young people leave the Núcleo to attend university or college elsewhere (which occurs because of the lack of options in the community itself), it is not unusual for them to have trouble adjusting to life outside of the safe and controlled atmosphere in which they grew up. In addition, some interview participants regard the security and isolation of the community as a barrier for child and youth development in regards to learning important self-protection and survival skills.

> *"The teenagers who grew up here are a little out of it and spoiled—I have noticed that. There are many teenagers who have a hard time when they need to leave to go to university. It's different and difficult because there's no violence or muggings here."* (Female employee living in the Núcleo Urbano de Carajás)

- **Negative Changes since Privatization**

> *"Vale has changed a lot since the privatization—it used to be a lot better. I wouldn't say we would have been in heaven living here, but it would have been pretty close to it."* (Male employee living in the Núcleo Urbano de Carajás)

There seems to be a general feeling that the quality of the urban environment and community services provided in the Núcleo Urbano de Carajás, and salary and benefits as well, have declined since the privatization of Vale. Longtime residents tend to speak with melancholy about

better housing, infrastructure maintenance and general morale in the community before the company was privatized. For example, in the past, the company was financially supportive of individuals renovating their houses in the Núcleo. Current company housing policies do not encourage such remodeling as the company will not reimburse employees for any personal investment in improving company homes.

Hedges are also remembered as healthy and trimmed, marking off property lines and creating a sense of intimacy. The current lack of maintenance of hedges has contributed to the lack of privacy of homes, since these hedges were the only dividing elements between lots.

- **Adaptation and Coping Strategies**

Several interviewees living in the Núcleo Urbano de Carajás discussed strategies for adaptation and coping with the challenges of living in a small, paternalistic, company-controlled town. The Núcleo residents brought forward several strategies:

  - **Addressing Feelings of Isolation**

  One of the suggestions for mitigating feelings of isolation involved leaving the Núcleo as much as possible:

  > *"I am always going away with my family—we don't live locked up here… I see this place more like my workplace, Carajás is the place where we have the work and study routine, but every long weekend and vacation time we go somewhere [out of town]."* (Female employee living in the Núcleo Urbano de Carajás)

  It was also noted that perceiving the Núcleo as a neighborhood of Parauapebas, and therefore a part of a larger community, might encourage individuals living in the Núcleo to breach the perceived barriers between the 2 communities:

  > *"I see Parauapebas as a cool place, and when I have time off I always go there. I go [to Parauapebas] on Sundays, have lunch, and even sleep over there. I love Parauapebas—my sister lives there… I see several people from Carajás there, at the town square, at the ice cream parlor. There are nice things in Parauapebas."* (Female employee living in the Núcleo Urbano de Carajás)

- **Addressing Work-Life Balance Challenges**

To mitigate the challenge of achieving a healthy work-life balance, some employees suggested that aiming to make friends outside of the workplace and refraining from "talking shop" outside of working hours might be a good strategy:

> *"Even though I work a lot, when I leave work I meet with people outside of my work, and I have conversations that are not work related—I discuss other sorts of issues, I take part in different activities."* (Male employee living in the Núcleo Urbano de Carajás)

Keeping priorities straight was also identified as a strategy to mitigate the difficulties of balancing work and private life:

> *"When I came as an intern, my supervisor told me what he thought the rules of this place are: your first and foremost priority is the company, then family, and then the other "stuff". At that moment I knew I had to take the opposite approach to be able to survive here—my family comes first, I came here for them, so that we could have a better life and future."* (Male employee living in the Núcleo Urbano de Carajás)

Moreover, choices regarding friends and companions are thought to impact levels of depression and boredom. Three employees suggested that spending leisure time with co-workers might make it difficult to separate private life and work:

> *"You have to choose your friendships well so that you are not working 24 hours a day."* (Male employee living in the Núcleo Urbano de Carajás)

- **Addressing Boredom and Depression**

Interview participants living in the Núcleo Urbano de Carajás offered several thoughts on how to address boredom and feelings of isolation. One of the suggestions (referring to wives or husbands of mine employees) involved being open to trying different things and training for the employment opportunities available in the community:

> *"The company helps… There's a lot of training available. There is a job bank… And you see lots of employees' wives working… For the company, it is better if they find work— this reduces [the company's] costs because these wives already have a home to live in and are already familiarized with the community. [Vale] give[s] you priority, and I think there's a lot of value in that. You come here to accompany your husband, but they also value you. However, you need to continue to deserve that position that was given to you. You need to be proactive and can't just*

> *wait for things to happen. Nowadays, everybody in Brazil and in the world has to work hard for these things— there are a lot of people wanting to take our place here."* (Female resident living in the Núcleo Urbano de Carajás)

Another suggestion was to use time wisely:

> *"I think you need to occupy yourself with constructive things, not with the activities that are exhaustive. You can only spend all your time going to parties for so long before you get tired of it, and then you have to find meaningful things to do with your time… You need to find those people who are similar to you in a way, who have similar interests."* (Male employee living in the Núcleo Urbano de Carajás)

Varying the weekly routine by taking advantage of facilities available and events in the Núcleo as well as in Parauapebas was also identified as a way to avoid feeling bored and isolated:

> *"I have a varied schedule: once a week I go to the movies, once a week I rent a DVD, twice a week I go to the Spiritualist Centre*[49]*… I try to diversify my activities. Because there's no real shopping here, once a week I go to the community market in Parauapebas."* (Male employee living in the Núcleo Urbano de Carajás)

Finally, one resident of the Núcleo suggested that personalizing one's home or space—i.e., treating the company house as if it were your own and modifying it to bring you increased comfort and wellbeing—is a good strategy for addressing depression:

> *"Many people say, "I am not going to modify the house because one day I will leave". Imagine if I had had this attitude until this day—for 23 years I would have been kept awake at night, annoyed, upset, complaining… So I think I need to be able to transform this place in the best way [I can]… So that I can be happy, and my family can grow happily."* (Female resident living in the Núcleo Urbano de Carajás)

- **Addressing Peer Pressure and Privacy Issues**

Several interview participants living in the Núcleo Urbano de Carajás mentioned privacy issues as a significant problem in their community; some were able to offer their own strategies to reduce the impact of the lack of privacy on their quality of life.

[49] Spiritualism is a religion widely popular in Brazil. The main difference between Spiritualism and other religions is that it is founded on the belief that there is life after death and that there is a path of eternal progression for all mankind with the acceptance of responsibility for all one's own actions.

One of the suggestions was to make an effort to ignore what others think or say about one's personal life or personal choices:

> *"This* Big Brother *thing does not bother me anymore because I no longer care about what others say about me".* (Female employee living in the Núcleo Urbano de Carajás)

Another suggestion on how to mitigate the privacy challenge in the Núcleo was to be protective of one's privacy:

> *"We try to keep our voices down at home—we can hear the neighbors. We don't want the entire community to know what happens in our home."* (Male employee living in the Núcleo Urbano de Carajás)

5.2.3. Canaã dos Carajás

a. Most Satisfying Things about Canaã dos Carajás

> *"For me, the greatest advantage of living in Canaã is the peace that this town still offers. We can still go out without fear of being mugged; we can sleep without the fear that our home will be broken into; we can meet up with friends at the town's square for a leisurely chat".* (Male employee living in Canaã)

During the qualitative interviews, participants living in Canaã were asked to list the 3 best things about their community. The answers to the question "What are the best things about living in Canaã?" were analyzed and coded. Table 5.27 depicts the concepts identified during interviews, classified into the QOL domains, as well as the frequency with which each concept was mentioned during the interview process.

For residents of Canaã, aspects associated with the environment (12), social (12) and health (10) domains were the most frequently identified as the most positive aspects of the community. Interestingly, these issues are closely related and associated with the fact that Canaã is a small and quaint town, experiencing dramatic change and growth.

Table 5.27: Best Things about Living in Canaã dos Carajás

QOL Domain	Concepts	Frequency*
Environment	Quaintness/rural atmosphere	07
	Continuous development	03
	Environmental qualities	02
	Total	**12**
Social	Sense of connection with the community	06
	Quality of social interaction/networks	05
	Cultural diversity of the population	01
	Total	**12**
Health	Tranquility	06
	Sense of security	04
	Total	**10**
Work	Employment and professional growth opportunities	03
	Total	**03**
Economic	Business opportunities in the booming community	01
	Total	**01**

*Refers to number of times a concept was mentioned during interview process

b. Least Satisfying Things about Canaã dos Carajás

> *"I don't have a family, but I can imagine that it is much more complicated for those who do—if you have a stay-at-home wife and kids, it's harder to have good quality of life… You work all week and what happens to your wife? And what about your kids? What options do they have? There's nothing around here*."
> (Male employee living in Canaã)

The negative aspects of Canaã dos Carajás were also identified through a structured and open-ended question about the "three worst things" about Canaã. Table 5.28 depicts the concepts identified and classified into the QOL domains, as well as the frequency with which each concept was mentioned during the interview process.

Interestingly enough, the most frequently identified negative issues during interviews were also associated with the health (14), social (12) and environment (10) domains. While positive aspects seem to be mostly about the character of the community, negative aspects seem to be

associated with a lack of basic infrastructure—due to Canaã's "growing pains"—and the social implications of Canaã's remoteness, boom phase and high cost of living (3).

Table 5.28: Worst Things about Living in Canaã dos Carajás

QOL Domain	Concepts	Frequency *
Health	Lack of entertainment and recreational facilities	5
	Inadequate health care services and facilities	5
	Monotony and boredom	4
	Total	**14**
Social	Isolation and disconnection from the world	5
	Inadequate social services	3
	No educational opportunities after K–12	2
	High turnover of residents	1
	Lack of job opportunities for spouses of Vale employees	1
	Total	**12**
Environment	Deficient basic infrastructure	5
	Pollution from field burns for cattle raising	2
	Lack of transportation options	2
	Overcrowding in shared company homes (*repúblicas*)	1
	Total	**10**
Economic	High cost of living	3
	Total	**3**

*Refers to number of times each concept was mentioned during interview process

c. Priorities for Canaã dos Carajás

> *"I think we are missing a well-structured recreation center, and the constant power blackouts are annoying."* (Male employee living in Canaã)

At the end of each interview, participants were asked to identify priorities for improvement and/or to make suggestions for improving the quality of life in Canaã. The priority issues and suggestions brought forward during the interviews are displayed in Table 5.29.

Similar to the Núcleo Urbano de Carajás, feelings of isolation resulting from the remoteness of the community and boredom (the feeling that there is "nothing to do" in the community) were also strongly identified as priorities for improvement in Canaã dos Carajás. As illustrated in

Table 5.29, suggestions to reduce the remoteness of the community were made. These suggestions include improving access to Canaã and the community's communication systems. Suggestions to mitigate the boredom problem focused on improving entertainment and recreational opportunities (and increasing the variety of options) as well as opportunities to participate in community events.

Table 5.29: Areas of Priority: Canaã dos Carajás

Priority Issues to be Addressed	Suggestions	Frequency*
Feelings of isolation and boredom	Increase entertainment/recreational opportunities and variety	4
	Improve communication systems	3
	Encourage employee engagement with the community	2
	Improve access to and from the community	1
	Total	**10**
Lack of basic infrastructure	Improve basic services and infrastructure	5
	Total	**5**
Lack of basic community services	Improve basic community services such as banking, post office, transportation, etc.	5
	Total	**5**
Education	Improve educational opportunities for the community	1
	Total	**1**

*Refers to number of times a concept was mentioned during interview process

Several participants also view the infrastructure challenges and lacking community services as main priorities for intervention. One respondent highlighted the need to improve the education opportunities for the community as a whole.

Through the Canaã interviews' coding process, other relevant concepts were identified and categorized. The recurring concepts are regarded as "other major themes".

d. Other Major Themes

- **Vale's Responsibilities towards the Development of the City**

A recurring topic brought up by Vale employees related to the lack of clarity of the differences between the corporate (Vale) and municipal government responsibilities towards the

development of Canaã dos Carajás. Vale has participated in building a hospital, an elementary school and a community cultural center; laid asphalt in parts of the city, paid for the lighting of the major access street, etc. Some perceive that there is a general expectation that the company will solve all of the problems created by the rapid growth of the population and increasing need for basic infrastructure and services. There is also the perception that the municipal government has counted on the company to be the major player in the development of the community. Interview participants often pointed at the municipal government for not maintaining the infrastructure built by Vale:

> *"The relationship between Vale and Canaã is positive, not negative. On the other hand, the municipal government thinks that Vale has to do everything. Yesterday I was arguing about that with the guy from the Municipal Chamber of Commerce —they keep waiting for stuff. I told him, 'You need to start walking with your own feet.' "* (Male employee living in Canaã)

- **Socio-economic Impacts of the Sossego Copper Mine**

Long-term residents—people who witnessed the boom of the city and the impacts of this boom on the existing population—brought up interesting concepts. Perceived socio-economic impacts of mining activity are both positive and negative. Some of the positive impacts were the increase of goods and services available, a perceived reduction in serious crimes and more job opportunities:

> *"The city has improved a lot—we now have asphalt, a bank… We have water distribution systems—before we needed to have our own wells in the backyard. [And} there were tonnes of kids without schools*." (Male resident living in Canaã)

Negative impacts relate to pressure on community services, such as schools and health facilities, and the significant increase in the cost of living:

> *"Before the mine, we did not have violence or child prostitution. Moreover, we could sleep with our windows and doors open without fear of being robbed. We did not have homeless problems—everyone had a place to live, food to eat… We would never see anybody on the streets asking for food, and nowadays we see all of that in Canaã. Violence levels have increased, the problem[s] of hunger, housing shortages, informal and illegal settlements… With this mine], the inflation has gone off the roof… Land prices have increased… A housing lot you could buy for 400 Reais is now 5,000 to 6,000."* (Male resident living in Canaã)

Canaã is a booming town. As with any fast-growing city, both positive and negative changes have occurred during the economic boom. The economic benefits of the mine development to

the city are undeniable. As the city has grown, social indicators, including health and employment levels, have improved (Chapter 3). However, with the growth and economic development of Canaã, the cost of living has increased, and social and physical infrastructure are severely lacking.

- **Sossego Camp**

Three of the Phase III interview participants lived at the Sossego Camp. The camp is located on the outskirts of Canaã (not at the mine site) and includes dormitories, a cafeteria and some administrative offices. The camp was built as a temporary facility to house Sossego Mine employees while company homes were built and basic infrastructure of the city was completed. An area near the camp has been allocated for a recreation centre which will include gym facilities, sports fields and a swimming pool. In of August 2006, construction of this facility was underway. Once the recreation centre in completed, current camp residents will have immediate access to the sports and recreational facilities it will offer.

Permanent Sossego Camp residents are Sossego Copper Mine interns and single employees at the technician level and above, including engineers and analysts. The only differentiation is that employees with a university degree have individual rooms while all others have shared rooms. Visitors to the mine site and consultants on short assignments also use the Sossego Camp facility on a temporary basis.

With the analysis of the qualitative data from the focus group in Phase II, it became apparent that for young interns, the Sossego Camp seems to be appreciated for the brotherhood bonds that are created by living there. However, while some appreciate the comfort and convenience of living in a hotel-like facility, others are dissatisfied with the lack of privacy and distance from the city centre and its services. As stated by a male employee living in the Sossego Camp at the time he was interviewed:

> *"I lived in a military camp before and I will tell you, compared to that this is a great camp! It's like living in a hotel. I don't have to cook, clean or do laundry—it's all done for me… I don't have a problem going to town, so I hang out with people from the community, not only Sossego employees. I see that the interns though, they stay in the camp all the time [and] only make friends with other interns for the year they spend here."*

However, another male employee offered a different perspective:

"I hate living in this camp. I am a single adult, and an engineer and I have a Masters degree—I was promised a company house but they changed the rules on me when I got here. Sure it's nice to live in a hotel-like place for a while, but I like to cook my own food and have my friends over for homemade dinners. This is not a way to live—I don't have [the] privacy or freedom that I would have in my own home."

5.2.4. Parauapebas

a. Most Satisfying Things about Parauapebas

"The best thing about Parauapebas is the interaction with the neighbors—I have met so many people from different places." (Male employee living in Parauapebas)

Interview participants from Parauapebas were also asked to list the 3 best things about their community. Their answers were analyzed and coded. Table 5.29 depicts the concepts identified during interviews, classified into the QOL domains, as well as the frequency with which each concept was mentioned during the interview process.

In comparison with the other 2 communities, Parauapebas respondents identified only a few positive aspects of their community. As shown in Table 5.30, the most recurrently mentioned positive aspects of Parauapebas were the social aspects of the community (8), followed by the abundance of work opportunities (6) Respondents who had lived in Parauapebas for a number of years also mentioned the fact that the city has evolved in the last decade or so, the availability of jobs and the vibrant economy.

Table 5.30: Best Things about Living in Parauapebas

QOL Domain	Concept	Frequency*
Social	Profusion of concerts and dancing parties	4
	Cultural diversity	2
	Social networks and personal relationships	2
	Total	**8**
Work	Abundance of work opportunities	6
	Total	**6**
Environment	Continuous development of the city	5
	Total	**5**
Economic	Vibrant economy	1
	Total	**1**

*Refers to number of times a concept was mentioned during interview process

b. Least Satisfying Things about Parauapebas

> *"One thing that really bothers me in Parauapebas is the issue of sanitation—there is none. The infrastructure is very deficient. Our treated water often has too much chlorine, and the sewage system does not work—sometimes you can see the sewage draining on the street, and this is really bad because there's this bad smell right in front of your home. There's a broken sewage pipe in front of my house right now—it's been a month and nothing has been done about it*."
> (Female employee living in Parauapebas)

The negative aspects of Parauapebas were also identified through a structured and open-ended question about the "three worst things" about the city. Table 5.31 depicts the concepts identified during the interviews, classified into the QOL domains, as well as the frequency with which each concept was mentioned during the interview process.

As depicted in Table 5.31, issues related to the physical environment (29) seem to be the most problematic in Parauapebas, followed by health issues (15), particularly the inadequacy of health care services (4) and monotony and boredom (4), which can be said to affect the mental health of Parauapebas residents. These are followed by social issues (9) such as violence and crime (8), limited educational opportunities (1), and economic challenges (4) such as the high cost of living (3) and poverty and inequality in the community (1).

Table 5.31: Worst Things about Living in Parauapebas

QOL Domain	Concept	Frequency*
Environment	Inadequate public/community services	9
	Inadequate urban and basic infrastructure	9
	Garbage, dirt and unpleasant odours	4
	High temperature	2
	Environmental degradation	2
	Inadequate housing	2
	Noise and chaos of the urban environment	1
	Total	**29**
Health	Inadequate Sanitation	9
	Inadequate health services	4
	Monotony and boredom	4
	Total	**15**
Social	Violence and crime	8
	Limited educational options/opportunities	1
	Total	**9**
Economic	High cost of living	3
	Poverty and inequality in the community	1
	Total	**4**

*Refers to number of times a concept was mentioned during interview process

c. Priorities for Parauapebas

> *"It's always the same story: you go to the hospital the night before, get a number, sleep in the line up to be seen by a doctor the next day."* (Male resident living in Parauapebas)

Similar to the process used with participants from the Núcleo Urbano de Carajás and Canaã dos Carajás, Parauapebas interview participants were also asked to identify priorities for improvement and/or to make suggestions for improving the quality of life in their community. The priority issues and suggestions brought forward during the interviews are displayed in Table 5.32.

As illustrated in Table 5.32, suggestions were quite varied, and several priorities were identified. These were related to issues of health care (6); violence and crime (4); basic infrastructure and sanitation problems (3); lack of educational opportunities (3); poverty and inequality in the

community (2); inadequate housing quality and availability (2); lacking community services (2); and the lack of support for culture (1).

Table 5.32: Areas of Priority: Parauapebas

Priority Issues to be Addressed	Suggestions	Frequency*
Health care	Improve health care services and facilities	6
	Total	**6**
Violence and crime	Improve security and contain violence	4
	Total	**4**
Basic infrastructure and sanitation	Improve basic community services such as banking, post office, transportation, etc.	3
	Total	**3**
Lack of educational opportunities	Improve education and training opportunities	3
	Total	**3**
Poverty and inequality	Improve living conditions for the poor	1
	Reduce inequality	1
	Total	**2**
Inadequate housing	Address housing availability, quality and affordability	2
	Total	**2**
Lacking community services	Improve community and public services	2
	Total	**2**
Lack of support for culture	Increase access to cultural events and facilities	1
	Total	**1**

*Refers to number of times a concept was mentioned during interview process

d. Other Major Themes

A great variety of other major themes were also identified with the qualitative data collection. These issues include corruption, social segregation and discrimination of the Parauapebas residents, the fact that many individuals come to Parauapebas as a sacrifice to succeed financially, and the city's overcrowding. What follows is a discussion, supported by participant observation data, of these themes.

- **Corruption**

Several interview participants (from all 3 case study communities) mentioned the issue of corruption of politicians in Parauapebas, and one participant mentioned the corruption of police officers. Parauapebas receives large amounts of money in the form of royalties paid by the company, and many participants pointed out that these royalties are inadequately used or not used at all to develop the city. Interview participants generally blamed politicians for misusing royalty money and accused the former mayor and other municipal staff of corruption and incompetence:

> *"Public funds in Parauapebas are very badly managed; this has always been the case—it's a cultural issue related to the political process*." (Male employee and former resident of Parauapebas now living in Canaã dos Carajás)

It is quite disturbing to observe the poverty levels in Parauapebas and the quality (or lack thereof) of its urban environment considering that the city is the second wealthiest city in the State of Pará. Even though a new mayor has been in power for the last 2 years, the fact that the same family had controlled the political power in the city for over 15 years also adds to the perception of corruption and the municipal government's lack of transparency.

- **Social Segregation and Discrimination**

The issue of social segregation of and discrimination against Parauapebas residents was mentioned in interviews with residents of both Parauapebas and the Núcleo Urbano de Carajás. These discussions revolved around the perception that the "elite" lives in the Núcleo, while the poor and disadvantaged population lives in Parauapebas. It is important to note here that in Brazil, the economic elite is more often than not also the social elite—education and wealth are closely associated in Brazilian society. Expressed concerns relate to the perception that Parauapebas residents are stigmatized, discriminated against and regarded as inferior by Núcleo's residents:

> *"The people from up here (the Núcleo), they discriminate against people from Parauapebas, and vice versa."* (Male employee living in the Núcleo Urbano de Carajás)

Municipal statistics clearly show the inequality in Parauapebas (Atlas do Desenvolvimento Human Brasil, 2006). The segregation is indeed very apparent. Higher job classes (with consequently higher salaries) are eligible to live in a company-provided house in the Núcleo Urbano de Carajás. All others need to fend for themselves in expensive and low-quality housing in Parauapebas, which increases differences in available income and access to basic services. The physical barrier and distance between the 2 communities intensifies this separation.

- **Life of Sacrifice**

Most Parauapebas residents are migrants from the Northeast or other northern states. They seem to often come alone to find work at the mines. Some participants said that they have lived a life of sacrifice:

> *"I went through a lot of challenges to get here. Since I got here I have faced many others… Not financial problems, but being far from friends and from home… I miss home a lot. For 10 months I had to suffer, missing home… I am divided—I came here to make money, to accomplish something for myself, [things that] I would not have been able to do back at home. The work here gives me the opportunity to improve myself, to take courses… and home is where I left my loved ones, my origins. I miss that tremendously, but I am surviving*." (Male contractor's employee living in Parauapebas)

The attitude and feeling exemplified by this quote seem to be widely held by residents of Parauapebas. Migrants who travel to the Carajás region to find work are often responsible for supporting family elsewhere. Many of these workers send away part of their salaries to families in other parts of the state or country, and as a result are not able to spend their earnings to improve their living conditions in Parauapebas.

- **Overcrowding**

It became clear through the interviews that service providers and contractors' workers were dealing with the housing affordability issue by living in overcrowded conditions:

> *"We share a rented house. I work at Intertec, and we pay the rent ourselves. We are 7 men in a 4-bedroom house*." (Male contractor's employee living in Parauapebas)

Indeed, with the shortage of housing and the rapidly increasing need for accommodations for employees of both Vale and outside contractors, all sorts of units are coming onto the Parauapebas housing market. Rental housing units are usually very small and offer minimal amenities, or are larger renovated homes. These larger units are often shared by large groups of workers, who usually work shifts and therefore do not refrain from sharing homes and rent with many others.

The housing challenges in Parauapebas, and also in Canaã dos Carajás, are very significant. Vale is not investing in housing construction in Parauapebas (except for camp accommodations for short-term interns), and the local government has failed to provide decent housing options to the community as a whole. It has become very clear that this problem is in fact getting worse, and that significant interventions are needed to avoid overcrowding and to provide housing options that respect human rights and provide healthy living environments for mineworkers and other residents.

CHAPTER 6: DISCUSSION

This chapter aims to discuss the findings presented in Chapter 5 in light of the objectives set out for this research. This deliberation includes a discussion of the results of the triangulation of the qualitative and quantitative results, and an attempt to provide answers to the research questions. It also includes the identification of opportunities for interventions that could result in improved quality of life (QOL) in the communities investigated in this research and perhaps in other remote mining communities around the world.

The first objective of this research was to develop a subjective quality of life framework that can be integrated into lifecycle planning of new and existing mining operations in remote locations. The framework suggested here is one that takes into account the factors defined as the predictors of satisfaction with QOL—those factors that seem to most impact mineworkers' perception of quality of life in remote mining communities. The definition of these factors was accomplished with the findings of the first research question: "What appear to be the main factors impact the quality of life of mineworkers in Canaã dos Carajás, Parauapebas and the Núcleo Urbano de Carajás?" All domains identified as predictors for the population sample as a whole were considered: i.e., the economic, environment, social and health domains. In designing new mines in remote areas or addressing challenges in existing remote mining communities, these domains should therefore be used as parameters for design, evaluation and intervention. As it was done in these 3 case studies, context-relevant indicators could be developed in order to evaluate and monitor performance more closely and identify specific areas of concern or success.

The second objective of this research was to identify opportunities to improve the quality of life of mineworkers in the 3 case study communities: Canaã dos Carajás, Parauapebas and Núcleo Urbano de Carajás. This was accomplished by using the subjective quality of life framework to identify mineworkers' perceptions of quality of life in the 3 case study communities, and by investigating the way in which the communities' and the workforce's characteristics impact these perceptions. Specifically, once the 4 QOL domains (predictors of satisfaction with QOL) were defined, answers to the next 3 research questions were sought:

2. How differently do mineworkers living in these three communities perceive their quality of life?

3. What appear to be the most and least satisfying aspects of the quality of life in these communities?
4. How do the mineworkers' characteristics appear to impact their perceptions of their own quality of life?

Based on the research findings, opportunities for interventions that would result in improved QOL in remote mining communities were addressed by the formulation of suggestions and recommendations directed at mining companies in general, at Vale and at local decision makers. These opportunities for intervention were identified as a potential means to improve the quality of life in remote mining communities and the level of satisfaction of mine employees in remote mining communities.

The chapter is therefore divided into 3 distinct sections to a) address research questions, b) identify opportunities for intervention and c) discuss methodological findings (Figure 6.1).

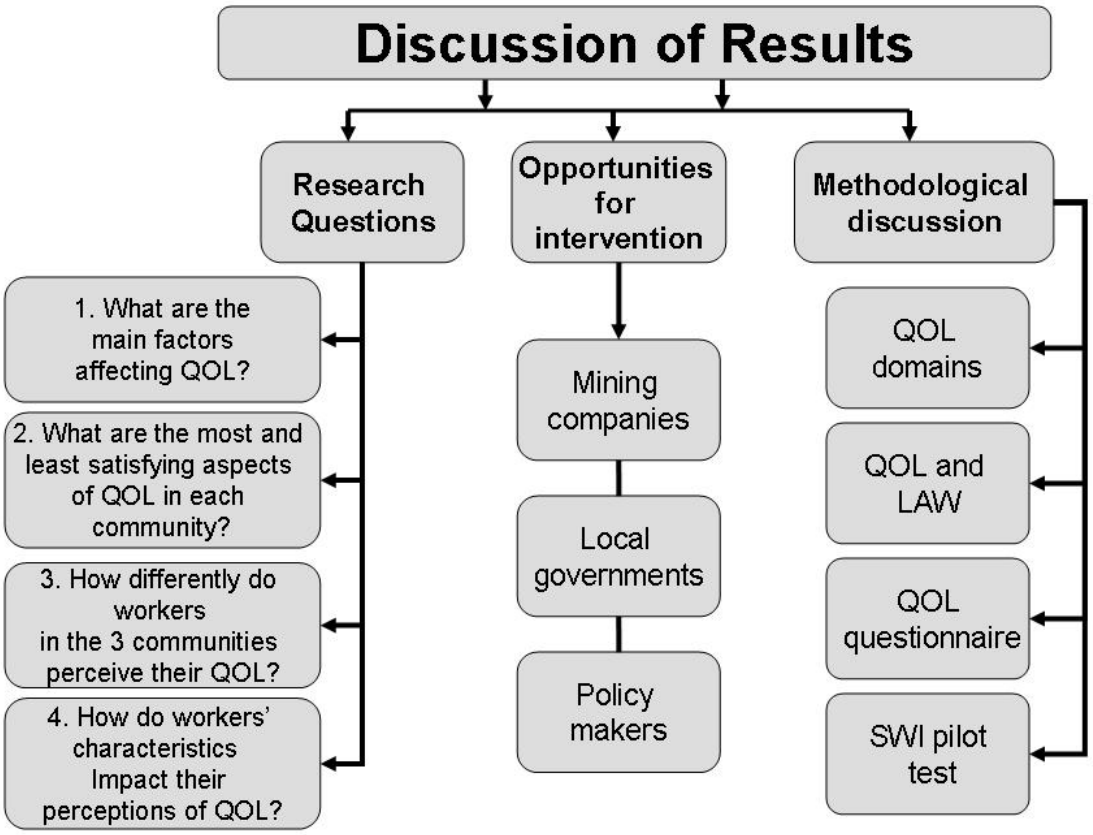

Figure 6.1: Structure of Chapter 6

Within the first section of the chapter, the intent is to propose answers to the 4 research questions initially established for this research. The 2nd section of this chapter includes the discussion of opportunities for intervention directed at mining companies planning and operating mines in remote areas, local governments and policy makers. The 3rd and final section of this chapter includes a discussion of the findings in regards to the methodology used for this research. This section also makes methodological recommendations regarding measuring and monitoring quality of life in remote mining communities.

6.1. Addressing Research Question 1: Main Factors That Appear to Impact Perceived Quality of Life

The process to define the main factors affecting perceived quality of life in the case study communities was initiated in Phase I and completed in Phase III of the research. It included the triangulation of results from mixed-methods. Refer to Figure 6.2 for a diagram summarizing the overall approach used to answer Research Question 1.

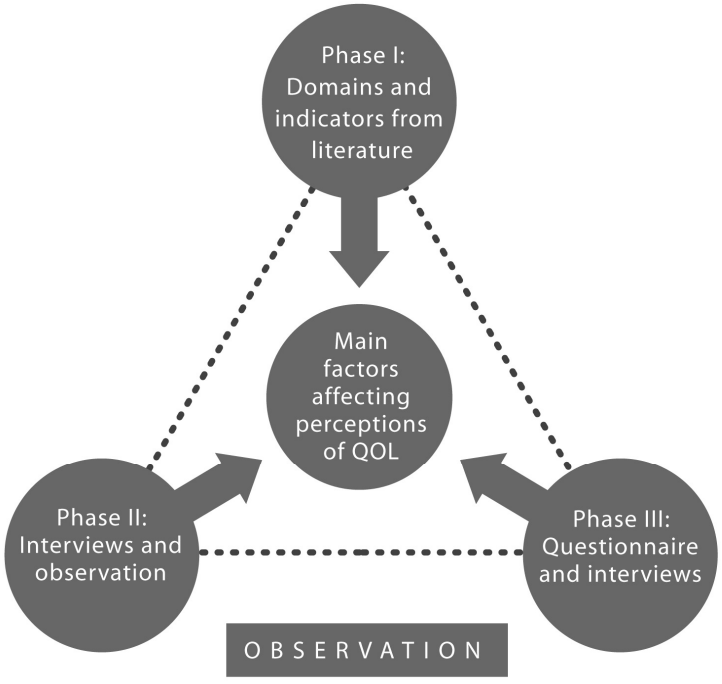

Figure 6.2: Approach to Answering Research Question 1

Phase I of the research strategy included a literature review and the first conceptual quality of life (QOL) model development. The definition of the 5 quality of life domains (deconstruction of the QOL concept) and indicators (further deconstruction of QOL domains) was finalized with qualitative on-site interviews during Phase II of this research. Phase II generated a list of 5 domains (Figure 4.2), as well as indicators that make up each domain, all of which are assumed to affect the perception of quality of life in remote mining communities (Table 4.2).

In Phase III, 461 mineworkers at the Carajás Iron Ore Complex, the Azul Manganese Mine and the Sossego Copper Mine completed a quality of life questionnaire. Of specific relevance to the first research question are the results of the statistical analysis of this questionnaire, which determined, through linear regression, the predictors of quality of life—the aspects that seem to uniquely predict variance in satisfaction with quality of life in the sample population. The quantitative evidence was supported by qualitative results of this research.

Phase III further investigated the mineworkers' quality of life and their communities through 40 in-depth interviews with employees and residents living in the 3 communities. The qualitative and quantitative results were triangulated with participant observation to identify the factors that most significantly affect perceptions of quality of life in the sampled population. Specifically, these factors are the quality of life domains defined in Phase I: i.e., economic, social, health, work and environment domains.

This investigation resulted in the definition of predictors of satisfaction with quality of life in the region as a whole, using data from the entire sample population, and in the 3 communities separately, using the sub-population samples from each community.

6.1.1. Predictors of Satisfaction with Quality of Life

It was assumed that the determinants of quality of life (QOL)—i.e., predictors of satisfaction with QOL—of the population as a whole were the social, economic, environment, work and health domains, as depicted in Figure 4.2. This assumption was based on the literature review in Phase I and preliminary interviews conducted on site during Phase II. The QOL survey questionnaire results suggested, however, that the predictors of satisfaction with quality of life (QOL) for the population as a whole are in fact the social, economic, environment, and health domains. Figure 6.3 is a diagram depicting these findings.

Predictors of QOL satisfaction for respondents living in the Núcleo Urbano de Carajás involve satisfaction with the social and economic domains (Figure 6.4), while for respondents living in Parauapebas, main predictors involve satisfaction with the health and social domains (Figure 6.5). For respondents who live in Canaã dos Carajás, the main predictors of satisfaction with QOL involve satisfaction with the health and economic domains (Figure 6.6). Figures 6.3, 6.4, 6.5 and 6.6 show the domains with significant Beta coefficient levels, denoting the ability to uniquely predict satisfaction with QOL.

The fact that satisfaction with the work domain was not identified in the regression analysis as a predictor of satisfaction with QOL could be attributed to the lack of variation in the means of the work domain in this single-employer population. It is possible that the single-employer aspect of the domain restricted the range of possible scores, resulting in little variation. The inclusion of individuals who were not employed by Vale in the analysis might add an improved understanding of the relationship between the level of satisfaction with work and satisfaction with QOL within the target population.

Similarly, satisfaction with the environment domain seems to uniquely predict satisfaction with QOL for the entire population because there was significant mean variability with satisfaction with this domain among the 3 communities. However, when analyzing each community individually, satisfaction with the environment domain no longer uniquely predicts variance in QOL satisfaction. This could be attributed to the lesser variability of within-communities' means of satisfaction with the environment domain.

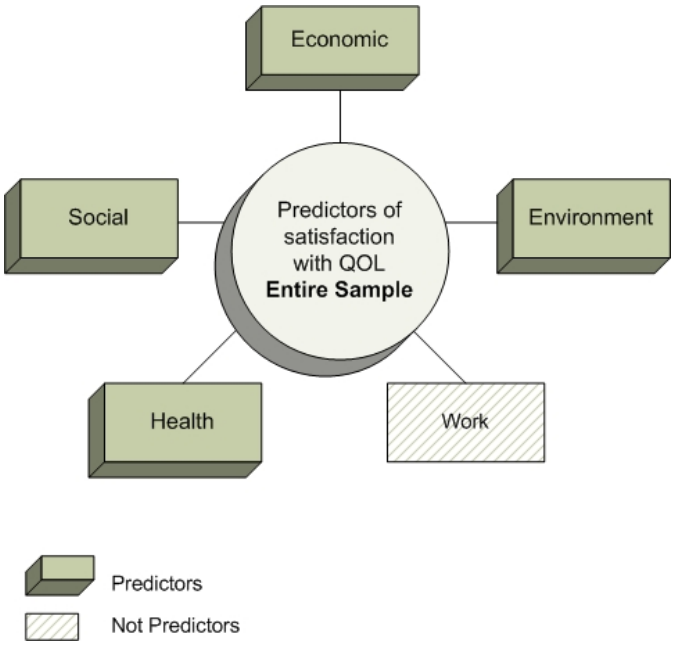

Figure 6.3: Quality of Life Domains Affecting Perceptions of Quality of Life in the Population Sample (includes all 3 communities)

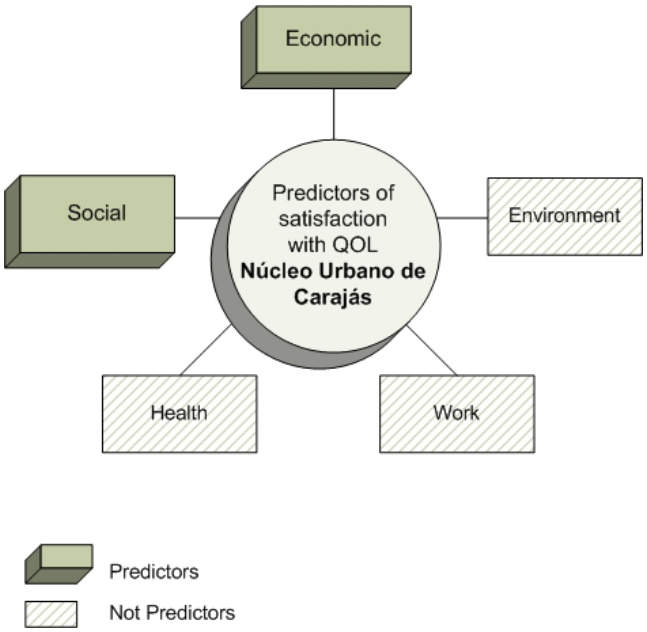

Figure 6.4: Quality of Life Domains Affecting Perceptions of Quality of Life in the Núcleo Urbano de Carajás ("the Company Town")

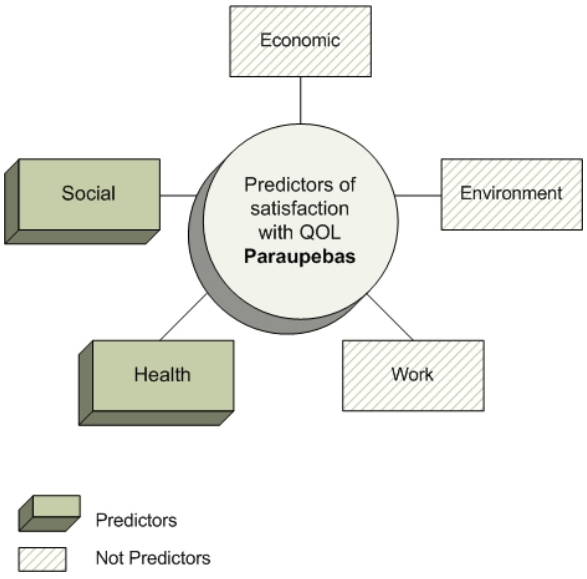

Figure 6.5: Quality of Life Domains Affecting Perceptions of Quality of life in Parauapebas ("the Gate Development")

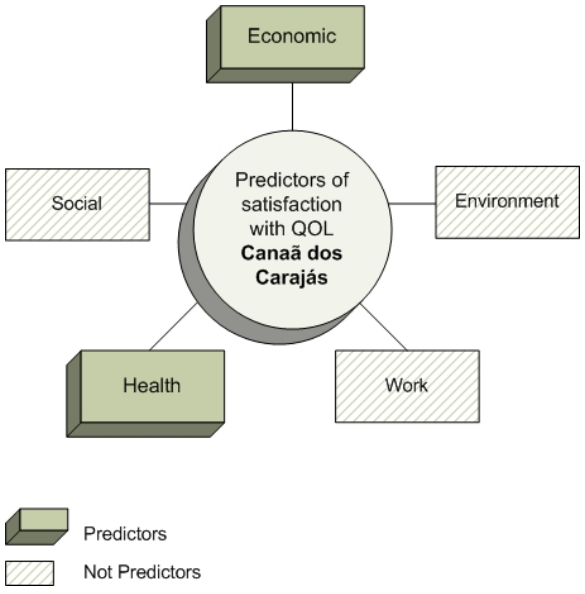

Figure 6.6: Quality of Life Domains Affecting Perceptions of Quality of Life in Canaã dos Carajás ("the Integrated Community")

a. Social Domain

The indicators of the social domain were defined as: *relationship with family*, *relationships with friends*, *love life*, *privacy*, *participation in community events*, *participation in community decision-making* and *educational opportunities*. Satisfaction with the social domain proved to be a predictor of satisfaction with quality of life in the sample population as a whole (Figure 6.3), and for the Núcleo and Parauapebas sample populations, as depicted in Figures 6.4 and 6.6.

The social domain was expected to be a predictor of satisfaction with quality of life (QOL) because of the cultural context and the particular situation of the population under scrutiny. Moreover, some of the indicators in this domain have been validated as measurements of satisfaction with Life as a Whole (LAW) or QOL in previous studies, or were robustly present in the initial data collection (i.e., unstructured interviews) that helped define the QOL domains. The importance of indicators of the social domain was also strongly supported by data collected through structured interviews.

Social life and personal and community relationships are highly valued in South American culture, and these are particularly important in remote rural communities. Existing research has shown that social networks can act as social support systems to promote mental health and buffer psychological stress (Greenblatt et al., 2001; Kawachi and Berkman, 2001). Since many of the residents of the 3 studied communities are immigrants from other cities and regions who, within their new communities and new environments, find themselves distanced from extended family and friends. This situation is not uncommon in Brazil, but it is still generally challenging within the Brazilian culture, which is characterized by strong family bonds and familial interdependency. This became very clear during interviews:

> *"I'm adapted here, but I miss my mother, my family. This is the hardest part. If I could I would enjoy my family and my mother's company more."* (Male employee living in the Núcleo Urbano de Carajás)
>
> *"It was hard when I came here because I was by myself. It was harder in the first 3 months because my family was far away."* (Male contractor's employee living in Parauapebas)

Establishing strong and healthy personal bonds and social support networks is therefore a very important coping strategy as it helps individuals to live well in remote locations and clearly impacts quality of life in the region. Local social networks are critical to the wellbeing of

newcomers to a mining community as they adjust to the lack of direct support from relatives and old friends (Sharma and Rees, 2007), and provide a range of benefits to them (Neil et al., 1983; Cotterell, 1984). Making new friends, getting involved with the community and perhaps finding life partners are important means of creating social networks. As explained by interview participants:

> *"I always meet people that I really like here. It's just because it's such a small place, we develop good relationships, strong bonds, stronger than in other places. Here we have strong relationships and there's something behind that: the people who live in Carajás generally are far from their parents, brothers, cousins, so they are very lonely and need to create these strong bonds while living here."* (Female employee living in the Núcleo Urbano de Carajás)

> *"Something that helps people to live well here in Parauapebas is the friendships they make here."* (Male resident living in Parauapebas)

Another important aspect of the social domain that was well discussed during interviews is education. It was apparent from qualitative interviews that Vale employees value education as a means to improve themselves and grow professionally. As discussed by an employee living in Canaã dos Carajás:

> *"People here are really interested in education. Many employees are taking those on-line courses. Vale has an agreement with the Yankee Program, and they reimburse some of the costs. You see, I work in a team of twelve people, of which 6 are taking a university program in Parauapebas."* (Male employee living in Canaã dos Carajás)

A sensible interpretation of these results seems to be that personal relationships, community participation and access to education are of great concern to mineworkers, and their satisfaction with these factors greatly impacts their perceptions of quality of life. Unfortunately, even though the employees seem to have little difficulty creating social networks, the opportunities for participating in community events and community decision making are quite limited in the 3 case study towns. Moreover, educational opportunities are restricted because of the remoteness of the area, and because of the lack of communications infrastructure available in the Núcleo, Canaã and Parauapebas. These combined limitations certainly provide an indication of why the larger population's (i.e., the combined population of 3 studied communities) levels of satisfaction with the social domain and with average quality of life are not very high—6.19 and 5.72 respectively (on a scale of 0–10 points).

b. Economic Domain

The indicators of the economic domain were defined as: *what you can do and buy with your money*, *material belongings*, *economic situation of surrounding community*, *ability to save for the future*, and *financial stability*. Numerous studies have explored the relationship between income and wealth and life satisfaction and happiness (Frank, 2005). The consensus seems to be that for the relatively poor, money can increase wellbeing, while for the relatively well off, increased wealth does not typically mean increased life satisfaction (Frank, 2005; Helliwell and Putnam, 2005). Satisfaction with the economic domain proved to be a predictor of satisfaction with quality of life in the sample population as a whole (Figure 6.3) and for the Núcleo and Canaã sample populations (Figures 6.4 and 6.5).

Since access to most amenities, education, goods and services largely depends on material wealth, and considering the poverty levels of the state of Pará, it is not surprising that the economic domain proved to be a predictor of quality of life for the 3 communities as whole (Figure 6.3) and for 2 out of the 3 communities in this study (the Núcleo and Canaã, Figures 6.4 and 6.5 respectively). In fact, the pursuit of economic wellbeing seems to be one of the main reasons why individuals migrate to the region. It has been recognized that the primary reason for people moving to remote single-industry towns is economic, since these communities are often characterized by high remuneration and plenty of job opportunities (Neil, 1988; Nadkarni and Stening, 1989; Mitchell and Williamson, 2000). This was well illustrated during the interviews:

> *"I went through a lot of challenges just to get here. Since I got here I have faced many others…not financial problems, but with being far from friends and from home…I miss home a lot. For 10 months I have suffered, missing home. I am divided—I came here to make money, to accomplish something for myself, which I would not have been able to do at home."* (Male contractor's employee living in Parauapebas)

> *"I'm here because I need to work, I need to help my family, and I can't complain about this place because I have accomplished things here."* (Male employee living in the Núcleo Urbano)

According to Sharma and Rees (2007), even though remote mining communities often offer limited resources and opportunities for the mineworkers' family members, most couples that move to these communities actually make a conscious decision to do so and aim at a highly

remunerative employment for one partner for a certain period. These couples regard themselves as engaged in a "joint project" that involves working towards certain goals, including a better upbringing for their children and the accumulation of savings for retirement or to start their own businesses (Gibson, 1992). Evidence of this strategy was often observed in the Núcleo Urbano de Carajás and Parauapebas.

c. Health Domain

The health domain in this study includes the following indicators: *recreation and entertainment options*, *stress levels*, the *food you eat, physical activity*, *health services and facilities*, and *ability to balance work and life*. Collectively, these indicators were deemed predictors of quality of life in the whole population sample (Figure 6.3) as well as in the Canaã and Parauapebas sample populations (Figures 6.5 and 6.6).

The health challenges in the 3 communities were not unexpected. Remote rural communities worldwide have a lower health status than urban dwellers. Moreover, limited access to health and welfare support services can further jeopardize the health status of rural and remote community residents (Birrell et al., 2000; Wainer and Chester, 2000). Health care and other issues affecting health are part of many everyday conversations in the 3 case study communities. As discussed by residents:

> *"Here in Parauapebas you need to go to the hospital at night and sleep in the line up to be attended the next day. And it never changes. There's investment, there's public money and people are coming from other towns, they are coming while there's service available for them. And there are lots of medical cases that cannot be treated here and people have to be sent to another city nearby."* (Male resident living in Parauapebas)

> *"The worst problem here in Canaã is health and doctors. Unfortunately we have gone through real bad situations here because of this problem and it's very sad."* (Male employee living in Canaã dos Carajás)

> *"It's hard to have a balanced life here. Some people overwork themselves because they feel that they need to do it to keep their jobs. They feel that they need to keep their jobs at any cost."* (Male employee living in the Núcleo Urbano de Carajás)

d. Environment Domain

The environment domain includes the following indicators: *your home, order, access to nature, cleanliness and security, basic infrastructure, services and goods available* and *transportation options.* Satisfaction with the environment domain proved to be a predictor of satisfaction with quality of life for the sample population as a whole (Figure 6.3). However, statistically, satisfaction with the environmental domain does not uniquely predict satisfaction with quality of life in any of the sample populations of the 3 communities individually (Figures 6.4, 6.5 and 6.6).

It is clear from the literature review, qualitative analysis and participant observation that environmental aspects are of critical importance to quality of life in general (e.g., Takaro et al., 2002; Sarvan, 2006). Most of the participants in this research mentioned environmental qualities as a significant determinant of satisfaction with quality of life in their region:

> *"Quality of life is good living conditions, a good physical infrastructure, security, and facilities such as grocery stores, restaurants, Internet, a variety of friends, a social life in the community and work—happiness at work."* (Male employee living in the Núcleo Urbano de Carajás)

> *"Something really good for my quality of life here in the Núcleo is to get home and have a good sleep with no worries. It's very important for my quality of life to have security."* (Male employee living in the Núcleo Urbano de Carajás)

e. Work Domain

As evident in Figures 6.3– 6.6 and in Table 6.1, even though concepts related to "work"—e.g. professional achievements, employment opportunities, relationships at work and good compensation—were brought up as factors of quality of life in the qualitative interviews, the work domain did not prove to uniquely predict quality of life in any of the 3 communities through statistical analysis of questionnaire data (Figures 6.3–6.6).

However, as the literature makes clear, residents of occupational communities such as mining towns tend to consider work very important in their lives, since work often influences their self-image, their choice of reference groups and their choice of friends (Near et al., 1980). On-site observations and the qualitative analysis of interviews indicate that work is in fact a significant part of the lives of people in the 3 case study communities.

It became clear that in these 3 communities, individuals' experiences at work affect community connectedness and social networks, as well as personal relationships, including family relationships. Studies on structural aspects of work suggest that shift-work schedules typical to mining operations generate spillover (the transfer of workers' negative moods and energy level brought from the workplace to the home and family members), and that work-life conflicts can affect not only a worker's physical and mental health, but also quality of family life and marital satisfaction (Staines and Pleck, 1984; Hughes et al., 1992; Rosa, 1995; Major et al., 2002; Grosswald, 2003).

Within the case study communities, one's work to a large extent defines one's socio-economic class, the environment one lives in, and the services and facilities employees and families are able to access. In fact, work is a factor that impacts the other QOL domains, even though conceptually it does not seem to be a QOL domain in itself. Moreover, work was found, through statistical analysis of the questionnaire data, to be a significant predictor of satisfaction with LAW in the sample population.

6.1.2. Predictors of Satisfaction with Life as Whole (LAW)

The investigation of LAW was included in this research project as a means to explore how individuals conceptually differentiate it from QOL. Predictors of LAW were defined through statistical analysis of the questionnaire data using linear regression.

Findings from the LAW regression models indicate that for the entire sample population, only the work and the economic domains were predictors of satisfaction with life as a whole. These findings indicate that in order to impact satisfaction with life as a whole in the region, close attention must be given to work- and economic-related aspects of life.

In investigating differences among responses from residents of the 3 case study communities, it was determined that while satisfaction with life can be predicted by the satisfaction with the economic and environmental domains for respondents living in the Núcleo Urbano, satisfaction with the work and economic domains are the predictors in Parauapebas, and only satisfaction with the health domain appears to be a predictor of satisfaction with life as a whole for respondents from Canaã.

For both Núcleo and Parauapebas, a great portion of one's life is dependent on one's work and economic status. These 2 communities are physically very close together—the Núcleo is in fact part of the municipality of Parauapebas—yet they are worlds apart in terms of development. The Núcleo is often described as a "utopia", a carefully planned and groomed community protected from the harsh realities of poverty and social chaos that pervade life in Parauapebas. As one participant described:

> *"The gate separating Núcleo from Parauapebas is not a simple gate: it is a portal—it takes you to a different reality."* (Male employee living in the Núcleo Urbano de Carajás)

The importance of the work and environment indicators to the satisfaction with life as a whole of residents of the Núcleo and Parauapebas are interesting findings particularly because of the clear physical and psychological separation between these 2 communities. This dramatic difference is reflected in socio-economic segregation and discrimination as well as stress over job security. In the view of the general population, the Núcleo is a place for the elite, while Parauapebas is the city for the lower socio-economic classes. This separation is in fact a result of company policy, since only people with certain job classifications are eligible to get a house in the Núcleo as part of their benefits package. The aspects of workers' lives that create that separation are clearly related to the work and environmental indicators and seem critical in their own judgments of satisfaction with life as a whole.

Socio-economic segregation exists in much lower intensity in Canaã than in the Núcleo and Parauapebas. Because company homes are distributed in different neighborhoods, there is not a physically defined separation between Vale workers and other community members. Moreover, because most managers have yet to move to Canaã, it does not seem that there are issues related to segregation by job class among employees.

In Canaã, satisfaction with health seems to impact satisfaction with life. This is probably because the city is going through the early phase of development, with increasing population and limited services. This phase is characterized by limited recreation and entertainment facilities, limited goods and services and particularly problematic health services. Since the early stages of the Sossego Copper Mine development, Canaã has been going through an expansion phase, where infrastructure is being improved to accommodate migration needs. Health services are a critical part of this infrastructure. At the time of the data collection (August 2006),

a new hospital was being built to address this demand, but it was not yet operational. This was an obvious cause of concern for the workforce:

> *"I feel very anxious regarding the health care in Canaã—there are no resources at all here."* (Male employee living in Canaã)

6.2. Addressing Research Question 2: Comparing Satisfaction Levels in the Núcleo Urbano, Canaã dos Carajás and Parauapebas

The investigation of the effects of the variable *community of residence* on mean scores of satisfaction uncovered differences in perceptions of quality of life (QOL) of employees living in the 3 communities investigated in this research. These findings are supported by qualitative data from interviews and participant observation.

The approach to answer the second research question included 2 main steps: a) the comparison of mean scores for satisfaction with average quality of life (AQOL = mean of 31 questionnaire items) and b) the comparison of the mean scores for satisfaction with each of the 5 domains (i.e., economic, environment, social, health and work) of respondents living in the Núcleo Urbano, Parauapebas and Canaã dos Carajás.

Results of the statistical analysis of the questionnaire data suggest that the variable *community of residence* affects respondents' satisfaction with the work, health, and environment domains and with AQOL (analysis suggested that statistically significant differences exist between means from the different communities). The *community of residence* variable did not affect satisfaction with the economic and the social domains (analysis suggested that there are no statistically significant differences between means from the different communities). Table 6.1 summarizes the results presented in Chapter 5. Means were extracted from Tables 5.5, 5.7, 5.10, and 5.17. Interpretation of these findings indicates that while there are differences in how residents in the 3 case study communities perceive their quality of life, as well as differences in their satisfaction with the work, health and environment domains, their perceptions do not differ—i.e., they are just as satisfied as one another—with the social and economic domains. Figure 6.7 illustrates these findings and sets up the structure for the analysis and discussion that follows.

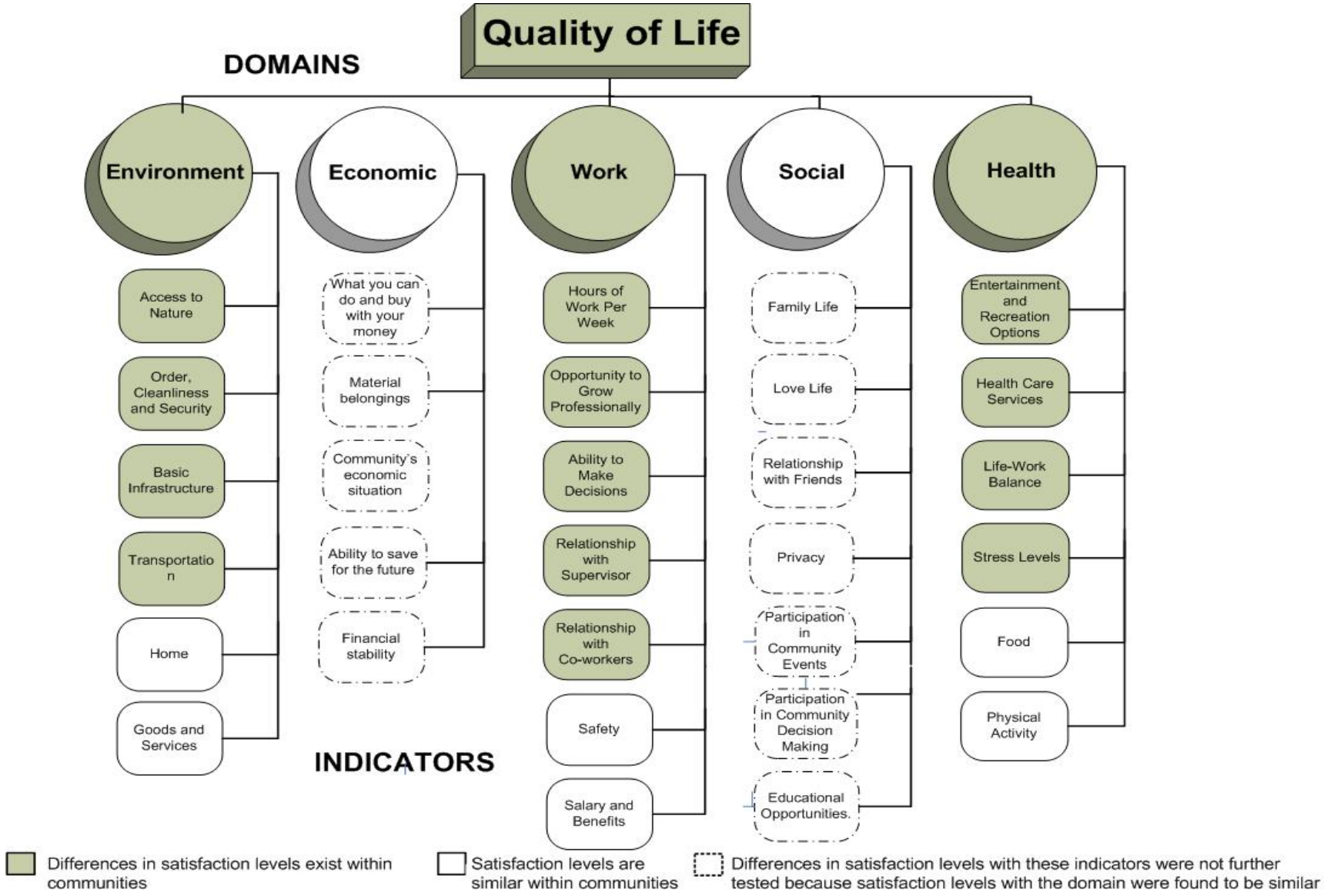

Figure 6.7: Comparing Communities.

Table 6.1: Variation of Means by Community of Residence

Domain	Mean		
	Núcleo	Canaã	Parauapebas
Environment	5.58[a]	3.52[b]	4.12[c]
Work	6.85[a]	7.23[a,b]	7.56[b]
Health	4.86[a,b]	4.60[a]	5.13[b]
AQOL	5.85[a]	5.33[b]	5.73[a]

[a, b]Groups in each row that share a superscript are not significantly different from each other. Confidence level: 97.5%.

Data in Table 6.1 indicate that the reported levels of satisfaction with AQOL are not dissimilar between residents of Núcleo and of Parauapebas, but are slightly lower for Canaã residents. To investigate the reasons for these differences, each of the 3 domains in which statistical tests indicated a statistically significant difference among means—i.e., the environment, work and health domains—was examined individually. This examination resulted in the identification of indicators in each domain where differences in perception exist (Figure 6.7). What follows is a discussion of these differences in each domain.

6.2.1. Comparing Perceptions of Environment Domain

As demonstrated in Table 6.2, employees residing in the Núcleo Urbano de Carajás reported the highest levels of satisfaction with the environment domain (mean = 5.58), followed by Parauapebas (mean = 4.12) and Canaã (mean = 3.52). A further investigation of means for the indicators of the environment domain in juxtaposition with the qualitative data provides insights important to the interpretation of these results.

Noticeable differences were found in levels of satisfaction with *access to nature*, *order cleanliness and security, basic infrastructure, services and goods available,* and *transportation options* (Table 6.3). Respondents from Núcleo consistently rated satisfaction with these indicators higher than respondents living in the other 2 communities. The only exception was *goods and services available,* which Núcleo and Parauapebas residents rated similarly.

Table 6.2: Environment Indicators by Community of Residence

Indicator	ANOVA	Community	Mean	Std. Dv.	n
Access to Nature	F (2,455) = 11.60, p < 0.001	Núcleo Urbano [a]	7.95	2.08	168
		Canaã dos Carajás[b]	5.52	2.94	75
		Parauapebas[b]	6.76	2.82	215
Order, Cleanliness and security	F (2,455) = 29.52, p < 0.001	Núcleo Urbano[a]	8.40	1.94	168
		Canaã dos Carajás[b]	5.15	2.67	75
		Parauapebas[b]	5.86	3.19	215
Services and Goods Available	F (2,455) = 10.45, p < 0.001	Núcleo Urbano[a]	5.46	2.77	168
		Canaã dos Carajás[b]	3.88	2.34	75
		Parauapebas[a]	5.40	2.71	215
Basic Infrastructure	F (2,455) = 89.85, p < 0.001	Núcleo Urbano[a]	9.02	1.56	168
		Canaã dos Carajás[b]	3.70	2.80	75
		Parauapebas[b]	4.55	3.05	215
Transportation Options	F (2,455) = 12.35, p < 0.001	Núcleo Urbano[a]	6.03	2.70	168
		Canaã dos Carajás[b]	4.12	2.75	75
		Parauapebas[c]	5.05	3.08	215

[a,b,c]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%.

As was easily observed in the field and frequently mentioned in interviews, the Núcleo has a significantly higher-quality urban environment and urban infrastructure, facilities and services than Parauapebas or Canaã. The Núcleo Urbano de Carajás has well-planned and well-maintained facilities, green areas and a privileged location in regards to climate and ventilation. Therefore, it was anticipated that residents of the Núcleo would have higher levels of satisfaction with the environment domain than residents of the other 2 case study communities.

The fact that Canaã residents rated their satisfaction with the environment domain lower than Parauapebas residents, however, was not expected at the outset. The very low level of satisfaction with the environment domain in Canaã (mean = 3.52) is better understood through analysis of the qualitative interviews and on-site observations, which indicate that negative perceptions of these issues in Canaã are largely attributed to the fact that infrastructure expansion has not been able to keep up with population growth. Even though Parauapebas clearly has inadequate basic infrastructure and urban services, and is generally seen as a dirty

and unsafe place, Parauapebas is a larger and more mature city, offering more variety in services and goods and transportation options when compared to Canaã.

An important observation is that the mean scores for satisfaction with the environment domain were pitifully low—even in the Núcleo, the mean score was lower than 6, which denotes a positive satisfaction but is close to neutrality. In Parauapebas and Canaã, the scores were quite low, indicating significant dissatisfaction with the indicators of the environment domain. These findings highlight to the pressing need for intervention in this area.

6.2.2. Comparing Perceptions of the Work Domain

As demonstrated in Table 6.3, residents of Parauapebas reported slightly higher levels of satisfaction with the work domain (mean = 7.56) than residents of the Núcleo Urbano (mean = 6.85). The mean for the level of satisfaction with the work domain for Canaã residents (7.23) was not statistically different from those of the Núcleo or Parauapebas when tested with a 97.5% confidence level.

Analysis of variance (ANOVA) was used to determine if there were significant differences among the means of respondents' satisfaction with the work domain in the 3 population samples.

Statistical analysis determined that the Núcleo's residents reported lower satisfaction levels with the *number of hours worked per week*, *opportunities to grow professionally* and *ability to make decisions on your own* at the workplace than the other 2 communities. Núcleo residents also reported lower satisfaction levels with *relationships with co-workers* and *relationship with supervisor* than Parauapebas residents, but similar to the levels of satisfaction of Canaã residents. Statistical differences for the indicator *safety at work* ($F(2,452) = 3.666$, $p = 0.026$) were only marginally significant. No statistical differences exist among means for the other indicators, *job stability* ($F(2,452) = 2.187$, $p = 0.113$) and *salary and benefits* ($F(2,452) = 1.133$, $p = 0.322$).

What follows is a detailed examination of the results for each of the indicators where statistically significant differences were found for the 3 communities.

a. Hours of Work per Week

The investigation of the indicator *hours of work per week* suggests that residents of the Núcleo are less satisfied than Canaã and Parauapebas residents, who reported statistically similar satisfaction levels (Table 6.3).

Table 6.3: Satisfaction with Number of hours you work per week by Community of Residence

Community	Mean	Std. Deviation	n
Núcleo Urbano de Carajás[a]	6.12	2.75	167
Canaã dos Carajás[b]	7.01	2.54	74
Parauapebas[b]	7.09	2.78	214

ANOVA: F (2,452) = 6.430, p = 0.002

[a, b]Groups in each row that share a superscript are not significantly different from each other.

Levene's test of equality of error variance: F (2,452) = 0.677, p = 0.509

Note: groups in each row that share a superscript are not significantly different from each other. Post hoc test: LSD. Confidence level: 97.5%

This finding was not unexpected. According to interview data and observation in the field, overwork or "workaholism" is a serious issue in the Núcleo. It appears that residence in the Núcleo Urbano de Carajás often means longer hours and more work-related stress being brought into employees' personal lives. As expressed in interviews:

> *"I have the feeling that I live inside the company—often you are called back to work on your day off or time off. I feel like I need to be available at all times."* (Female employee living in Núcleo Urbano de Carajás)

b. Opportunities to Grow Professionally

Results regarding satisfaction with the *opportunities to grow professional*ly indicate that Núcleo residents are less satisfied than residents of the other communities, as depicted in Table 6.4.

Table 6.4: Satisfaction with Opportunities to Grow Professionally by Community of Residence

Community	Mean	Std. Deviation	n
Núcleo Urbano de Carajás[a]	6.25	2.80	167
Canaã dos Carajás[b]	7.14	2.74	74
Parauapebas[b]	7.47	2.59	214

ANOVA: F (2,452) = 9.82, p < 0.001

[a, b]Groups in each row that share a superscript are not significantly different from each other.

Levene's test of equality of error variance: F (2,452) = 0.70, p = 0. 49

Note: groups in each row that share a superscript are not significantly different from each other. Post hoc test: LSD. Confidence level: 97.5%

These results might be explained by the fact that residents of the Núcleo are generally more educated and therefore hold better positions than employees from the other 2 case study communities (Figure 6.8). Consequently, residents of the Núcleo generally have higher expectations of growth and professional development than residents of Parauapebas or Canaã.

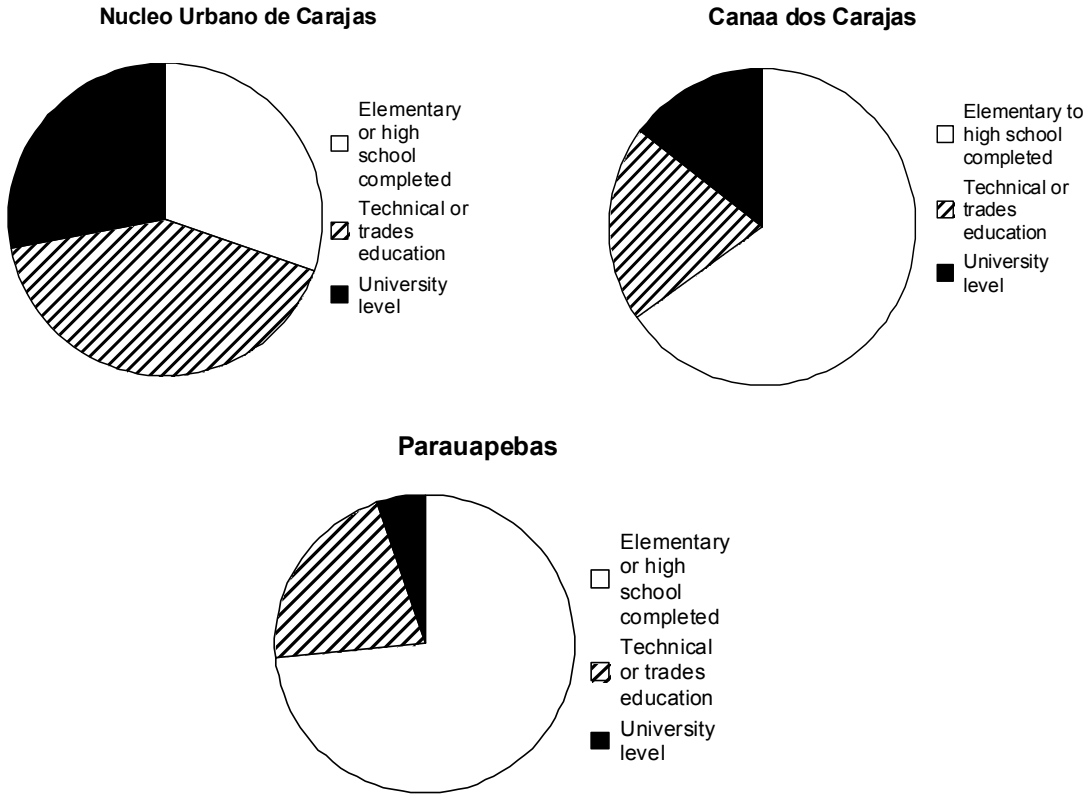

Figure 6.8: Population Samples: Education Levels

Interviews and on-site observations made it clear that residents of the Núcleo Urbano de Carajás feel that the higher their education level, the more difficult it is to access further education and professional development opportunities. This is a result of the remoteness and isolation of the Núcleo in relation to tertiary education and post-graduation programs. As noted by university-level employees of Vale:

> *"Something that I would improve in Carajás is education; I mean high levels of education. The company could bring in some Masters programs, because here we just have undergraduate-level courses. There could be some programs with face-to-face classroom time for all the engineers, it would be very interesting."* (Male employee living in the Núcleo Urbano de Carajás)

> *"Something that is negative here is that we don't have a university for our wives to study at, or even for us to take another course or do a post-graduation program. This is something that has a negative impact on our lives. Because here we just have on-line university programs and I believe that classroom time is actually much more valuable."* (Male employee living in the Núcleo Urbano de Carajás)

These findings seem to indicate that the area of professional development and education opportunities available could be defined as an important part of a strategy to increase quality of life, employee retention and job satisfaction, as well as to provide more opportunities for employees' family members.

c. Ability to Make Decisions on Your Own

Results from the statistical analysis reveal that Parauapebas residents reported the highest level of satisfaction with their ability to make decisions on their own at work than respondents from the other case study communities (Table 6.5). However, the concept of "empowerment" in the workplace did not significantly appear in the interviews of residents of any of the 3 communities. This is probably a reflection of the interview design, which did not include work satisfaction or topics directly related to work, but focused instead on community-related issues. Because many of the community features and aspects of life in the region are so influenced by one's experiences at work, a significant amount of work-related content was exposed in the interviews.

Table 6.5: Satisfaction with "Ability to Make Decisions on Your Own" at Work by Community of Residence

Community	Mean	Std. Deviation	n
Núcleo Urbano de Carajás[a]	6.82	2.41	167
Canaã dos Carajás[a]	6.70	2.51	74
Parauapebas[b]	7.55	2.14	214

ANOVA: F (2,452) = 6.28, p = 0.002

[a, b]Groups in each row that share a superscript are not significantly different from each other.

Levene's test of equality of error variance: F (2,452) = 1.24, p = 0.29

Note: groups in each row that share a superscript are not significantly different from each other. Post hoc test: LSD. Confidence level: 97.5%

d. Relationships at Work

Even though satisfaction with relationships at work (i.e., relationships with co-workers and supervisor) were well rated across the board (Table 6.6), it is possible that the Núcleo residents' low satisfaction levels relative to Parauapebas residents' satisfaction levels can be explained by the fact that personal relationships in the Núcleo are somewhat stressed by the blurred lines between personal life and work life. Interview participants often highlighted this aspect of life in the Núcleo:

> *"You can be approached about work issues anywhere; even at the grocery store my manager has stopped me to ask about work stuff."* (Female employee living in the Núcleo Urbano de Carajás)

Table 6.6: Satisfaction with Relationships at Work by Community of Residence

Relationship with…	ANOVA	Levene's Test of Equality for Error Variance	Community	Mean	Std. Dv.	n
Co-workers	F (2,452) = 0.332, p < 0.001	F (2,452) = 0.332, p = 0.718	Núcleo Urbano de Carajás[a]	8.07	1.70	167
			Canaã dos Carajás[b]	8.34	1.72	74
			Parauapebas[b]	8.77	1.74	214
Supervisor	F (2,452) = 4.831, p = 0.008	F (2,452) =0.301, p = 0.740	Núcleo Urbano de Carajás[a]	7.57	2.25	167
			Canaã dos Carajás[a,b]	8.15	2.09	74
			Parauapebas[b]	8.25	2.17	214

6.2.3. Comparing Perceptions of the Health Domain

Respondents from Parauapebas rated their satisfaction with the health domain higher than Canaã residents did, while no statistically significant difference exists between the Núcleo residents' mean scores and the scores for the other 2 case study communities. A further investigation of the indicators of the health domain sheds some light on this matter. Table 6.7 displays the ANOVA results.

Analyses of variance indicate that differences in reported levels of satisfaction with the indicators *food you eat* ($F(2,449) = 0.95$, $p = 0.39$), and *physical activity level* ($F(2, 449) = 1.88$, $p = 0.153$) are not statistically significant.

a. Stress and Work-Life Balance

Analyses of variance demonstrated that Parauapebas residents rated their satisfaction with the indicators *stress levels* and *ability to balance work and life* higher than respondents living in the other 2 case study communities. This is probably explained by the extra degree of separation from work that employees seem to experience in Parauapebas, a separation that is physical as well as psychological.

Most Parauapebas residents live in rentals or own their homes, interact with other people when they go home after work, and do not feel the same "24-hour" commitment sensed by residents of the Núcleo and some Canaã residents. Even though this "life is work" attitude appears to be much worse in the Núcleo than in Canaã, the latter still offers little to employees after work hours, and is small enough and close enough to the Sossego Mine to maintain that feeling of "living at work". The fact that so many respondents reside in company-provided accommodations (mostly shared homes) (Figures D, E and F in Appendix D) and have co-workers as roommates certainly contributes to the difficulty to separate work from their personal lives.

Table 6.7: Health Indicators by Community of Residence

Indicator	ANOVA	Levene's Test of Equality for Error Variance	Community	Mean	Std. Dv.	n
Stress Level	F (2,449) = 11.60, p = 0.021	F (2,449) = 0.87, p 0.052	Núcleo Urbano de Carajás[a]	5.60	2.42	167
			Canaã dos Carajás[a]	5.47	2.50	72
			Parauapebas[b]	6.22	2.57	213
Entertainment and Recreation Options	F (2,449) = 12.68, p < 0.001	F (2,449) = 0.15, p = 0.087	Núcleo Urbano de Carajás[a]	5.27	2.84	167
			Canaã dos Carajás[b]	3.64	2.78	72
			Parauapebas[b]	3.99	2.85	213
Health Care Services	F (2,449) = 14.15, p < 0.001	F (2,449) = 1.31, p = 0.27	Núcleo Urbano de Carajás[a]	5.29	2.77	167
			Canaã dos Carajás[b]	3.24	2.49	72
			Parauapebas[c]	4.36	2.92	213
Ability to Balance Life and Work	F (2,449) = 11.10, p < 0.001	F (2,449) = 2.62, p = 0.074	Núcleo Urbano de Carajás[a]	6.71	2.39	167
			Canaã dos Carajás[a]	7.10	2.52	72
			Parauapebas[b]	7.81	2.12	213

[a,b,c]Groups in each row that share a superscript are not significantly different from each other. Post-hoc test: LSD. Confidence level: 97.5%.

b. Entertainment and Recreation Options

Residents of the Núcleo reported the highest levels of satisfaction with this indicator. However, mean scores were still quite low—only slightly above neutrality. The Núcleo Urbano de Carajás, Parauapebas and Canaã dos Carajás are quite remote locations and have a somewhat "work-oriented" culture. In the Núcleo, a clear effort was made to provide entertainment and recreational opportunities, such as the recreation centre, a movie theatre and events such as sport competitions and summer camps for kids.

Other than a poorly maintained recreation centre where weekly dances take place, entertainment and recreation options in Parauapebas are very limited. Residents seem to spend most of their free time in bars or watching TV programs or music videos. In Canaã,

entertainment and recreation options are even fewer, with the *Casa da Cultura* (cultural centre) weekly live music event being the only source of entertainment mentioned during interviews.

c. Health Care Services

Parauapebas residents rated their satisfaction with health care services slightly lower than residents of the Núcleo, but higher than Canaã residents. The variance of responses might be partly explained by the fact that in essence, employees who live in Parauapebas or in the Núcleo have similar access to health care facilities. In Canaã, access to health services is not seen positively, and is clearly one of the most distressing issues for mine employees.

6.3. Addressing Research Question 3: Aspects that Most Impact Satisfaction with Quality of Life

The third research question focuses on how the characteristics of each community affect residents' perceptions of their quality of life. The approach to answering this question included identifying the most and the least satisfying aspects of quality of life (QOL) in the 3 case study communities separately. Results from the statistical analysis of the questionnaire responses and the qualitative results from the in-depth interviews were triangulated to validate and provide a more comprehensive discussion of findings regarding the community characteristics that appear to impact mineworkers' satisfaction with quality of life (Figure 6.9).

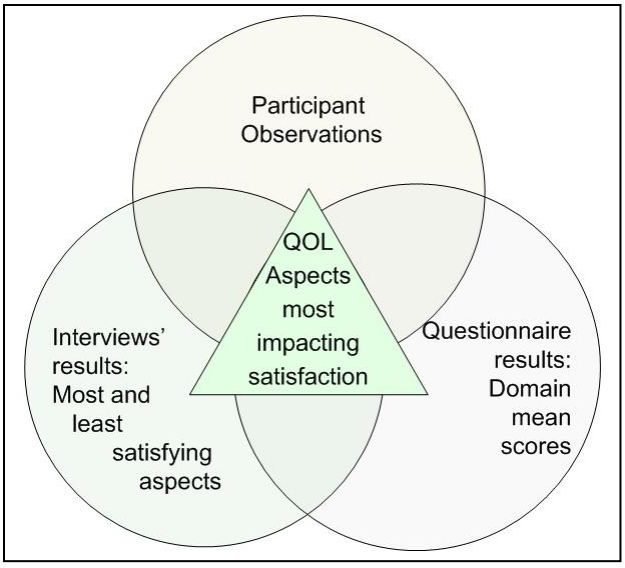

Figure 6.9: Approach to Defining Aspects Most Affecting QOL Satisfaction

6.3.1. Criteria for Most and Least Satisfying Aspects of Quality of Life

When interpreting quantitative results, the definition of what were the most and least satisfying aspects was not simply a matter of identifying the highest and lowest mean scores, but a result of the triangulation of the mean scores with the qualitative data from interviews and researcher observations, as illustrated in Figure 6.8.

The quality of life (QOL) questionnaire satisfaction scales ranged from zero (completely dissatisfied) to 10 (completely satisfied), with 5 denoting a neutral satisfaction level. The condition for defining a quantitative "least satisfying" item was a mean score lower than 6, denoting a mean score for level of satisfaction around neutrality or less[50]. For defining a "most satisfying" item, the criterion was a mean score of 7 or higher, denoting reasonable satisfaction levels.

For concepts resulting from the qualitative analysis of the interviews, the criterion for least and most satisfying was that a concept was mentioned at least once as an answer to the questions "What are the best things about living in your community?" and "What are the worst things about living in your community?"

The overlap of results for least and most satisfying items from the qualitative research (frequency in which concepts were mentioned in interviews) and quantitative research (mean scores lower than 6 for least satisfying and 7 or more for most satisfying) was used to define least and most satisfying aspects for each community[51]. Participant observation notes produced by the researcher during field visits were also triangulated and assisted with the establishment of relationships between qualitative concepts from interviews and questionnaire items.

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[50] In defining least satisfying aspects of the Núcleo Urbano, in two instances mean scores higher than 6 were included in triangulation because of the overwhelming evidence from the qualitative research and observation notes that these issues significantly impact the quality of life of Núcleo residents.

[51] In defining the least satisfying aspects of Parauapebas, in one instance one concept identified with the coding of interviews did match up with any of the items from the QOL questionnaire. This concept was included in the discussion because the frequency in which it surfaced in interviews was considered significant, and the researcher's participant observation corroborated its importance.

In the following section, a detailed discussion of results of triangulation is presented, including all items considered least of most satisfying for each community. Quotes from qualitative interviews back up the findings.

6.3.2. Núcleo Urbano de Carajás

a. Most Satisfying Aspects of the Núcleo Urbano de Carajás

Table 6.8 includes the aspects that appear to be the most satisfying in the Núcleo Urbano de Carajás. The means displayed were extracted from Table 5.3 and Table 5.27.

Environment Domain

Order, Cleanliness and Security in the Community

Of the 3 topics included in this questionnaire item, this was most discussed during interviews with employees living in the Núcleo. It is quite clear that the orderly and clean environment and personal security are some of the most appreciated qualities of this community.

Table 6.8: Most Satisfying Aspects of the Núcleo Urbano de Carajás

Item	Mean Score	Frequency*
Environment		
Order, cleanliness and safety in the community	8.40	17
Access to nature	7.95	13
Basic infrastructure	9.02	2
Social		
Relationship with friends	8.4	4

*Refers to number of times related concepts were mentioned during the interview process

Note: means from quality of life questionnaire (scale 0 to 10).

As noted by an employee:

> *"I was attracted to come to Carajás because I was born inside another closed community, in another Project, as people say. So that's why I already knew how life is in a place like this. So I'm conscious about the quality of life in this place, especially about security."* (Female resident living in the Núcleo Urbano de Carajás)

Nevertheless, some residents claim that security in the community has steadily declined throughout the years:

> *"Nowadays safety is not what it used to be [before privatization]; you don't see security guards doing rounds. Just last June, in my neighborhood, people tried to break into the house across the street 4 times. 2 other houses were broken into, all in one month."* (Female employee living in the Núcleo Urbano de Carajás)

> *"It used to be more tranquil and safe—you could sleep with your doors and windows open, leave your house unlocked, with children at home. Now we even hear of tarados [sexual predators]. There used to be unheard of. I raised my 2 daughters here."* (Female employee living in the Núcleo Urbano de Carajás)

However, there is no doubt that the Núcleo is perceived as a fairly safe place to live, especially if compared to neighboring Parauapebas:

> *"I am worried about retirement—I am reticent about having to leave the Núcleo to live in Parauapebas; it is dangerous there."* (Male employee living in the Núcleo Urbano de Carajás)

Because of strict rules and behavioral codes, the Núcleo is closely monitored, and security guards are constantly circulating to maintain order and preserve a sense of security.

Access to Nature

The easy access to nature offered by the Núcleo and the quality of the natural environment surrounding this community were 2 factors that were highly regarded by residents' responses in the QOL questionnaire (Table 6.8). These results are strongly supported by the interview data, with several residents emphasizing this aspect of the community. As an employee living in the Núcleo highlights:

> *"It is really peaceful to be so close to nature. I like the environment here—this is wellbeing*." (Female resident living in the Núcleo Urbano de Carajás)

The natural environment in the Núcleo is in fact very pleasant. The community is located within the Carajás National Park and is thus known as the "city in the forest". It provides the residents with open spaces, tree-lined streets, and the peace and quiet characteristic of a gated community. Other residential areas in the region, which have been heavily deforested for agricultural, livestock and urban development purposes, are more lacking in these aspects of

quality of life. The fact that the park is located in the highlands also adds to the positive qualities of the natural environment, as it provides for a more moderate climate in what is a very warm region, particularly in the Amazonian summer (June–November).

Basic Infrastructure

Not surprisingly, reported satisfaction levels with the basic infrastructure were quite high (Table 6.9). It was also mentioned as one of the "best things about the Núcleo" by 7 of the 18 interview participants. The Núcleo was built to provide the residents with the entire infrastructure, services and comfort of a small town. The community is well serviced, and the asphalt streets are well maintained. Moreover, as a rule, families living in the Núcleo do not pay for utilities such as water and electricity (although they do pay for optional phone lines and satellite TV). Households are only required to pay for utilities when monthly use goes over a certain cash amount that seems to generally be perceived as reasonable.

In addition to the urban infrastructure *per se*, the Núcleo also has several community facilities and services for residents, such as a large recreation facility, a school (including a library) and daycare, banks, a post office, a hospital, and churches of several denominations. Commercial services available include an English school, 2 beauty parlors, 2 hotels, a few restaurants, several stores, a travel agency and 2 fair-sized grocery stores. The Núcleo Urbano de Carajás is also home to a zoo and a small botanical museum featuring regional flora and fauna. Because the population in this community is quite small (around 5,500), generally there is not much pressure on services. As expressed in interviews:

> "*I think it is very convenient to live in the Núcleo. Everything is planned out, the grocery store is on one corner, and the bank is on the other… We also have the* club *[recreation center]. I would not want to have to go to Parauapebas to go to the bank… the line ups there are crazy, just inhumane."* (Male employee living in the Núcleo Urbano de Carajás)

Social Domain

Relationships with Friends

The analysis of the questionnaire responses indicates that *relationships with friends* (mean 8.4) are one of the most positive aspects of life in the Núcleo. Personal relationships in general were also often highlighted in interviews:

"I have lots of friends here. Most of them already went back home. This is the hardest part in Carajás, because we miss our friends a lot when they leave."
(Female employee living in the Núcleo Urbano de Carajás)

These results were anticipated, since personal relationships are widely recognized as one of the strengths of small communities, particularly communities composed of migrants with similar objectives and hopes. The distance from extended family emphasizes the need and desire to establish good friendships, which are often formed very quickly upon arrival in the community. In effect, a similar phenomenon was observed in the other 2 case study communities.

b. Least Satisfying Aspects of the Núcleo Urbano de Carajás

Table 6.9 depicts the aspects of the Núcleo that appear to be the least satisfying. It presents the questionnaire items and their mean scores (Table 5.3), as well as the frequency in which concepts associated with these items were identified in the interviews as "worst things" about living in the Núcleo Urbano de Carajás (Table 5.28).

Table 6.9: Least Satisfying Aspects of the Núcleo Urbano de Carajás

Item	Mean Score	Frequency*
Health		
Entertainment and recreation options	5.29	12
Ability to balance life/work	6.71	12
Stress levels	5.60	3
Social		
Privacy	6.93	12
Economic		
What you can do and buy with your money	5.58	4

*Refers to number of times related concepts were mentioned during the interview process

Note: means from quality of life questionnaire (scale 0 to 10).

The inclusion of 2 specific items in Table 6.9, *ability to balance work and life* and *privacy,* warrants further justification. Even though the mean scores for these 2 items do not fit the criteria (lower than 6), they were included in this table because of the overwhelming evidence from the qualitative research that these issues pose a significant threat to the quality of life as perceived by residents of the Núcleo Urbano de Carajás.

The lack of entertainment variety and recreation and cultural opportunities seem to seriously impact the quality of life of residents of the Núcleo. Even though efforts have been made to increase entertainment and recreation options, as described earlier in this chapter, the reality is that the Núcleo is indeed a very small community where activities easily become repetitive. Residents' entertainment options are limited to a couple of restaurants and the *padaria/pizzaria* (bakery and pizza place)—a popular "hang-out" spot where people of all ages gather to watch TV, drink beer and eat pizza—going to the movies once a week, and drinking at one of the local bars. In all of these activities, residents are bound to see familiar faces, and often co-workers end up "talking shop".

The following is a discussion of the items identified as least satisfying aspects of life in the Núcleo Urbano de Carajás.

Health Domain

Stress and Inability to Balance Family and Work Life

Negative aspects of life in the Núcleo appear to be closely related to stress and inability to balance work and personal life. As highlighted by interview participants:

> *"Another thing is that people live for the Vale do Rio Doce. If you live in the Núcleo, you are a 24-hour employee. When they give you a cellular phone, it's the end of it. When you are sitting on the toilet, you are on your cell; at the bar, at a birthday party… the cell is always on. You live for the company. I currently don't carry a cell, but even so, when I worked for the iron-ore mine, I used to get home sometimes and find messages for me. My husband would say, "She's not at home", and they would say, "But she is on her way—when she gets there, tell her to call back". Nowadays, you get a cell and you don't have any peace. There is a total lack of respect for the professional here. If you work with travel planning, for example, you don't have any personal life or tranquility. They give you a cell and want you to have it on 24 hours a day. They ask you not to turn it off when you leave work, and there is no extra financial compensation for that."* (Female employee living in the Núcleo Urbano de Carajás)

The work-related stress and inability to balance work and family life are closely related to other negative aspects of this community that are discussed under the social domain.

Social Domain

Challenges in the Núcleo Urbano de Carajás seem to be very much associated with dissatisfaction with the lack of privacy, blurred boundaries between personal and professional life and isolation.

Lack of Personal Privacy

The privacy issue is in fact really obvious in the Núcleo. Because it is a very small community, limited social interaction creates a situation in which people often run into their co-workers outside of work. A long-term employee stated:

> *"There is no difference between your private life and your work—if your kid does something wrong in the community and someone calls security, they will tell your boss and you'll hear about it at work. I know someone who was fired because his son was caught with marijuana—they told him to leave or send his kid away. Would you send your son with a drug problem away? This is when your kid needs you the most."* (Female employee living in the Núcleo Urbano de Carajás)

> *"One of the things that really bothers me, living in a closed community, is the intervention—I don't know if this is the right word, but the way people "intervene", the way people worry about your life. I feel a lot of pressure from these social rules and expectations."* (Female employee living in the Núcleo Urbano de Carajás)

The feeling of "lack of privacy" seems to be aggravated by the proximity and design of the company houses:

> *"Here we live in a place where people are always watching you, you don't feel comfortable to do certain things and we don't have high enough fences. For example, if I get out of the shower and need to get out to the clothesline in the backyard, I can't go wearing a towel because my neighbors could spot me. That's awful because even if you are inside your own home you have privacy, it seems like homes are transparent."* (Female employee living in the Núcleo Urbano de Carajás)

> *"The proximity between houses here is a huge problem because you can hear your neighbors arguing, and you know everything about their lives, even if you don't want to know."* (Male employee living in the Núcleo Urbano de Carajás)

> *"It's the lack of privacy, because sometimes you have to turn the TV on trying not to hear your neighbor's conversations, and [the lack of privacy] is embarrassing because just passing by on the sidewalk you can hear intimate conversations."* (Male employee living in Núcleo Urbano de Carajás)

The problem with the lack of privacy is closely related and contributes to the blurred boundaries between personal and professional life, highlighted in the discussion about health issues and the difficulty of achieving work-life balance in a company town such as the Núcleo Urbano de Carajás.

What You Can Do and Buy with Your Money

For the respondents from the Núcleo, the comments associated with "what you can do and buy with your money" were directed at the high prices of food, goods and services in the community. Because of the remoteness, goods are more expensive than in most residents' communities of origin. Also, as expected, goods and services in the Núcleo have inflated prices when compared to Parauapebas, simply because of the higher economic status of most residents in the Núcleo and the limited competition in such a small community.

6.3.3. Canaã dos Carajás

a. Most Satisfying Aspects of Canaã dos Carajás

Table 6.10 depicts the most satisfying aspects of Canaã as identified by the triangulation of qualitative, quantitative results and observation. The values in Table 6.10 were extracted from Table 5.3 and Table 5.31.

Table 6.10: Most Satisfying Aspects of Canaã dos Carajás

Item	Mean Score	Frequency*
Social		
Relationship with friends	8.18	5
Environment		
Quaint rural atmosphere: peace and quiet	n/a**	17

*Refers to number of times related concepts were mentioned during the interview process
**Not a questionnaire item

Note: mean score from quality of life questionnaire - scale 0 to 10.

Relationships with Friends

During interviews, employees living in Canaã mentioned concepts related to the quality of social relationships and networks as the best things about Canaã. These concepts were associated

with “relationships with friends” (mean = 8.18). This result is also consistent with high scores for the SWI item “personal relationships” (mean = 8.00).

Similar to the Núcleo Urbano de Carajás, it is expected that migrants coming to a small mining community such as Canaã will quickly create a network of friends and acquaintances. These new friends and acquaintances are usually the primary support network for both singles and families that have recently moved to town for work-related reasons, often leaving behind a larger family and community. The high scores for the items *personal relationships* and *relationships with friends* seem to indicate that the ability of individuals to create a social network for themselves and “fit in” to the community is very important. As observed in other case studies (e.g., Robinson, 1962; Lucas, 1971; Riffel, 1975), social connections help new residents cope with adapting to being physically distant from family, to a new job and to a new environment.

The other aspect of Canaã that seems to be considered very positive is the sense of security and tranquility associated with its rural atmosphere. During interviews, concepts related to the “quaintness” of the community were mentioned quite often (frequency = 17). In fact, it was observed that this community has small-town atmosphere that offers peace and quiet to those who appreciate small-town living and a simple lifestyle.

b. Least Satisfying Aspects of Canaã dos Carajás

Table 6.11 depicts what seem to be the least satisfying aspects of Canaã dos Carajás. Mean scores exhibited in Table 6.11 were obtained from Table 5.3. Frequencies were obtained from Table 5.32.

Table 6.11: Least Satisfying Aspects of Canaã dos Carajás

Item	Mean Score	Frequency*
Health		
Health care services	3.24	5
Entertainment and recreational options	3.64	5
Environment		
Basic infrastructure	3.69	5
Transportation options	4.12	2
Economic		
What you can do and buy with your money	5.55	3
Social		
Educational opportunities	4.16	2

*Refers to number of times related concepts were mentioned during the interview process

Note: mean score from quality of life questionnaire (scale 0 to 10).

Health Domain

Inadequate Health Services

It is anticipated that a booming city like Canaã would experience "growing pains" while the provision of infrastructure and services adapt to meet the needs of a rapidly growing population. Many employees seem to fear the lack of health services accompanied by the remoteness and isolation. Employees do not have access to resources that could mitigate these problems, such as a helicopter for health emergencies that occur outside of the workplace, or a temporary clinic or health centre. As described by a Sossego Mine employee:

> *"The first negative point here in Canaã is the quality of health services and doctors. Unfortunately we have real examples of when the health care services have failed us, and it's very sad. There was a guy who had a cancer in his leg, but the doctor said it was a psychological problem, not cancer. What kind of doctor is that? Can you imagine if a child has an accident or is bitten by a snake? I worry because there are lots of snakes here. And there's nothing we can do."*
> (Male employee living in Canaã dos Carajás)

Lack of Entertainment and Recreation Options

The lack of entertainment and recreation options in Canaã is a result of the lack of infrastructure evident in the community. As described elsewhere in this thesis, the community of Canaã dos Carajás is being developed using a very different approach from the one used for the

development of the Núcleo Urbano de Carajás, which initially resulted in the segregation of employees from the rest of the community. Canaã is being developed using an "integrated approach"—the goal seems to be to facilitate the integration of the Vale workforce with the community and to improve the living conditions of not just Vale employees but the community as a whole. However, while Canaã's population has grown quite rapidly, development is moving at a slower pace. This problem is also reflected in environment and social domain indicators. As discussed by a resident:

> *"In my opinion, the negative aspects of Canaã are the lack of recreation and entertainment options, so we end up living a "work and study" routine. Entertainment is limited to watching TV. We don't have access to lots of things that are available elsewhere. For example, access to information, communication, entertainment and recreation. It is hard to find a good variety of food products. I find this really hard, but I must admit that it has improved a lot."* (Male resident living in Canaã dos Carajás)

Environment Domain

Deficient Basic Infrastructure

As mentioned elsewhere in this Chapter, the slow pace of development accompanied by a fast pace of population growth has resulted in a lack of basic infrastructure in Canaã, which is a real challenge for Vale employees living here. It seems that water shortages are a particular inconvenience that has occurred frequently and is considered a major source of discomfort:

> *"Sometimes we don't have water. Recently it hasn't been so bad, but some months ago it happened very frequently. Can you imagine waking up in the morning and having no water to shower with before going to work? Or coming home after work and there's still no water?"* (Male employee living in Canaã dos Carajás)

Inadequacy of Transportation Options

Transportation options are also a significant problem for current residents of Canaã. Simply put, there is no reliable public transit in the city. Transportation within this community is limited to private vehicles and bicycles, horse-drawn wagons, or commercial passenger vans and *motoboys* (motorcycle taxis), which are not regulated and do not follow any safety provisions. The inter-municipal transportation system (Canaã–Parauapebas or Canaã–Marabá) is also provided by private vans, which are reportedly expensive and unsafe:

> *"Another disadvantage of living in Canaã is that you depend on the* perueiros *(van drivers). They are reckless drivers, and the vans are always overcrowded. [The* perueiros*] are rude, imprudent and irresponsible. They carry many people inside a vehicle and they drive at 100 or 120 km/h. And there's another problem: the prices. It costs R$8.00[52] per person to go to Parauapebas."* (Male employee living in Canaã dos Carajás)

Moreover, the inter-municipal transportation problem is quite significant in Canaã because of its clear relationship with the sense of isolation and remoteness intensely reported by residents interviewed. The difficulties in accessing and leaving Canaã, along with communication problems (lack of internet access, difficulty in finding magazines and newspapers, and limited TV access), collectively make the community significantly isolated. This is evidenced by residents' comments about the need to improve access to the community and communication systems as priorities for Canaã (Table 5.33).

Economic Domain

What You Can Do and Buy with Your Money

The high cost of living in Canaã dos Carajás is also a reflection of the rapid population growth and relatively slow infrastructure development. Shortages of goods, services and housing are evident. Consequently, prices have increased very quickly, making it difficult for Vale employees and often more difficult for other community members, who might not have benefited from the mine development, to adapt. As noted by a Canaã resident:

> *"People come here after a dream to work for Vale. They arrive and face the situation of high living costs and unaffordable housing." (*Male resident living in Canaã dos Carajás)

Social Domain

Lack of Educational Opportunities

Throughout the interview process, it became very clear that education and the ability to access professional development programs are very important for residents of the 3 communities investigated. Respondents from all 3 case study communities highlighted the lack of educational options at both the technical and university levels as a rather negative aspect of living in the

[52] About CAD $4.00 in August 2006

region. Respondents from Canaã rated their satisfaction with educational opportunities as quite low (mean = 4.16). In Canaã, the situation is worse then that in the Núcleo or Parauapebas because of this community's greater isolation and the lack of access to on-line education:

> *"Another negative aspect in Canaã is education. Although I have a bachelor degree, I aspire to take a post-graduation program, and we're always so dependent on the company. If the company doesn't pay for these courses, we have no means to do that. Even If we can pay the fees, we can't go ahead with it because we have to work and we can't just leave our jobs to go elsewhere for school. And the reality is that there are no interesting courses in Canaã."* (Male employee living in Canaã dos Carajás)

6.3.4. Parauapebas

d. Most Satisfying Aspects of Parauapebas

The QOL aspects that appear to be the most satisfying for employees living in Parauapebas are presented in Table 6.12. The mean scores in this table were obtained from Table 5.3 and Table 5.35.

Table 6.12: Most Satisfying Aspects of Parauapebas

Questionnaire Item	Mean	Frequency*
Social		
Relationship with friends	8.91	2
Work		
Opportunity to grow professionally	7.47	6

*Refers to number of times related concepts were mentioned during the interview process

Note: means from quality of life questionnaire - scale 0 to 10.

Relationships with Friends

Similar to perceptions of employees who live in the Núcleo Urbano and Canaã dos Carajás, Parauapebas residents seem to appreciate the ease with which they are able to form friendships and create social networks in their community. With over 100,000 inhabitants, Parauapebas is a relatively small city of migrants who have mostly come to find employment. As described by a resident:

> *"One thing that helps people to live well here is the relationships and friends you make here. Here you have good friends. Maybe this is the big difference for me,*

> *because wherever I go I have friends, and I know it helps me. These are long-time friends, and I am constantly making new friends… These are friends that you can count on."* (Male resident living in Parauapebas)

Parauapebas' population is culturally diverse and relatively young, while unemployment here is relatively low, particularly compared to the neighbouring municipalities and states. Drinking establishments abound, and parties and northern/northeastern music concerts are very frequent. These characteristics make Parauapebas a community where it is fairly easy to meet people, socialize and make friends.

Opportunities for Professional Growth

Parauapebas residents were the only participants to highlight a work-related topic as one of the most satisfying aspects of life in their communities. This is not unexpected and can probably be explained by the fact that many of the residents who work for Vale have almost certainly come to Parauapebas to actively look for work and were successful. Most residents acknowledge the fact that the city indeed offers abundant job prospects for individuals with little training:

> *"Anyone can get a job here; you don't stay unemployed too long."* (Male resident living in Parauapebas)

e. Least Satisfying Aspects of Parauapebas

Table 6.13 shows the aspects that appear to be the least satisfying in Parauapebas. The mean scores displayed were obtained from Table 5.3, and frequencies from Table 5.34.

<u>Environment Domain</u>

Results in Table 6.13 demonstrate the significance of challenges related to the environment domain in Parauapebas. It is obvious that a lack of basic infrastructure and services, pollution, and a lack of order and security make the city of Parauapebas a very challenging place to live.

Table 6.13: Least Satisfying Aspects of Parauapebas

Item	Mean Score	Frequency*
Environment		
Order, cleanliness and security	5.86	22
Basic infrastructure	4.55	9
Health		
Entertainment and recreation options	3.99	4
Health care services	4.36	4
Economic		
What you can do and buy with your money	5.90	3
Social		
Educational opportunities	5.50	1
Social services available	n/a**	9

*Refers to number of times related concepts were mentioned during the interview process.
** Not a questionnaire item

Note: means from quality of life questionnaire - scale 0 to 10.

Order, Cleanliness and Security

The high frequency with which concepts related to this item were mentioned in the interviews can be explained by the fact that this indicator actually includes 3 concepts which are of major importance to Parauapebas: the lack of order or perception of "lawlessness", the filthiness of the city and the fear of violence and crime. As stated by residents:

> *"I feel unsafe in Parauapebas – I don't even go to the bus stop in the morning on my own. My uncle comes with my sister and I because we find it dangerous to stand there waiting."* (Female contractor's employee living in Parauapebas)

> *"There are several issues here. I think the city is growing chaotically; there are new housing developments that nobody knows about, and more people migrating here—Parauapebas is growing with no organization or planning. The result is that our security is compromised. We need more security."* (Female contractor's employee living in Parauapebas)

Indeed, there is a general feeling that Parauapebas is not, in effect, a "regulated" municipality, in the sense that people can do what they please, including leaving garbage on the streets or burning it in their backyards, not complying with building codes, playing loud music at late hours,

etc. The general feeling is that Parauapebas is a 'wild west' community, with a corrupt police force and very little will to enforce any kind of order or bylaw.

The waste management problem in Parauapebas seems to be a result of several interrelated issues, such the inadequate garbage-removal services, inadequate sanitation infrastructure and the population's general lack of environmental and health education. As a result, garbage and open sewers reduce the quality of life in city because this creates discomfort as well as health risks to the community and to the environment:

> *"Something that really bothers me is the sanitation problem in Parauapebas, because we just don't have it. It's really very bad. We have drinking water, but sometimes the level of chlorine is so high we can smell it. And the sewers are bad too. Sometimes we can see the open sewers running on the streets, and this is too bad because of the bad smell in front of our homes. There has been a broken sewer pipe in front of my place for one month now and nothing has been done yet to fix it."* (Female employee living in Parauapebas)

The prevalence violence and crime also impact Parauapebas residents' quality of life very negatively. As in many cities in Pará and in Brazil, there seems to be a general feeling of insecurity and fear of muggings, break-ins, rape and even murder. Parauapebas, however, has a reputation for violent crime and impunity. The topic of violence comes up very often in daily conversations, and the atmosphere of fear is widespread. As described by a male contractor's employee living in Parauapebas:

> *"One thing that really bothers me here is the violence; this is a lawless land. I had considered moving to Rio de Janeiro, but I preferred to come here because I thought this would be a safer, calmer place. Since I moved here, I have seen many things—bad things, deaths and stuff like that. There are contracted murderers here. They kill for money… 10 Reais[53] is enough to kill someone. This is the worst thing here.*"

Basic Infrastructure

The basic infrastructure in Parauapebas is severely inadequate, which is a significant problem, particularly for those who come here from communities with a reasonable infrastructure and thus are not used to the frequent water shortages and power outages. The situation is even

[53] About CAD 5.00 in August 2006.

more chaotic for residents in the newly developed neighborhoods, which have been constructed with little care, inadequate materials and often not following a building code.

Health Domain

Lack of Entertainment and Recreation Options

When compared with the 2 other communities studied in this research, Parauapebas seem to be a more “complete” community with more services and business, including Internet cafes, gyms, bars and restaurants. However, Vale employees who live in Parauapebas seem to consider the lack of entertainment and recreation options to be one of the worst things about Parauapebas. Indeed, very little is offered in terms of sports or recreation, such as recreation facilities, green and open spaces, municipal squares, etc. The lack of cultural facilities is also striking. The city does not have not a library or an actual bookstore (except for a small Christian bookstore), nor is there a cinema or community theatre. Entertainment in Parauapebas seems to be limited to the consumption of alcohol at home and in public places, barbecues, and the weekly dances or local band concerts. Most people seem to spend their free time watching TV or movies and Northern and Northeastern music DVDs, which are widely popular in the region.

Inadequacy of Health Care Services

Public health care services are one of the greatest Brazilian challenges. Poor-quality services and facilities are not unique to Parauapebas or to Northern Brazil, but are certainly aggravated in this community by its remote location and rampant population growth. The municipality is relatively young at around 2 decades old, and estimates indicate that the municipal population has already reached more than 100,000 inhabitants (Instituto Brasileiro de Geografia e Estatística, 2007). The pressure on community services and infrastructure is evident not only in health care, but also education and other social services.

Even though participants generally indicated dissatisfaction with health care in Carajás and Parauapebas, Vale employees and other larger contractors’ employees often have employee benefits programs that include private health care insurance. This insurance provides them with different levels of access to the health care services of the Yutaka Takeda Hospital, which is located in the Núcleo Urbano de Carajás and is widely regarded as the best health care facility in southern Pará. Private health insurance also provides employees with varying levels of

access to other private health clinics and specialized services in Parauapebas, such as ophthalmology, dentistry, gynecology and counseling psychiatry.

Economic Domain

What You Can Do and Buy with Your Money

Similar to the situations in the Núcleo Urbano and Canaã dos Carajás, the high cost of living in Parauapebas seems to be a noteworthy problem for Vale employees, particularly for those who have lower-paying jobs or families to support.

In Parauapebas, a great example of this phenomenon is the housing costs. For the most part, land prices are increasing as a result of speculation because of the Vale mine expansion plans, building materials come for distant locations at high prices and labor costs are higher because of the job market in the region. In Parauapebas, small and substandard duplexes and apartments have sprung up throughout the city, as a market response to the increasing housing demand. However, these units are being built in a rush and with little regard for comfort or aesthetics. Water and power supply are often poorly provided, while rents are quite high. New, better built mid-rise apartment buildings are offering apartments at unprecedented prices. As described by an employee:

> *"Parauapebas Municipal government built some house, but they are too small. So someone that makes the minimal wage can buy one of these, but these houses are only about 40 square meters, so they are too small for families of 4 to 5 people. For those who have nothing, this is not such bad deal ...but rent is very expensive and it is almost impossible to afford to buy a decent place...you would need 150, 200 thousand Reais. And with 200,000 you could get a pretty nice place in Minas or Vitória."* (Male employee living in Núcleo Urbano de Carajás)

Social Domain

Lack of Social Services

In Brazil, the challenge of providing social services is not unique to remote resource-based communities experiencing fast growth. However, the situation in Parauapebas is accentuated by the incessant migration of unskilled and poverty-stricken individuals and families. Municipal efforts are failing to meet the growing needs of the city. In the last few years, under new political leadership, the municipality has made efforts to offer social services to women, the elderly and

children; however, the community's social needs are still tremendous and continue to grow at a rapid rate.

Large numbers of unskilled individuals who hope to find a better life arrive in Parauapebas almost on a daily basis. It is not easy for unskilled workers to find formal work in this city. According to the Municipality's Secretariat of Social Development, many of these migrants arrive in Parauapebas with limited or no education, training or work experience, and often without official documents. Government services are available locally to provide documentation to those without official identification documents and without a *carteira de trabalho* (the official work registry card, necessary for formal work in Brazil). This process, however, is time consuming and results in waiting times without formal income. Once documents are provided, individuals are able to take formal jobs. However, formal jobs are usually only easily available to workers with at least some training and experience.

6.4. Addressing Research Question 4: Respondents' Characteristics and Satisfaction with Quality of Life

The 4th research question explores how the characteristics of respondents (variables such as *gender*, *age*, *region of origin* and *job class*) affect their satisfaction with their quality of life. The intent of this question is to investigate the ability of individuals to adapt to the challenges of living and working in remote mining communities, and also to determine which groups might be at greatest risk of discontent, so that intervention might be planned accordingly.

The results of this investigation were produced mainly through the statistical analysis of the QOL questionnaire data. Because this study was of an exploratory nature, hypotheses for each variable and each domain were not necessarily determined upfront. However, some assumptions and expectations are articulated in this discussion. The analyses only included the examination of the way individual variables uniquely affect satisfaction levels with the various chosen domains, average quality of life (AQOL) and life as a whole (LAW).

The following discussion, however, also takes into consideration the data from qualitative interviews and observations made on site.

a. Gender

The independent sample T-tests run for gender and all domains, Subjective Wellbeing Index (SWI), AQOL, and LAW indicate that there are no significant differences between mean scores for satisfaction of males and females. These results seem to support previous life satisfaction research findings that suggest that perceptions of one's life are strikingly similar for both genders (Helliwell and Putnam, 2005). Studies focused on gender and SWB have also failed to find consistent differences between women and men (Sirgy et al., 2006).

These results were not interpreted as a demonstration of equality among females and males, since the questionnaire and interviews did not deal directly with gender or equality issues of the case study communities or at work. Typically, mining communities do not provide for equality between female and male residents (Sharma and Rees, 2007). The results from this investigation only suggest however that female research participants have views of their quality of life that are similar to those of their male counterparts.

b. Age

There is little agreement on the impact of age on reported subjective wellbeing (Sirgy et al., 2006). Some research on the relationship between age and subjective wellbeing suggests that, among equally healthy people, older people are more satisfied with their lives (Helliwell and Putnam, 2005). The results from this research suggest that in this sample population, in isolation, the variable *age* only effects the respondents' satisfaction with the environment domain ($F(2, 450) = 13.554$, $p = .005$). As demonstrated in Table 5.12, the ratings for satisfaction with the environment domain increased with the age of the respondents. However, satisfaction levels in the 3 age categories (*18–30*, *31–40* and *41 and older*[54]) consistently reported a clear discontent with the environment domain indicators, with only the *41 and older* category rating satisfaction barely above neutrality (mean = 5.42).

These findings seem to indicate that younger adults have higher standards for physical environment and infrastructure, and perhaps suggest that as individuals age and mature, they

[54] The initial age categories were 18–25, 26–30, 31–40, 41–50, 51–60 and over 60. These were consolidated in three categories: 18–30, 31–40 and 41 and older—this was done to balance the categories since some of the initial categories had very low frequencies while others had very high frequencies.

become better prepared to cope with the challenges posed by environmental factors and deficiencies in infrastructure and services.

Qualitative data from interviews also provides insights into these findings. Younger interview participants often mentioned how difficult it is to be a young person living in the case study communities, particularly in the Núcleo Urbano de Carajás. Undeniably, there are very limited options for young people in the 3 communities. As a male employee who was living in Parauapebas at the time he was interviewed but who had lived in the Núcleo for a year as an intern simply described:

> *"This place is for families. For young single guys like me, it is just plain boring."*

c. Educational Level

Educational level is the variable that seemed to uniquely impact the highest number of QOL domains, even though differences were very small in every instance (see Table 6.15). These differences, however, have proved to be statistically significant for the economic, social, health and work domains, as well as for the AQOL, as illustrated in Tables 5.5, 5.6, 5.8, 5.15 and 5.18.

For AQOL, respondents with elementary school to high school certificates and no specific technical training reported a higher level of satisfaction with the social, health and work domains than respondents who had technical or trades training or a university degree. However, respondents who had a university-level education reported slightly higher satisfaction levels with the economic domain than did individuals without any post-secondary education, and individuals with trades/technical training were on average the least satisfied with the economic domain (Table 6.14).

It is important to note, however, that even though the *educational level* seems to impact respondents' ratings of their satisfaction with QOL domains, in reality these differences were quite small for all 4 domains and for AQOL. In no instances were these differences of even 1 full point in the 11-point scale (0 to 10).

Table 6.14: Educational Level – QOL Domains

Domains	Mean Scores for Categories		
	Elementary to High School*	Technical or trades training**	University Level***
Economic	5.71[a]	5.23[b]	5.99[a]
Work	7.49[a]	6.91[b]	6.93[b]
Social	6.39[a]	5.90[b]	5.91[b]
Health	5.24[a]	4.47[b]	4.94[b]
Average QOL	5.85[a]	5.47[b]	5.59[b]

* Not including any trades or technical program
** Might be a high school degree with a trades/technical program or a certificate from a post-high school technical/trades institution
*** Graduate or post-graduate level
[a,b,c]Groups in each row that share a superscript are not significantly different from each other.

d. Region of Origin

Surprisingly, the statistical results provide no indication that the variable *region of origin* uniquely affects reported levels of satisfaction with any of the QOL domains. These results suggest that, regardless of where they come from, respondents have similar perceptions of their living situations in all 3 case study communities. These findings challenge the assumption that northerners would more easily adapt to life in the region or have a more positive outlook of their surroundings. In fact, further interpretation of these results suggests that it is not any easier to satisfy northerners than it is to meet the expectations of migrants from other regions. In a sense, most employees are migrants: since development in the region is so recent (i.e., is has only taken place for about 25 years), it is hard to find adults who have spent most of their lives in one of the case study communities.

It seems reasonable that further investigation into this matter would include the examination of the individual indicators of each quality of life domain. This investigation could result in more findings that could be used to identify approaches to recruiting campaigns designed to entice workers to remote areas.

An evaluation of the use of the variable *region of origin* suggests that other, more relevant variables could have been used—e.g., variables related to size (population) or nature (rural, urban, major urban centre) of the community of origin.

e. Job Class

The statistical analysis of the questionnaire data does not indicate that *job class* uniquely affects the reported levels of satisfaction with any of QOL domains.

f. Area of Work

Similar to *job class*, *area of work* does not appear to uniquely impact the reported levels of satisfaction with quality of life. It is important to note that this variable was added to reflect a specific interest from the Vale staff involved in the questionnaire development. The intent was to explore the perspectives of the operations' workers— who often work in shifts —and employees whose work routines follow more traditional schedules. To that effect, *area of work* did not uniquely impact respondents' perceptions of quality of life, but could in fact affect responses to each individual indicator. The effect of *area of work* on indicators could also be the focus of further investigation.

g. Length of Employment

The variable *length of employment* seems to only uniquely impact the respondents' satisfaction with the work domain (Table 5.9). The only suggestion from the data analysis is that respondents who had been working for Vale for one year or less reported higher levels of satisfaction with the work domain than respondents who had been working for the company for between 3 and 15 years.

The results appear to indicate that recently hired individuals (i.e., those who had worked for the company for 1 year or less) are more satisfied with the work domain then employees who have been employed for much longer. Respondents who had been working for Vale for more than 15 years reported satisfaction levels that were not statistically dissimilar to those of other *length of employment* categories. Therefore, these results suggest but do not provide an unambiguous indication that satisfaction with the work domain decreases with length of employment. More in-depth investigation and the qualitative examination of the reasons for such results would be necessary to provide more definitive conclusions regarding the relationship between *length of employment* and satisfaction with quality of life in these communities.

Because this research did not focus on *work satisfaction* or *quality of work life (QWL)*, but on work as a domain of quality of life, findings related to the work domain are limited in nature. In further research, qualitative interviews would include questions directed at *work satisfaction* factors or indicators and would be supported by the vast amount of literature available on work satisfaction or QWL.

h. Length of Residence

Interpretation of the results of the statistical analysis of the questionnaire data indicate that in isolation, the length of time residents have lived in the 3 communities does not significantly affect their perceptions of quality of life. These results were somewhat surprising. Qualitative data analysis, however, suggests that this may vary depending on the community of residence.

While *length of residence* in Canaã and Parauapebas seems to impact perceptions of quality of life in a positive way, the satisfaction of residents of the Núcleo generally seems to decrease with time.

Participants' perceptions appear to be that both Canaã and Parauapebas are improving as communities. Parauapebas has grown from a remote and isolated town to a busy small urban centre where businesses thrive and offer a variety of goods and services. The very nature of the community seems to be slowly changing over time, from a "wild west" town to a more mature community. As described by a male contractor's employee who has visited Parauapebas many times throughout the years:

> *"The first time I came here, Parauapebas was a 3-street village. On Main Street, all you could find were whorehouses and bars. Right by Vale's entrance gate, they had facilities to select people who were coming from everywhere looking for work. They would basically wash them down here before they were able to go up the mountain. Things have changed. As time went by and people settled down and had kids, things started to improve because they would care more about the community. They want something better for their families, so they brought a better sense of decency and morality to the place."*

Consequently, even though Parauapebas still, in the eyes of newcomers, has a "wild west" feel, individuals who have been familiar with the community since its inception, when the Carajás Mines were first being developed, have different views. Indeed, it is probably fair to say that even though rampant population growth is one of the reasons why this municipality does not

seem to be able to cater its population's needs, this growth has also resulted in steady development; and although this development has so far not managed to keep up with the ongoing population growth, it is still perceived by many to be a step in the right direction in terms of improving the general quality of life in this community.

In the case of Canaã, the perception of continuous improvement seem to come from the fact that investments are being made incrementally; and while change seems to be slow paced, clear improvements, particularly to the physical environment, have been accomplished since development of the Sossego Mine began.

i. Housing Status

The results reported in Table 5.11 suggest that individuals living in company-provided accommodations are the most satisfied with the environment domain, followed by individuals who are homeowners and renters.

The most significant finding in the investigation of how housing status impacts satisfaction levels with the environment domain is that employees living in company housing in the Núcleo and in company homes in the Sossego Camp in Canaã tend to perceive their physical environment more positively than employees without housing benefits. This finding is certainly reflective of the housing shortages and low quality of housing observed in the 3 case study communities.

j. Dependent Children

The variable *number of dependent children* seems to uniquely impact the respondents' satisfaction with the social and environment domains. As illustrated in Table 5.16, data analysis indicates that respondents who have children are generally slightly more satisfied with the social domain than those respondents who do not. Similarly, as illustrated in Table 5.13, results suggest that satisfaction with the environment domain increases slightly with the number of dependent children one has, with respondents with no children reporting the lowest levels of satisfaction.

Data analyses results also indicate that the levels of satisfaction for social and environmental domains increase with the number of dependent children, with individuals with no children

reporting the lowest levels of satisfaction in both domains. However, in both cases, the differences in mean are very small, of less than 1 point on the 0–10 point scale.

Specifically, employees with children appear to be more satisfied than childless employees with the following indicators: *access to nature*, *order, cleanliness and security*, *basic infrastructure*, and *services and goods available* (environment domain); and *love life*, *educational opportunities* and *participation in community events* (social domain).

Investigation of the means for the social domain indicates that satisfaction levels are above neutrality (around 6), and that the more dependent children a respondent has, the higher their satisfaction levels with the social domain tend to be. Since the indicators for personal relationships (i.e., family, friends, and love life) were the highest rated indicators for the social domain across the board, it is suspected that these results might be a reflection of the cultural value placed on familial relationships, with satisfaction with personal relationships increasing with family size.

k. Marital Status

While *number of dependent children* seems to uniquely affect views of quality of life, statistical analysis of the questionnaire data did not indicate that the variable *marital status* uniquely impacts the reported level of satisfaction with any of the 5 QOL domains or AQOL.

6.5. Opportunities to Improve Quality of Life in Remote Mining Communities

The opportunities for intervention identified in this research stem from findings discussed in this chapter and from the coding of the interview question about suggestions or priorities for intervention in each community, which are summarized in tables 5.26, 5.29, and 5.32.

There are a few clear inferences that might direct mining companies towards specific areas of concern or further investigation, and local government and decision makers towards interventions and policy considerations that address remote mining community needs. This section provides a discussion of what these areas are and suggests approaches to intervention.

It is important to highlight the fact that there are expectations for continuous growth of the Carajás operation in close proximity to Parauapebas and the Núcleo Urbano de Carajás. Moreover, rapid and significant development of the area surrounding Canaã dos Carajás is expected with the upcoming long-term development of copper and nickel mining projects including a hydrometallurgical plant. The recommendations that follow are therefore also a reflection of the prospect of population growth and consequent need for proactive interventions to prepare both the case study communities and Vale for the long-term and sustainable development of the region.

6.5.1. Mining Companies

Opportunities to improve the quality of life for mineworkers in remote communities were identified as a result of this research. Even though some of the suggested interventions are directed specifically at the case study communities examined in this research and may seem context defined, some might be relevant for other companies operating in similar communities or areas throughout the world. Opportunities for intervention were categorized in 2 groups: a) addressing challenges to community quality of life and b) supporting new employees: implementing new-employee orientation programs.

a. Addressing Challenges to Community Quality of Life

<u>Empowering Mineworkers to Participate in Community-Related Decision Making</u>

One of the challenges of most resource communities, particularly “paternalistic” company-controlled mining towns, is that residents have little or no say in decisions that impact their lives and their families. This negative aspect of life in a mining community became very clear in findings stemming from the Núcleo Urbano de Carajás case study, and to a certain extent from residents of the Sossego Camp in Canaã dos Carajás. Several participants discussed the perception of oversight in the Núcleo and in the Sossego Camp and praised the freedom of living in their own rented or owned home.

Even though it is questionable that residents of Parauapebas and Canaã have a significant say in how their communities develop and are regulated, it is clear that the level of company control in the Núcleo is deemed unnecessary and undesirable. Some findings of this research support a change of the paradigm of governance in company-controlled towns to provide for a more

democratic and participatory model whereby residents would have a more empowered role to play in making decisions that affect the community and therefore their daily lives.

Reducing and Mitigating Impacts of Remoteness and Isolation

It has been recognized that feelings of isolation and inadequate social life are problematic for mineworkers living in remote areas and have resulted in cases of depression and incipient neuroses (Burvill, 1975). It is not surprising, therefore, that 2 of the greatest challenges in all 3 case study communities are their remoteness and isolation. These challenges are not particular to this research's case studies, but are certainly a common characteristic of natural resource exploitation communities in remote areas around the world.

Even though remoteness (i.e., the distance from urban centers or larger communities) cannot be easily mitigated, it seems reasonable to attempt to reduce isolation (i.e., the disconnection from other communities and lack of facilities and services) and mitigate its impacts. Among the 3 case study communities, the effects of isolation seem to be the most evident in Canaã dos Carajás. It seems that Vale could play a role in collaborative initiatives to mitigate challenges related to remoteness and isolation in Canaã by supporting the provision of temporary services to residents while the region's "growing pains" continue. Priorities could be identified by mineworkers who are Canaã residents, as well as by other employees who might be interested in moving there. The adoption of temporary services occurs in other remote mining accommodations around the world, such as fly-in-fly-out mining camps in South America, Australia, the USA and Canada, where facilities and services are provided to mitigate feelings of isolation as well as very tangible challenges of remote sites (Sibbel et al., 2006). In some of these camps, provisions exist for emergency health services and emergency transportation as well as regular transportation to and from larger towns. In the case of Canaã, similar transportation schemes could be set up to allow for easier travel to Parauapebas and/or Marabá.

Feelings of isolation are associated not only with physical, but also with psychological factors. A strategy to reduce and mitigate impacts of isolation in remote mining communities ideally would include initiatives related to access to communications systems, goods and services, and cultural, entertainment, recreation and education programs and facilities that have resonance with local community members.

Facilitating Access to Modern Means of Communication

A strategy to mitigate communication challenges would certainly improve the quality of life in remote communities, as it would facilitate the integration of the community in the regional and national context. It would also reduce residents' feelings of isolation and disconnection with the "outside" world. Better communication would enable residents to: a) maintain better communication with family living outside the region, b) maintain better communication with each other and thus feel less isolated and more engaged with the broader community, and c) be better informed and educated about issues that matter to their personal and professional lives.

Particularly in Canaã dos Carajás, where by the end of 2006 reliable and affordable Internet access was only available at the Sossego Copper Mine, better access would also facilitate the pursuit of education opportunities and enrollment in professional development programs.

Better access to telephone services in the Núcleo, Parauapebas and Canaã would certainly improve residents' ability to communicate within their community and with family and friends elsewhere. Because conventional telephone lines are typically expensive to acquire and maintain in Brazil, it seems that most individuals are opting to purchase a mobile phone and "pay-as-you-go" phone cards to communicate locally as well as to make long-distance calls. Even though this is generally perceived as a more affordable option than a traditional landline, mobile phones are still expensive and therefore not a viable option for many people living in the case study communities. At the end of 2006, when data collection for this research was completed, many individuals living in these communities would buy a mobile phone but often were not be able to use it regularly because they could not afford to refill their phone cards. Moreover, mobile phone service in this region is often unreliable, as is the availability of phone cards in service stores.

There are, therefore, opportunities for company support for the development of regional communication systems that are affordable and effective for the entire region, creating stronger connections regionally as well as with the rest of the country. This should not only improve quality of life in the region but also corporate communications overall.

Improving Physical Access to Remote Communities

As observed in resource communities throughout the world, the remoteness of the 3 case study communities implies limited access to and great difficulty in mobility for residents and visitors. This is an enormous challenge for workers who migrate from other regions and aspire to be able to regularly travel back to their home communities. This is also certainly a challenge faced by remote mining communities worldwide.

Some very specific suggestions can be made to improve physical access to the case study communities examined in this research. While Canaã dos Carajás can only be accessed by road, Parauapebas and the Núcleo are accessible via railway and aircraft as well as by road. Access to these 2 communities could be improved with better long-distance bus service, an increase in the number of publicly available flights to larger centers such as Belém (where connecting flights could be taken easily), and better rail service, which is currently notorious for its low quality and dreadful train conditions. A short local survey should be able to capture the residents' needs and provide for better definition of priority destinations.

For the community of Canaã, however, access is still a significant challenge. The closest airports are located in Carajás and Marabá (both more than a 2-hour drive from Canaã), and roads here are only partly paved and dangerous in the rainy season. Moreover, transportation services are limited to private van services, which are largely deemed as inconvenient, unsafe and overpriced. Significant improvements could be made to allow for easier access to Parauapebas (and to the Carajás airport located in the Núcleo) and to Marabá from Canaã. Reliable and safe roads as well as transportation services to these larger communities would certainly improve Canaã residents' ability to access both these and other destinations.

Enhancing Entertainment and Recreation Options

The lack of entertainment and recreational opportunities was a theme consistently present in interviews with residents of all 3 case study communities and is certainly a challenge common to rural and remote communities globally. Moreover, in the survey questionnaire, entertainment and recreation options were poorly rated across the board. Even though clear efforts have been made to provide employees with recreation centers and social activities, there is only so much company-related activities and facilities can do to provide a variety of entertainment and recreation opportunities to residents in remote communities.

The benefits of regular, long-term physical activity to human beings of both genders and all age groups are evident in the literature, and positively impact several QOL life domains, especially the social and health domains (Biddle and Ekkekakis, 2005). Only a vibrant and diverse community can offer the variety of activities, events and facilities that could be satisfactory for a diverse and educated workforce. In Canaã and Parauapebas, Vale has ample opportunities to contribute to increasing the number of entertainment and recreation options available to all local residents.

Even though the sports programs available at the Núcleo's recreation facility (*clube*) seem to be quite comprehensive and responsive to the community's needs, opportunities to expand recreation and entertainment programs targeted at children, youth, women and the elderly exist here. Some of the existing facilities, such as the Carajás theatre, seem to be underutilized. The *clube* offers an excellent swimming pool and sports courts, but the facility could benefit from an expansion of its fitness and wellbeing programs. It is therefore suggested that Vale invest in a strategy to maximize the use of existing facilities through the creation of new recreation and cultural programs and the hiring of professional program managers. In Canaã, the suggestion is to take a similar approach with this community's *clube* facility and the *Casa da Cultura* (cultural centre).

A potential strategy to deal with the challenges posed by the lack of entertainment and recreation options available in remote resource communities involves the creation of community-based social committees. These committees would consult with local residents and identify gaps in and priorities for entertainment and recreation programs and facilities. These committees would also create and implement, in collaboration with the resource company/companies operating in the area, strategic plans to address the needs identified and provide for programs and facilities that are culturally appropriate and sustainable in the long term. Moreover, the company/companies could also provide support for existing community-based clubs and organizations that offer or promote healthy and safe entertainment and recreation options, in particular initiatives that take advantage of the region's natural surroundings (i.e., nature walks and hikes).

Improving Access to Culture and the Arts

Similar to challenges related to entertainment and recreation options, it is fairly obvious that the Carajás region as a whole is quite deficient in cultural facilities and programs. Isolation is reflected in limited access to arts and culture, and compounded with the generally low educational levels of the population.

Mining companies have the opportunity to promote the arts and culture locally by supporting local governments and community-based organizations in the delivery of arts and cultural programs. Companies can also provide support for the development of facilities such as libraries, galleries, museums and theaters, as well as art education at different levels. Similar to the opportunities to expand entertainment and recreation options laid out above, companies could support or even initiate the establishment of community-based committees or associations to lead discussions locally and work collaboratively with the resource-extraction company/companies operating in the region and local governments to implement cultural and arts programs.

Improving the Quality of the Physical Environment

In western society, it is well understood that the physical environment and living conditions are critical to health and general quality of life. In fact, the social qualities of a place and its potential impacts on health are generally considered more important than its physical features (Frumkin, 2003). “Place” is also a social *construct*—it is a product of risks and opportunities, the nature of the social organization associated with it, the political, social and economic relationships with other locales, the psychological social features of the individuals living in the place, and the local culture (Fitzpatrick and LaGory, 2000). Perceptions of the quality of the physical environment are also dependent on individuals’ experiences within and expectations of this environment.

It is apparent from that the findings of this research that mineworkers are generally not satisfied with indicators that define the environment domain in this study. Even though differences do exist among the 3 case study communities, across the board, employees reported very low levels of satisfaction with the environment domain, which includes indicators related to physical amenities and natural qualities as well as goods and services available.

These results clearly demonstrate that physical improvements to all 3 case study communities are acutely needed. In particular, services available to each of the communities as a whole, such as entertainment and recreation facilities, access to modern communication and information, and transportation options require a great deal of improvement. In Parauapebas and Canaã, the lack of basic infrastructure (along with health care services) seems to be critical and a source of significant frustration among employees living in Canaã.

Opportunities to improve entertainment and recreation facilities, access to modern communication and information and transportation options are discussed elsewhere in this section. The discussions that immediately follow focus on other physical improvements to the 3 case study communities, such as basic infrastructure (specifically, roads, water supply and distribution, power supply and distribution, as well as sanitation—wastewater collection and removal, and solid waste collection and removal).

Contributing to the Improvement of Basic Infrastructure

It is apparent that of the 3 case study communities, satisfactory access to basic infrastructure is only available to residents of the Núcleo Urbano de Carajás. One cannot overestimate the importance of reliable access to drinking water, sewage treatment, and power to the quality of life in remote communities. Sanitation, specifically, is critical to both environmental and human health and can make a substantial impact on how people perceive their wellbeing. Therefore, it is suggested that Vale take a larger role in facilitating the development, expansion and maintenance of basic infrastructure in Parauapebas and Canaã dos Carajás. For the Núcleo, this infrastructure in considered satisfactory.

Because the construction and maintenance of basic infrastructure are mainly the responsibility of governments, it is suggested that mining companies operating in remote locations consider entering into partnerships with local governments and NGOs to identify needs and priorities for infrastructure improvement. This would in many cases facilitate the expansion of infrastructure that is reliable and supports the existing population and can be adapted to support increasing migration to remote regions.

Regarding the specific case studies examined in this research, it is important to note, that by the end of 2006, Vale had been actively involved in the expansion and development of urban

infrastructure in Canaã dos Carajás through agreements and partnerships with the municipality and through the Itakyra Foundation. This responsibility was a result of agreements that originated from the environmental and social impact assessment conducted for the Sossego Copper Mine.

Unfortunately, such assessment and negotiation processes did not occur and was not a requirement when the Carajás Iron-ore Mining Complex was developed. As a result, Parauapebas' infrastructure has not benefited from private-sector investment; necessary improvements and upgrades to this city's infrastructure were expected to be completed by the local government using money from taxes paid by Vale (da Silva, 1998). However, as it becomes clear that these tax revenues have not been sufficient to finance adequate improvements to Parauapebas' basic infrastructure and ability to provide a healthy environment and decent living conditions for general population, it is important that Vale intervenes. A clear lack of capacity within the community and its leadership, coupled with mismanagement of resources and possibly the loss of resources through corruption schemes, has created a situation in Parauapebas that deserves corporate attention. Vale could collaborate with the municipality and civil society organizations to better plan for infrastructure development, including better management of resources and budgets, definition of priorities and implementation of infrastructure programs, particularly in the newly developed areas of Parauapebas.

Addressing Housing Challenges

It has long been demonstrated that housing is an important determinant of health, and substandard housing is a major public health issue (Sharfstein and Sandel, 1998; O'Neil, 2000; Krieger and Higgins, 2002; Frumkin, 2003). A respectable body of evidence has been built associating housing quality with morbidity from infectious diseases, chronic mental illness, injuries, a range of psychological problems and poor nutrition (O'Neil, 2000; Frumkin, 2003).

Good-quality and adequate housing promotes the development of a broad range of fulfilling social interactions, resulting in a greater quality of life (Congress of Aboriginal Peoples, 1998).

On a regional scale, the housing issue is in the core of the livability[55] in the area where this research took place. As it became clear throughout this study, housing is a critical challenge for mining companies as well as municipalities and immigrants. Housing benefits are certainly well appreciated and critical to the success of a hiring program in the region. This became very apparent during interviews and through the analysis of survey questionnaire data.

In 2 of the case study communities, Parauapebas and Canaã dos Carajás, Vale has the opportunity to take a proactive role in fostering and participating in partnerships with local governments, civil society and multilateral organizations to develop healthy housing strategies and programs for the region as a whole. These partnerships would need to focus on affordability and livability (i.e., the environmental and social quality of spaces as perceived by users), avoiding the current model of affordable housing that has resulted in substandard housing, appallingly small square footages and inadequate services.

Also for Parauapebas and Canaã dos Carajás, it would be desirable for mineworkers to be involved in the design of company employee housing programs, and that these programs are expanded to mitigate the impacts of rising housing costs on new employees. Such programs could include a variety of options so that individuals could, as much as feasibly possible, be able to choose to live in shared accommodations (camp or shared house), rental houses, or rent-to-own schemes, which are already in place for Sossego Mine employees living in Canaã dos Carajás.

[55] ‘‘Livability” is a term closely associated with the term “quality of life”, and refers to the environmental and social quality of an area as perceived by residents, employees, customers and visitors. This includes safety and health (e.g., traffic safety, personal security, and public health), local environmental conditions (e.g., cleanliness, noise, dust, air quality, and water quality), the quality of social interactions (e.g., neighborliness, fairness, respect, community identity and pride), opportunities for recreation and entertainment, aesthetics, and the existence of unique cultural and environmental resources (e.g., historic structures, mature trees, traditional architectural styles). In the Urban Planning discipline, community livability is recognized as directly benefiting people, who live in, work in or visit an area, increasing property values and business activity, and it can improve public health and safety. Livability is largely affected by conditions in the public realm, places where people naturally interact with each other and their community, including streets, parks, transportation terminals and other public facilities, and so is affected by public policy and planning decisions (Alexander et al., 1997; Alexander et al., 2004).

Promoting and Facilitating Contact with Nature

Wellbeing research has long and repeatedly demonstrated that contact with nature has distinct benefits for human wellbeing (Burns, 2005). The literature on the health benefits of contact with nature reveals that views of natural landscapes can accelerate the recovery of post-operative patients (Ulrich, 1984). Contact with nature has been associated with fewer sick call visits among prisoners (Moore, 1982), improved attention among children with attention deficit disorder (Faber Taylor et al., 2001), and decreased mortality among senior citizens (Takaro et al., 2002). There is also evidence that contact with the natural environment improves emotional, cognitive, and values-related development in children, especially during middle childhood and early adolescence (Kellert, 2002). In the occupational realm, contact with the natural environment has been recognized as a stress reducer and work performance enhancer (Kaplan and Kaplan, 1995).

Since it is widely recognized that contact with nature provides a wide range of benefits to individuals, one would expect that remote communities located in environmentally privileged areas such as the Amazon would tend to offer more nature-related benefits to inhabitants' wellbeing. However, observations of the 3 case study communities examined in this research suggest that this is not necessarily true. Even though all 3 communities are located close to natural forested areas, it was these communities have limited access to green areas for recreation. Also, there is a clear lack of public green spaces in urban areas. Safe access to the natural forest, such as interpretive trails and camping areas, are practically non-existent.

The evidence from the literature and the research findings has important potential implications for the design of the built environment in remote mining communities. In some remote regions, the natural environment could be one of the attractions for individuals interested in recreational activities related to the wilderness. In the specific cases of this research, it would be beneficial if Vale collaborated with Instituto Brasileiro do Meio Ambiente (IBAMA) or other environmental organizations to improve recreational and educational access to the Carajás National Park as well as other natural areas in closer proximity to Canaã dos Carajás. Moreover, urban design of new developments, as well as architectural design of housing and workspaces in the region, should include the integration of gardens, including community orchards and vegetable gardens.

Improving Access to Goods and Services

Some of the biggest challenges of life in remote communities involve the difficult access to a variety of goods and services, and the high costs of goods that travel long distances to arrive at local commercial venues.

Even though much of what is required for the availability of goods and services in remote locations is probably out of company control, there still exist opportunities for corporate interventions. These could include, for example, the establishment of communication and collaborative work with private service providers like banks and insurance companies. Mining companies could also support capacity building—i.e., the development and of local services and business that would increase the quality and variety of available services and thus reduce frustration with the lack of services or the low quality of existing services.

In the Núcleo Urbano de Carajás case study, increased competition or rental subsidies could result in lower prices for basic goods. The limited availability of goods could arguably be mitigated by good on-line purchasing systems supported by good-quality and reliable mail and transportation services. All of these would imply an investment in strengthening the institutional capacity in the region, as well as capacity building in the small business sector.

Improving Health

Promoting Improved Access to Health Care

Access to health care is a major problem for all communities in southern Pará. The Carajás area actually seems to have an advantage in comparison to the rest of the state (except for the capital, Belém) in regards to health care. This advantage is, however, only obvious for residents of Parauapebas and the Núcleo Urbano de Carajás, who have access to public facilities and well as high-quality private facilities such as the Yutaka Takeda Hospital, located in the Núcleo. In 2007, just after this research was completed, the population of Canaã was finally able to access the private facility which was constructed by the Itakyra Association and includes some beds available for public health access.

The major challenge related to health care in the region seems to be that public facilities are under-equipped and under-staffed relative to the population they are supposed to service. According to qualitative data collected in this research, these facilities also seem to have been serving regional populations, with people from other communities traveling from outside of Parauapebas to use the medical facilities located in this community.

Promoting Preventive Health

Preventive health is a significant issue largely overlooked in the region. The focus of the few existing health services is certainly illness treatment, and very little effort seems to be put into illness prevention. An important aspect of preventive health is a healthy environment—both natural and human-made. The links between lack of basic infrastructure and illness and disease are clear in the literature (Krieger and Higgins, 2002), as is the link between community design and land-use choices and public health (Dannenberg et al., 2003), and, as discussed earlier, the association of housing quality with major public health issues (Howard, 1993; O'Neil, 2000; Frumkin, 2003). Moreover, air pollution and other environmental contamination are direct and severe threats to human health, particularly in locations where health care services and facilities are precarious, such as in Parauapebas and Canaã dos Carajás.

The problem of housing mould and dampness, for example, is critical throughout most of the Amazon region. Damp and mouldy housing is associated with asthma and other chronic respiratory diseases, even after potentially confounding factors such as social class, smoking, income, crowding and unemployment are taken into consideration (Peat et al., 1998; Bornehag et al., 2001). It is therefore critical that this problem is addressed as part of a preventive health strategy.

The combination of insufficient health care and significant environmental health threats (e.g., pollution, lack of waste collection or sewage treatment), along with the psychological challenges posed by the feelings of isolation and work stress typical of occupational communities, make the region quite vulnerable.

Another important aspect of preventive health is education. Mining companies in remote locations are generally in a position to promote health education and preventive health care in

the regions in which they operate by making it a priority in its corporate policy as well as by promoting it as a priority for contractors' policies and lobbying local decision makers.

Improving Access to and Quality of Education

Education is often a significant challenge for mining workforces because of the typical remoteness and early stages of development the communities in which they reside. For example, the largest city studied in this research, Parauapebas, is only about 19 years old and has very few educational facilities, as highlighted several times throughout this thesis. Even though Vale has made efforts to improve the opportunities for training and education in Parauapebas, these have clearly failed to meet the expectations of the employees as well as the mining company itself.

Vale's policy to support the professional development and education of current employees seems to be highly regarded by employees. However, the options seem to be quite limited. In the case of Canaã residents, access seems to be an additional problem, since free and reliable Internet access is, for most employees, only available at the mine site.

Vale recently entered into a partnership with the Federal University of Pará to create a Mining Engineering and Environmental Management Program in the city of Marabá, which is located about 3 hours from Canaã and almost 5 hours from Parauapebas. This program is expected to help Vale fulfill its needs to hire locally, but it will hardly meet the needs of current employees. It seems clear that mining companies and workforces would benefit from focused education programs made available to all employees. To mitigate the specific situation of the 3 research case studies, it is suggested that Vale enter into further agreements with local universities and colleges to bring more relevant courses to Parauapebas and Canaã dos Carajás. Both university-level and technical-level training are necessary to meet the needs of the area's mining industry, of the local population and of sustainable economic and regional development.

Another area of intervention that would be of great value to the community and could certainly bring benefits to mining companies operating in remote areas in the long term is the local K–12 education. There is a wealth of knowledge and experience within the mining workforce and their families that could be imparted if these individuals participated in voluntary programs in local schools to improve the community's understanding of mining and mining processes, as

well as other general subject matters. Such programs would not only improve the quality of education in the community, but also promote better integration of mineworkers and the community as a whole.

Promoting Work-Life Balance

It is apparent that one of the great challenges to quality of life in each of the 3 case study communities is the ability to balance work and personal or family life. This is not an issue unique to life in remote mining communities, but it is a significant challenge for individuals living in a single-industry town, particularly for those in company-town style communities such as the Núcleo Urbano de Carajás.

There are several ways in which mining companies around the world could equip themselves to support employees in achieving a healthy balance between work life and family life. Interventions could and should address the need to improve entertainment, recreation and cultural facilities and programs and opportunities highlighted under recommendations 3 and 4.

Adopting Workplace Policies that Support Work-Life Balance and a Healthy Lifestyle

It was highlighted throughout the qualitative data collection in this research that the nature of the industry and proximity to the workplace has resulted in a general feeling (particularly for those living in Carajás) that employees need to work after hours and on weekends, and be available to the company at all times. Mining companies operating in remote areas (particularly when company towns and mine camps are the chosen settlement model) should adopt clear corporate policies that discourage managers from requiring subordinates to work overtime or after hours, and that give flexibility to employees who have family elsewhere to be able to reach or travel to them in emergency situations. Other policies could include measures to support employees going through demanding life events such as weddings and childbirth.

Healthy lifestyle policies could potentially encourage employees' involvement in after-work activities that have wide health benefits, such as sports and/or other mind-body activities like yoga and meditation.

Promoting the Integration of the Workforce with the Local Community

Another means to promote a balanced lifestyle is through the integration of resource-extraction company employees with the community in which they live, allowing for a greater degree or empowerment and citizenship. A closer integration would benefit both the community and the individual employees.

For the Núcleo Urbano de Carajás, greater integration would result from better access and transportation to Parauapebas, as well as a wider access to the Núcleo for Parauapebas residents. Even though employees demonstrate conflicting opinions about the "opening of the gates"[56] (major concerns relate to the loss of the sense of security and an increase in traffic volume in the Núcleo), it seems that increased access would enrich the life of residents of both the Núcleo and Parauapebas. Other means of supporting this integration could involve volunteer programs and more structured participation of mineworkers in decision making through political activity and advocacy, or the creation of social capital through associations, clubs and other civil society organizations.

Establishing Accommodations Standards for Contractors' and Suppliers' Workforces

Mining companies worldwide are increasingly tending to change their human resources strategies to reduce the number of employees and increase the use contractors' workforces. Vale is no exception. Consequently, increasing numbers of contractors' crews are moving to mining communities close to where they work, often without much housing support or orientation programs. In order to improve the quality of life of the community as a whole and reduce disparities between mine employees and contractors' workers, mining companies should define or suggest operating standards for their contractors and suppliers. In the case of Vale's Northern System, health and safety standards are in place. However, there seems to be no

[56] Utterly open access is, however, not a realistic option because the Núcleo is located inside a National Park. Park access is controlled, but not closed. As of the end of 2006, access to the Núcleo is only possible with authorizations provided by Parauapebas' municipal government, Vale, employees residing in the Núcleo and individuals who had bank accounts in the banks located in the Núcleo. Another way to access the Núcleo is to buy a movie ticket to the cinema located in the community. In addition, access via airplane or helicopter remains uncontrolled. Since late 2006, access to the National Park has been open to general public for a small fee, not without controversy among residents of the Núcleo who wanted to preserve their privacy and were concerned about security issues. According to residents of the Núcleo, the volume of people entering the community increased slightly once park access was made more available.

articulated expectations regarding how these contractors address their employees' living conditions or the needs of the communities in which they live.

b. Supporting New Employees: Implementing New-Employee Orientation Programs

It is apparent that for many Vale employees, the physical and social environments in the south of Pará are both intriguing and challenging. These challenges are definitely not unique to Vale or to the workforce examined in this research. For many mining operations in remote locations, the remoteness, different social structures and local cultures, and often-challenging environment create difficult conditions to which new employees need to adapt if productivity and safety are to be maintained and continuously improved.

It seems critical that any mining company operating in a remote location develops and implements a strategy to support new employees and their families when they are moving to remote locations.

Orientation programs have been recognized as an effective means to mitigate the initial difficulties faced by new employees in several industry sectors worldwide. In the case of mining in remote locations, these programs seem to be of critical importance, but are surprisingly rare.

Firstly, it is important that during selection programs for key positions, prospective employees are able to visit their future community of residence along with their families so that an educated decision can be made about what could be a major change in family life. Full orientation programs, including mentorship and counselling programs, should be offered to employees, spouses and children.

Even though the feasibility of pre-employment programs may be limited to key positions, it is recommended that new employee and new resident orientation and support programs be offered to all employees (and their families) joining the mining workforce in remote locations. Findings from this research reveal that a wealth of experience and knowledge of coping skills and strategies exists within the current mining workforce in the 3 case study communities. These individuals could be excellent mentors if they were to participate in peer support programs.

6.5.2. Local Governments

It seems that constant immigration and consequent population increases in mining areas such as Parauapebas and Canaã dos Carajás has been a great barrier to the development of healthy, well-planned and safe resource-based communities in remote areas around the world. In Parauapebas and Canaã dos Carajás, it is apparent that the quality of basic infrastructure and public and community services, particularly health, education and security, require the immediate attention of local authorities.

In Parauapebas, the intense migration, poor management of public resources and lack of planning has resulted in an unsafe and unhealthy urban environment. Newcomers are often taken aback by the dramatic difference between the well-planned and clean Núcleo and the fetid, noisy and unsafe urban environment in Parauapebas. It is not surprising that even though life in the Núcleo Urbano de Carajás seems a bit monotonous to many, living in Parauapebas is an undesired and often feared option. In Canaã, the lack of reliable health care services and inequality in the delivery of education is evidently a major concern for both mineworkers and other residents.

a. Working towards Sustainable Development

Sustainable development has been widely defined as development that meets the needs of the present generation while making sure that future generations will be able to meet their needs (Bruntland, 1987). Unfortunately, the current reality of the Carajás region as a whole includes the extraction of resources, unplanned development, rapid urbanization and extensive environmental devastation (Godfrey, 1990; Hecth and Cockburn, 1990; Browder and Godfrey, 1996; Barros et al., 2002). There is very little evidence here of development that takes into consideration the needs of future generations or preservation of the natural environment.

Sustainability has been described as a process that includes ecological, social, cultural, and economic dimensions (Berkes et al., 2005). Even though statements that refer to these dimensions are presented in the websites and charters of local government and corporations, there is very little evidence that these are taken into consideration when decisions are made in the 3 case study communities. It seems that a clear focus remains on exploiting natural

resources to create wealth with little consideration for equality, environmental stewardship, or social, community or institutional development.
The first opportunity identified for local governments is therefore to focus on sustainable development and environmentally sensitive land development with the goals of minimizing dependence on auto transportation, reducing air pollution, and making infrastructure investments more efficient. Short-term and long-term priorities need to be set along with a clear identification of goals and ways to achieve these goals. Sustainable development in this context would also imply the consideration of economic diversification strategies that would provide for viable communities once the operating mines have been permanently closed.

Even though national and local statistical data indicate that the 3 case study communities rate relatively well in social indicators including the Human Development Index (HDI), as described in Chapter 2, it is apparent from findings of this research that there are acute needs that should be addressed immediately. Obvious areas of concern requiring immediate intervention are the deficient infrastructure (particularly drinking water and sewage treatment) and local public services, such as policing and public transit.

A potential strategy is for local governments (at both the municipal and state levels) to establish public-private partnerships with national and international organizations as well as private corporations in the region to address some of the pressing issues identified in this research. As noted before, the areas of priority seem to be related to basic infrastructure, health care and illness prevention and environmental management. Critical needs exist in the areas of basic and emergency health care, basic sanitation and waste management, and pollution prevention. The partnerships could address some of these short-term critical needs as well as increase capacity in the communities to develop long-term strategies to improve quality of life and of the environment of the region as a whole.

b. Improving Local Infrastructure

Along with income, social status and the existence of strong social support networks, a healthy human-made environment is a key determinant linked to enhanced physical and emotional health (Krieger and Higgins, 2002). Features of substandard infrastructure, such as a lack of drinking water, ineffective waste disposal, and the existence of disease vectors such as insects and rats attracted by open sewage have long been identified as contributing to the spread of infectious diseases (Marsh, 1982; Mood, 1993). Findings stemming from this research indicate

that severe basic infrastructure needs exist in Parauapebas and Canaã dos Carajás. As would be the case in any other community, the health implications of this problem are far reaching, affecting mineworkers as well as other community members.

Immediate interventions are necessary to implement infrastructure improvements regarding sanitation, drinking water, waste disposal, and proper sewage treatment in Parauapebas and Canaã dos Carajás, particularly in the most recently developed residential areas.

c. Adopting Municipal Collaboration and Cross-Sectoral Planning

The integration of various municipal departments to collaboratively analyze and attempt to solve problems is critical for remote communities. Most of the challenges identified with this research are interrelated, such as health and environmental issues. The traditional compartmentalization of sectors in municipal government—health, education, transportation, etc—does not promote collaboration and often reduces the government's ability to address major issues, such as preventive health and housing, in a holistic and integrated way.

The development and implementation of municipal bylaws and guidelines should be achieved with the collaboration of government agencies that regulate, design and implement programs in the diverse areas of focus suggested in this research. Of crucial importance are the areas of basic infrastructure, health, education, housing, transportation, security and environmental health.

d. Establishing Participatory Planning and Transparency

Among residents of the 3 case study communities, there is a general belief that mining royalties paid to Parauapebas have been largely used by politicians to benefit their own interests, to the detriment of the needs of a booming town. It is also evident that corruption is an unspoken rule among political leaders and law enforcement personnel. The topic of corruption is a very complex and often overwhelming issue to address, and it has historical roots in the south of Pará. However, corruption in itself is not particular to this region of the state.

It is outside of the scope of this research to suggest strategies to overcome corruption in the region. It is believed, however, that shared decision making, transparency and accountability are areas that deserve particular attention from policy makers and local governments in this

region. It is critical that participatory Official Community Plans (OCPs) and municipal budgets are deemed priorities and get the resources and focus needed to properly develop them.

e. Developing a Public Housing Strategy

The issue of housing is relevant to all of the predictors of quality of life in remote mining communities identified in this research (i.e., the economic, environment, social and health domains). Therefore, it seems reasonable to suggest the development of housing strategies that address the needs identified in this research. Specifically, these needs are identified as human and environmental health concerns, affordability, security, livability and services. It also seems reasonable to expect that such strategies would include cross-sectional collaboration.

Another common problem with housing in booming communities is overcrowding. While this research was being conducted, this issue was observed mostly in Canaã dos Carajás and in Parauapebas, but also, though to a lesser extent, in shared housing in the Núcleo. Overcrowding is generally considered as more of a threat to mental health than to physical health, though the spread of infectious diseases such as tuberculosis (Britten, 1941; Schmitt, 1955; Coetzee et al., 1988), and scabies[57] (Green, 1989) have been associated with overcrowding. Other infectious diseases commonly linked to overcrowding include meningitis (Ghipponi et al., 1971; Stuart et al., 1988) and measles (Aaby et al., 1984).

The adverse psychological effects of overcrowding seems to be a result of the lack of personal control over available living space, rather than the actual limited size of the space (O'Neil, 2000). Privacy and circulation within residential dwellings are deemed to be significant factors for psychological wellbeing (Chapin, 1951; Loring, 1966). In a review of several studies of crowded conditions in public housing in Britain, Hopton and Hunt (1996) concluded that crowding has an adverse impact on mental health by enforcing undesired social contact. Other studies found that emotional distress in women increases significantly with overcrowding (Gabe, 1987) and that crowded living conditions negatively affect children's mental health (Platt et al., 1989).

[57] A contagious skin disease caused by the microscopic itch mite, *Sarcoptes scabiei,* which burrows under the skin (Green, 1989).

It seems critical that the issue of overcrowding in the Carajás region be addressed in housing strategies that take into consideration the specific needs of each of the 3 case study communities. Considering that the demand for accommodations for mineworkers and their families will continue to grow, the creation of strategies to accommodate people in efficient yet healthy living arrangements is imperative. It is of critical importance that local and external employers are able to provide residences for employees and their families without risking their health by housing them in overcrowded and unserviced buildings. Even though it is often the responsibility of employers to provide their workforces with suitable living arrangements, local governments everywhere should take their regulator and enforcer roles very seriously when housing is an issue.

6.5.3. Opportunities for Policy Development

Even though recommendations made to local governments can have policy implications at the municipal and state level, the suggestions for policy makers as defined here focus on the improvement of the federal Environmental and Social Impact Assessment Process for natural resources development in Brazil.

Because this research did not intend to analyze the current Environmental and Social Impact Assessment process in Brazil, the 2 recommendations made here for policy makers stem from a reflection on some of the findings of this research, namely the lack of clarity about private and public sector roles in providing for quality of life and the unintended negative impacts of natural resources development in remote and environmentally sensitive regions.

a. Defining the Roles of the Private and Public Sectors

There seems to be a need for policies that will more clearly define the roles of private and public sectors in mega development projects in the Amazon. This research provides evidence of the devastating results of a national strategy to exploit natural resources from a remote, environmentally sensitive site, marked by severe social conflicts over land and access to natural resources, and with a significantly large native population.

It appears that the combination of a lack of transparency and a lack of local government accountability has had a severe impact on development in Brazil's Northern region. It can be

argued that the massive and rapid development occurring in this region also warrants state and federal government support, which has been very limited. It seems clear that the municipalities alone, despite the royalties they receive from resource-extraction companies, are not equipped to deal with the complexity and scope of community development that needs to occur to effectively support the development of several mines in such an extensive and largely underdeveloped area. Even with contributions from major private sector players such as Vale, there is an obvious need for a national, or at least regional, strategy to address development in the Amazon.

It is argued here that the roles and responsibilities of the proponent (industry) and of the 3 levels of government (municipal, state and federal) are clearly defined in the early stages of major project developments as well as in smaller projects occurring in the Brazilian Amazon. It is important that every player be aware of its role and that the individual roles of the private and public sectors are clearly communicated to the general public, particularly the local communities most effected by development.

b. Adopting Integrated Assessment Models that Account for Cumulative Effects

There is a pressing need for the process of environmental and social assessment to address the fact that development in Brazilian Amazon has occurred and will continue to occur on a very large scale. It seems that The Great Carajás Project has failed to support sustainable economic, social and environmental development in the region, and has indirectly spearheaded rampant devastation of surrounding forests (Godfrey, 1990; Hecth and Cockburn, 1990; Barros et al., 2002). The cumulative impacts of several mines in the region—owned by Vale or not—have not been addressed in an integrated manner, and therefore have not been dealt with in a sustainable manner.

This research's findings support the argument for an environmental and social impact assessment process that will include a full and integrated consideration of the economic, environmental and social impacts of the migration to and consequent intensification of the already rapid urbanization of the Brazilian Amazon.

6.6. Other Considerations

6.6.1. Reflecting on Concepts of Quality of Life and Life as Whole

The findings from the questionnaire data analysis suggest that there is an unambiguous difference between how participants define QOL and LAW. Interpretation of these findings indicates that economic, social, health and environmental factors seem to be the main determinants of satisfaction with QOL in the sample population, while work and economic factors are the main determinants of satisfaction with LAW.

It is arguable that one's satisfaction with life includes more subjective and individually defined issues that are related to personal values and expectations, and that it is less associated with the particular conditions of an individual's community of residence. However, while also dependent on individuals' personal values and expectations, QOL satisfaction is more closely associated with the realities of the location or environment in which individuals live. In this sense, QOL is a concept or a goal which corporate and public policy can more directly affect.

6.6.2. Defining Quality of Life Domains

Triangulation of results suggests that 4 of the 5 domains—social, economic, health and environment—can be considered a first-level deconstruction the QOL concept and therefore conceptually adequate QOL domains.

In the sample populations of this research, however, the work domain does not uniquely predict satisfaction with quality of life. This might be attributed to the lack of variation in the means of the work domain in this single-employer population—it is possible that the single-employer aspect of the domain restricted the range of possible scores, resulting in little variation. The inclusion of individuals who were not employed by Vale in the analysis might had improved understanding of the relationship between the level of satisfaction with work and satisfaction with QOL within these case studies.

Data analysis supports its consideration as a LAW domain in the same population.

6.6.3. Reflection on the QOL Questionnaire and the SWI Pilot Test

Findings suggest that the QOL questionnaire used to gather data for this research is an adequate tool for measuring mineworkers' perceptions of quality of life in remote communities. The sample population included respondents who were residents of the 3 case study communities, each of which represents a distinct mining community model. For all 3 case studies, the questionnaire proved to have validity, and there was no evidence of cognitive problems. The validity of the QOL domains was also confirmed, and QOL questionnaire results were fairly well validated by data collected through interviews and participant observation.

The Subjective Wellbeing Index (SWI) pilot test also produced positive results. The correlations among the pilot-test short scale SWI (7 items), the Average Quality of Life (AQOL) (31 items) and the single-item quality of life (QOL) are strongly positive (Table 5.22). These results indicate a relative strength in the SWI scale and provide a rationale for pursuing further research to refine it and test its ability to be used in lieu of the 31-item QOL scale. Undoubtedly, further development and testing needs to take place before a shorter scale can be used to monitor perceived quality of life of mineworkers in remote locations.

CHAPTER 7: CONCLUSION

This chapter provides a summary of the findings of this research and is divided into 2 sections. The first section provides an overview of the findings regarding the perceptions of quality of life and the factors impacting quality of life (QOL) in the case study communities. It also summarizes the findings associated with the 4 research questions. The second section presents a reflection on the approach and methodological strategy used for this research, and summarizes recommendations for further methodological investigation.

7.1. Highlights of Quality of Life Findings

This research investigated the levels of satisfaction with QOL and specific QOL domains in 3 case study communities: the *company town* (Núcleo Urbano de Carajás), the *gate development community* (Parauapebas) and the *integrated community* (Canaã dos Carajás). This investigation resulted in the identification of priority areas for interventions by mining companies operating or planning to operate in remote locations, local governments, and other decision makers involved in resource development in remote areas.

7.1.1. Satisfaction with Quality of Life and Quality of Life Domains

Some of the statements that follow make reference to mean scores for levels of satisfaction with average quality of life (all QOL domains) and with specific QOL domains (all indicators in a single domain). The quantitative results are based on a 0–10 point scale of satisfaction and were supported and corroborated with the analysis of the qualitative data collected through interviews and participant observation.

a. Quality of Life

Research findings suggest the following:

- Even though the 3 case studies represent clearly different models of mining communities, in general, mine employees in the 3 case studies are only moderately satisfied with their

quality of life. Mean scores for satisfaction with average quality of life (AQOL) varied between 5.33 (just above neutrality) in the integrated community (Canaã dos Carajás), to 5.84 in the company town (the Núcleo Urbano de Carajás). This similarity is to due to the fact that means scores for satisfaction with AQOL represent an average of means of satisfaction with all five domains (without weighting), so even though some domains were scored differently in different communities, total mean scores were averaged.

- Employees living in 2 almost opposite models of mining communities—the company town (the Núcleo Urbano de Carajás) and the gate development community (Parauapebas)—seem to have similar levels of satisfaction with their AQOL. This finding suggests that the investment in infrastructure and services limited to the boundaries of the company town is not reflected in a generally improved perception of overall quality of life in this community.

- While there are no significant differences in how residents of the company town and the gate development perceive their quality of life, the residents of the integrated community are clearly less satisfied. This could be probably explained by the fact that the population of Canaã dos Carajás is currently growing at a very fast rate. This period of growth has been characterized by inadequate basic infrastructure and limited availability of goods, facilities and services, including transportation, education and, particularly, health care. The challenges associated with this boom are reflected in research findings in several quality of life domains.

- While there is some variance on how each case study community rated their satisfaction with the environment, health and work domains, ratings for satisfaction with the social and economic domain were quite similar in the three communities.

b. Social Domain

Research findings suggest the following:

- There are no significant differences among the levels of satisfaction with the social domain among the 3 case studies.

- Mine employees in the 3 case studies are only moderately satisfied (mean = 6.19) with the social aspects of their lives in their communities.

c. Economic Domain

Research findings suggest the following:

- There are no significant differences among the levels of satisfaction with the economic domain among the 3 case studies.

- Mine employees in the 3 case studies are only moderately satisfied (mean = 5.63) with the economic aspects of their lives in their communities.

d. Environment Domain

Research findings suggest the following:

- Even though significant resources have been dedicated to create a self-contained, self-sufficient and well maintained environment in the company town, residents of the Núcleo seem to be only moderately satisfied (mean = 5.58) with the environment domain.

- Employees living in the gate development community and in the integrated community are clearly dissatisfied with the environmental aspects of quality of life in their communities (means = 4.12 and 3.52 respectively). While the dissatisfaction with this domain in Parauapebas was certainly anticipated, the dissatisfaction in Canaã was not. This finding is probably due to the timing of the data collection for this research, since infrastructure expansion in Canaã has occurred very slowly. Even though significant improvements have been made to this community, it was observed and corroborated with interviews with mine employees that Canaã is widely perceived as a community which lacks the infrastructure and services necessary to properly support mineworkers' quality of life. It is expected that further research at a later date, when more infrastructure and services are available in Canaã would more adequately evaluate the performance on the *integrated community* model.

e. Health Domain

Research findings suggest the following:

- The levels of satisfaction with the health domain for residents from the 3 case study communities are just slightly higher or slightly lower than neutral.

- While no difference seems to exist in how Núcleo residents rated their satisfaction with the health domain when compared to the company town and integrated community's residents, residents of the gate development community are more satisfied with the health domain than the residents of the integrated community.

- Once again, the clear dissatisfaction of Canaã's residents with the health domain reflect the isolation and remoteness of the community and the lack of infrastructure and services characteristic of remote small communities. The rapid influx of migrants and workers seem to have put severe pressure on the existing infrastructure and services.

- Even though the medical services and facilities available in the Núcleo Urbano Carajás and Parauapebas are the best in the south of Pará, residents feel that these services and the quantity and quality of facilities and medical staff could be much better. The services in Parauapebas suffer from the lack of medical facilities, staff and equipment typical of remote communities. The challenge of providing health care to a rapidly growing population seems to be aggravated by the fact that people from other neighbouring municipalities also travel to use the facilities in Parauapebas.

f. Work Domain

Research findings suggest the following:

- Employees in the 3 case studies are reasonably satisfied (mean = 7.24) with the work-related aspects of life in their communities.

- Different levels of satisfaction with work-related aspects of life only exist between employees residing in the gate development community and those residing in the company town.

- Residents of the gate development community are slightly more satisfied (7.56) with work-related aspects of life than company town residents (6.85). Specifically, residents of the Núcleo are less satisfied with their workload, opportunities to grow professionally and empowerment at the workplace. This is clearly a reflection of their daily lives in a paternalistic and controlled social and physical environment. Another challenge identified in the company town was the intense stress employees seem to experience in their community. This stress is clearly a consequence of demanding work and work schedules, and of the difficulty to separate professional life from personal life.

7.1.2. Factors Affecting Satisfaction with Quality of Life

The objectives of this investigation included the identification of predictors of satisfaction with quality of life (QOL) in remote mining communities. The identification of predictors as general areas of concern should provide mining companies with a framework to conduct mine lifecycle planning in remote areas. It should also provide local governments and decision makers with a framework for evaluation and policy development for mine development in remote locations.

a. Main Factors that Appear to Impact Mineworkers' Quality of Life

Research findings suggest that mineworkers who live in the 3 case study communities define predictors of satisfaction with QOL differently; the Núcleo Urbano de Carajás, Parauapebas and Canaã dos Carajás each seem to provide distinct quality of life and life satisfaction models, with different combinations of predictors. Findings also provide a list of attributes that were identified as positive and negative aspects of the 3 communities (Table 7.1).

- The most appreciated attributes of the company town are associated with the quality of the physical environment and people's personal relationships, while the most satisfying attributes in the gate development community are associated with personal relationships and the abundance of work opportunities. The most appreciated attributes of the integrated

community were identified as personal relationships and the tranquility of the community lifestyle ("peace and quiet").

Table 7.1: Summary: QOL Findings in the 3 Case Studies

Characteristics	Company Town Model	Gate Development Model	Integrated Community Model
Approach	Paternalistic: • Company controls physical and social environments. • Company-owned and managed facilities.	Hands Off: • Limited and punctual support to development. • Little intervention in social or physical environments.	Collaborative: • Company contributes to development and promotes integration of the workforce with existing community
Predictors of Satisfaction with QOL	• Social domain • Economic domain	• Social domain • Health domain	• Economic domain • Health domain
Predictors of Satisfaction with LAW	• Environment domain • Economic domain	• Work domain • Economic domain	• Health domain
Most Satisfying Aspects	• Order, cleanliness and security • Access to nature • Quality of basic infrastructure • Personal relationships	• Personal relationships • Abundance of job opportunities	• Personal relationships • Peace and quiet
Least Satisfying Aspects	• Stressful environment • Challenge to balance work and personal lives • Lack of privacy • High cost of living	• High cost of living • Lack of order, high violence and insecurity • Lack of adequate waste management • Lacking basic infrastructure • Limited entertainment and recreation options • Inadequate health care • Limited educational opportunities • Limited social services available to the less advantaged	• Insufficient health care • Lack of entertainment and recreation options • Lacking infrastructure • Limited educational opportunities • High cost of living

- There is widespread concern over the high cost of living in each of the 3 case study communities. There is also agreement among all 3 communities that good personal relationships are significantly appreciated.

- There are similarities between perceived negative aspects of the gate development and integrated communities. Specifically, the lacking infrastructure and the challenges with health care and education, entertainment and recreation options warrant concern and intervention.

- The long list of negative attributes identified for the gate development community suggest that the "hands off" approach that resulted in this largely chaotic development at the gates of Carajás National Park has resulted in an alarming situation. Specific concerns include basic human needs for health care and a basic infrastructure that provides for environmental and human health as well as security and social equality.

b. The Impact of Mineworkers' Characteristics on satisfaction with QOL

In investigating the importance of the demographic variables to the perception of quality of life of mineworkers in the combined sample population of all 3 case study communities, the variable that seems to affect satisfaction the most is *educational level*. The educational level of employees impacted their responses even more so than their community of residence. These variables (i.e., *educational level and community of residence)* were the only variables that affected satisfaction with average quality of life (AQOL).

Research results indicate the following:

- In general, respondents with lower *educational level*s seem to be more satisfied with their quality of life and the social, health and work domains than respondents in the higher educational level categories. A possible interpretation of these results is that the expectations of the higher-educated individuals in the Carajás region's workforce are not being met, which in turn highlights the need to address these expectations as a means to recruit and retain a well-qualified workforce. Also, the apparent educational aspirations indicate that particular attention should be given to providing more education and professional development opportunities in the 3 case study communities.

- Employees' *age* appears to positively impact satisfaction with the environmental aspects of life. Older employees seem to be more satisfied with their surroundings and facilities and services available in their communities.

- The number of dependent children seems to positively impact satisfaction with both the social and the environmental domains. Specifically, employees with children appear to be more satisfied than childless employees with the following indicators: access to nature, order, cleanliness and security, basic infrastructure, and services and goods available (environment domain); and love life, educational opportunities and participation in community events (social domain).

- Employees living in *company-provided accommodations* (family housing, shared single housing, camp and hotel) appear to be the most satisfied with their surroundings and available facilities and services, followed by *homeowners* and *renters* respectively.

7.2. Highlights of Methodological Findings

7.2.1. Quality of Life Domains and Indicators

The investigation of QOL domains included the analysis of the data collected from the entire population sample, including residents living in each of the 3 case study communities. Research findings suggest the following:

- Even though life in mining communities is dramatically impacted by residents' work, findings from these case studies do not support the initial hypothesis that work is a QOL domain in remote mining communities. However, as findings indicate that work could be considered as a Life as Whole (LAW) domain, it appears that work could be considered a determinant of life satisfaction in remote mining communities.

- The indicators chosen for the economic, social, environment and health domains and indicators seem to be valid for the target population. Validity was confirmed with QOL

questionnaire results and supported by data gained from interviews and participant observation.

7.2.2. Quality of Life Questionnaire and Subjective Wellbeing Index Pilot Test

Research findings suggest the following:

- The 31-item QOL questionnaire appears to be a reliable and valid tool for evaluating and monitoring mineworkers' quality of life in remote communities. The QOL questionnaire proved to have validity. There was no evidence of problems with respondents' understandings of the questions, scale or instructions.

- There is a rationale for pursuing further research to refine the SWI and test its ability to be used in lieu of the 31-item QOL scale. Undoubtedly, further development and testing needs to take place before a shorter scale can be used to monitor perceived quality of life of mineworkers in remote locations.

CHAPTER 8: CLAIM OF ORIGINAL CONTRIBUTION

This research adopted an innovative approach to the evaluation of the performance of different models of mining communities in remote locations. It identified factors that most impact perceived quality of life in remote mining communities through a subjective quality of life approach and through the mineworkers' perspectives, effectively placing human wellbeing at the centre of the planning and evaluation framework.

9.2. Original Contribution to Theory and Research

The findings and discussions presented in this thesis offer an original contribution to the conceptual understanding of quality of life (QOL), in particular how these concepts can be applied to life in remote resource communities.

The findings regarding QOL domains and indicators contribute to QOL theory and provide new hypotheses for future research. The development and discussion of the QOL questionnaire used in this research and the short scale of subjective wellbeing are also a contribution to QOL research. Lastly, this was the first time the Personal Wellbeing Index (PWI) scale was tested in Brazil. Even though an adaptation of the PWI was used, the PWI translation to Portuguese was a specific contribution to the efforts of the International Wellbeing Group.

This research also contributes to the existing body of literature on single-industry and resource communities. It identifies 3 classifications of mining community models based on the approach taken by the mining company or operation associated with them. Furthermore, this research identifies factors that significantly impact quality of life in 3 distinct mining community models and provided a discussion on the implications of the different approaches to human wellbeing. This research also identifies general areas of concern, as well as specific issues and challenges relative to each model. The findings regarding the positive and negative attributes of each case study community will contribute to current and future efforts to classify and describe resource/single-industry community models.

The methodological strategy used in this research is also considered a contribution. The iterative approach involving triangulation of qualitative and quantitative methods provides an innovative model that can provide robust data and results.

9.2. Original Contribution to Professional Practice and Policy

This research also provides applied contributions. It aims to provide guidance for the creation of better-informed mining community development strategies that can be used to assist mining companies operating in remote areas to improve quality of life in the communities associated with their operations. Specifically, the discussion of research results identifies areas for practical intervention and strategies that mining companies may choose to implement in remote operations worldwide. Findings from this research also inform local governments and policy makers involved in planning, regulating and permitting mineral development in remote locations on areas of concerns for intervention and policy development, and ways to address challenges related to quality of life in single-industry remote communities.

The qualitative framework developed in this research can be used in lifecycle planning for new mines and for the evaluation and monitoring of existing single-industry community or other types of mineworker accommodations, such as permanent or fly-in-fly-out mine camps worldwide. It is hoped that findings of this research will also help companies, governments and policy makers to make improved decisions regarding the form of settlement and workers' accommodations schemes associated with any industrial development in remote locations.

CHAPTER 9: RECOMMENDATIONS FOR FUTURE RESEARCH

9.1. Future Methodological Research

Regarding methodology, it is recommended that the investigation of the possibility of using work as a determinant of both quality of life (QOL) and life satisfaction be further examined. Such examination would include (but not necessarily be limited to) the specific relationships between satisfaction with work and the other 4 QOL domains: the social, health, environment and economic domains. Moreover, results from the pilot test of the Subjective Wellbeing Index (SWI) indicate that there is enough strength in the proposed scale to justify further research and testing of a shorter questionnaire (7 items) as a proxy for the larger QOL questionnaire (31 items).

Other recommendations for further methodological research include: a) the use of a phased approach, in which hypotheses stemming from QOL questionnaire results are further examined with in-depth follow-up interviews, and b) the investigation of QOL perceptions of residents of remote mining communities who are not mineworkers in order to understand the impacts of mine-related work on perceptions of quality of life in remote communities.

9.2. Future Research on Quality of Life in Remote Mining Communities

Several opportunities exist for future research in this area. The following are two suggestions stemming from the findings of this research.

9.2.1. Investigating the Relationship between Quality of Life, Productivity and Occupational Health and Safety

Findings of this research suggest that satisfaction with work-related aspects of life does not significantly impact self-reported levels of satisfaction with QOL in any of the 3 mining community models investigated. This conclusion leads to questions about how quality of life

(QOL) and specific QOL domains impact productivity and health and safety performance at mines in remote locations.

The literature on quality of work life (QWL) provides a numerous factors that increase QWL, such as self-actualization at work, participation in decision making, compensation and benefits, teamwork, personal motivation, and good relationships between managers and subordinates (Sirgy et al., 2006). The existing body of QWL literature also provides strong evidence of the positive relationship between high QWL and productivity, and it suggests that QWL programs contribute to employee loyalty, low turnover rates, lower absenteeism and reduced strife between management and labour (Sirgy et al., 2006). Further research on the quality of life of remote communities could significantly contribute to the body of QOL literature by investigating the relationship between quality of life and productivity and health and safety performance.

9.2.2. Comparative Study: Brazilian and Canadian Mining Communities

Several results from this research seem to suggest a similarity between the current perceptions of single-industry communities and mining towns in Brazil and those of mining communities in Canada, notably remote communities in British Columbia and Ontario. These perceptions are well discussed in literature about remote Canadian mining communities, starting in the early 1950 (e.g., The Institute of Local Government, 1953; Robinson, 1962; Lucas, 1971; Riffel, 1975; Bowles, 1982; Bray and Thompson, 1992). For example, company control of the social and environmental domains and the fear of losing one's job impacts mineworkers' abilities and willingness to complain or lobby for improvement in Brazil, which is similar to pre-union times in Canada. Other similarities are the challenges presented by remoteness and isolation.

The Canadian mining sector has recently tended to favor fly-in-fly-out mine camps over the development of new mining communities in remote locations (Shrimpton and Storey, 1989a, 1989b, 1990; Storey, 2001; Veiga et al., 2001). However, Canada still has a significant number of mining-dependent communities (Natural Resources Canada, 2004). A comparative analysis of Canadian and Brazilian mining communities regarding the social and environmental challenges typical of remote and isolated resource or single-industry communities would certainly lead to an interesting topic for future research. Findings could provide insights into the aspects that most impact resilience and sustainability as well as quality of life in remote single-industry communities worldwide.

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APPENDIX A

Table A: Vale Northern System Mines Profile (Production year 2006)

Indicators	Carajás	Azul	Sossego
Main mine product	Iron-ore	Manganese	Copper
Area in hectares	3,467.15 ha	4,650ha	231 ha
Opening year	1984	1985	2004
Run of mine (ROM) Production in metric tones	90,800,710 t	2,635,638 t	11,200,000 t
Number of open pits	5	1	3
Nominal mill capacity	86.63 Mt/year	2.35 Mt/year	15 Mt/year
Direct employees**	2,151	151	596
Workforce total (includes contractors)	10,407	650	
Product volume for internal market (%)	8	50	11
Product volume for external market (%)	92	50	89
Number of person/hours (ph)*** worked without time lost accidents	695,892	1,135,170 (only March to October)	7,059,810
Number of ph worked****	16,581,415	2,006,940 ph	7,059,810 ph
Mine productivity (ROM/ph)	24t/ph	1.31t/ph	5.11 t/ph
Production plant (year/ph)	14t/ph	0.84t/ph	0.34 t/ph

Source: Revista Minérios & Minerales. 298 Edition. 09/25/07

* From 3 open pits in operation in 2006
**Source: Vale Human Resources Division Northern System, June 2006 data
***Person/hour (p/h) = unit of one hour worked by one person
****Includes total workforce (direct employees and contractors)

APPENDIX B

Table B: Population Frame: Northern System Workforce

Vale Workforce Characteristics		# of Employees	% of Total
Mine	Sossego Copper Mine	596	19
	Azul Manganese Mine	141	5
	Carajás Iron-ore Mine Complex	2,151	70
	Shared by all operations	203	7
Community of Residence	Carajás	1,230	40
	Canaã	420	14
	Parauapebas	1,441	47
Gender	Male	2,613	85
	Female	478	15
Job Class	Manager	63	2
	Supervisors	103	3
	Analyst	152	5
	Engineers and geologist	172	6
	Administrative and trades	1,397	45
	Technicians	899	29
	Apprentices	305	10
Marital Status	Married	1,372	44.4
	Common-law	425	13.7
	Single	1,266	41
	Divorced	22	0.7
	Separated	6	0.2

Table B: Population Frame: Northern System Workforce (CONTINUED)

Vale Workforce Characteristics		# of Employees	% of Total
Home State	PA	872	28.2
	MA	816	26.4
	MG	365	11.8
	PI	195	6.3
	RN	127	4.1
	TO	105	3.4
	GO	96	3.1
	SP	99	3.2
	BA	90	2.9
	RJ	53	1.7
	CE	49	1.6
	PE	40	1.3
	PB	40	1.3
	Others (i.e., PR, AP, DF, AL, AM, RS, MT, MS, RO, expatriates)	145	4.7
Total		**3,091**	**100**

Note: All employees are 18 years of age or older.
Source: Vale Northern System Human Resources. Data as of June 30 2006.

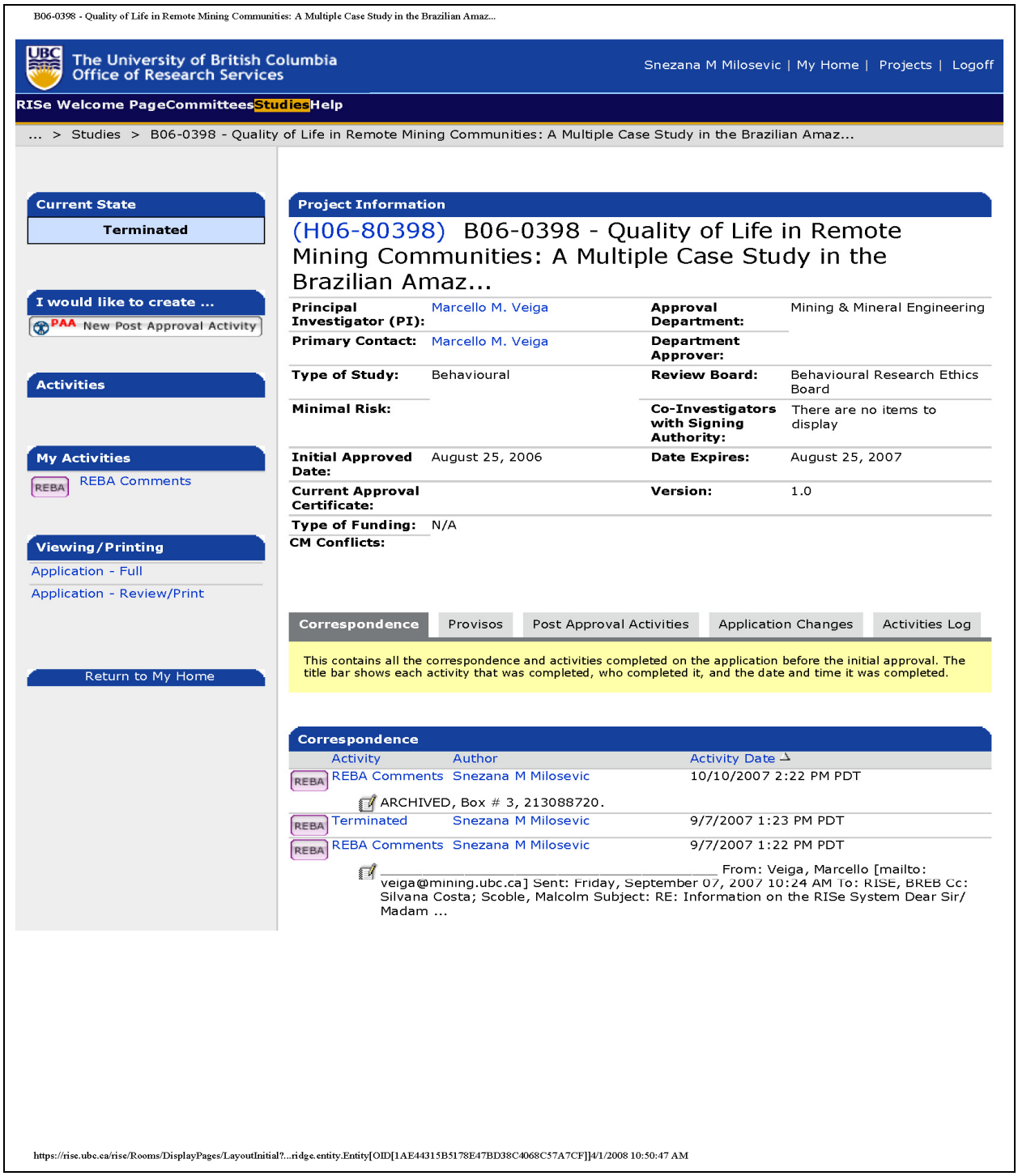

Figure B. Confirmation of Ethics Review Approval Provided by the University of British Columbia Office of Research Services on August 2006.

The University of British Columbia
Dept. Mining Engineering
6350 Stores Rd., Vancouver, BC, Canada, V6T 1Z4
Ph: (604) 8224332, fax: (604) 8225599; veiga@apsc.ubc.ca

Interview Subjects
Information and Consent Form

MINEWORKERS' QUALITY OF LIFE IN REMOTE MINING COMMUNITIES: A MULTIPLE CASE STUDY IN THE BRAZILIAN AMAZON

Principal Investigator:
Marcello Veiga, PhD. Associate Professor
Mining Engineering, University of British Columbia
Ph: 604 822 4332
veiga@mining.ubc.ca

Co-investigator:
Silvana Costa, M.E.Des. PhD Candidate
Mining Engineering
University of British Columbia
Ph: 3348 9987 (Parauapebas)
silvana@telus.net

You are being invited to take part in this research study because:

- You are a full time employee of CVRD AND
- You are a permanent resident of Canaã dos Carajás, Parauapebas or Núcleo Urbano de Carajás, AND
- You are 19 years of age or older.

Before you decide if you would like to participate, it is important for you to understand what the research involves. This document will tell you about the study, why the research is being done, what you can expect and what you would be expected to do if you decide to participate.

If you wish to participate, you will be asked to sign this form. You are still free to withdraw at any time and without giving any reasons for your decision.

If you do not wish to participate, you do not have to provide any reason for your decision. Please take time to read the following information carefully before you decide.

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Ph: (604) 8224332, fax: (604) 8225599; veiga@apsc.ubc.ca

MINEWORKERS' QUALITY OF LIFE IN REMOTE MINING COMMUNITIES: A MULTIPLE CASE STUDY IN THE BRAZILIAN AMAZON

The objectives of this project are to:

1. To identify factors that most impact quality of life of CVRD employees in Canaã dos Carajás, Parauapebas or Núcleo Urbano de Carajás;
2. To identify opportunities to improve the quality of life in these communities, and
3. To determine the major quality of life factors that should be taken into account by both mining companies and policy makers when dealing with mine development in remote areas in Brazil and throughout the world.

Research Methods: This research includes interviews and a quality of life questionnaire.

Findings: This project is the Doctoral research for Silvana D. Costa. Findings will be published in her doctoral thesis.

This study is funded by the University of British Columbia, Department of Mining Engineering, and Faculty of Graduate Studies. In kind contribution from CVRD includes transportation, accommodations and meals for Silvana Costa during her research visits.

If you agree to take part in this study, the procedures and visits you can expect will include the following:

You will be asked to schedule a 30 to 45 minutes interview with Silvana Costa at the location of your convenience (preferable not at your workplace).

Please indicate if you are interested in receiving a copy of the final report

Your participation in this research is entirely voluntary. If you decide to withdraw from the research project, you can communicate your decision at any time and without any penalty. You can withdraw without providing any explanation of their reasons for doing so, and you are not required to submit a request for withdrawal in writing.

If you choose to enter the study and then decide to withdraw at a later time, all data collected about you during your enrolment in the study will be retained for analysis. By law, this data cannot be destroyed.

The study investigators may decide to discontinue the study at any time, or withdraw you from the study at any time, if they feel that it is in your best interests.

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Please note:

There will be no costs to you or your legal representative for participation in this study. Signing this consent form in no way limits the legal representative's or subject's legal rights, against the investigators, or anyone else.

You will not be paid for participating.

Your confidentiality will be respected. No information that discloses your identity will be released or published without your specific consent to the disclosure. Absolutely no records, which identify you by name or initials, will be allowed to leave the Investigators' offices. You can be assured that your identity will be protected.

If you have any questions or desire further information about this study before or during participation, you can contact:

Marcello Veiga, PhD, Associate Professor
Mining Engineering
University of British Columbia, Canada
Veiga@mining.ubc.ca, phone: 604 822 4332

Dr. Veiga is Brazilian and speaks Portuguese.

If you have any concerns about your rights as a research subject and/or your experiences while participating in this study, contact the 'Research Subject Information Line in the University of British Columbia, Office of Research Services' at 604-822-8598.

Please sign consent form in the next page.

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Dept. Mining Engineering
6350 Stores Rd., Vancouver, BC, Canada, V6T 1Z4
Ph: (604) 8224332, fax: (604) 8225599; veiga@apsc.ubc.ca

Consent Form

MINEWORKERS' QUALITY OF LIFE IN REMOTE MINING COMMUNITIES: A MULTIPLE CASE STUDY IN THE BRAZILIAN AMAZON

This consent form is not a contract. You do not give up any legal rights by signing it.

By signing below, you are indicating that you have read, understood and appreciate the information concerning the study.

So please sign and date this form if you agree to the statements below:

- I have read and understood the subject information and consent form.
- I have had sufficient time to consider the information provided and to ask for advice if necessary.
- I have had the opportunity to ask questions and have had satisfactory responses to my questions.
- I understand that all of the information collected will be kept confidential and that the result will only be used for scientific objectives.
- I understand that my participation in this study is voluntary and that I am completely free to refuse to participate or to withdraw from this study at any time without changing in any way the quality of care that I receive.
- I understand that I am not waiving any of my legal rights as a result of signing this consent form.
- I have read this form and I freely consent to participate in this study.
- I have been told that I will receive a dated and signed copy of this form.

Printed name of subject	Signature	Date
Printed name of principal investigator/ designated representative	Signature	Date

The University of British Columbia
Dept. Mining Engineering
6350 Stores Rd., Vancouver, BC, Canada, V6T 1Z4
Ph: (604) 8224332, fax: (604) 8225599; veiga@apsc.ubc.ca

CONSENTIMENTO
(Autorização de uso de informação proveniente de entrevista)

QUALIDADE DE VIDA DE TRABALHADORES EM COMUNIDADES REMOTAS: estudos de caso na Amazônia Brasileira

Pesquisador principal:
Marcello Veiga, Professor
Norman B. Keevil Instituto de Engenharia de Minas,
Universidade da Colúmbia Britânica (UBC)
veiga@mining.ubc.ca

Pesquisador secundário:
Silvana Costa, Candidata a Doutourado
Norman B. Keevil Instituto de Engenharia de Minas
Universidade da Colúmbia Britânica (UBC)
silvana@telus.net
Tel: 94 3348 9987

Você é convidado a participar desta pesquisa porque:

Você reside em Canaã dos Carajás, Parauapebas ou no Núcleo Urbano de Carajás, e
Você tem 18 anos de idade ou mais.

Antes de decidir se você gostaria de participar de uma entrevista, é importante que você saiba mais sobre este projeto de pesquisa. Este documento descreve o projeto, os motivos por que ele está sendo realizado, e como participar.

Se você decidir participar de uma entrevista, pedimos que assine este documento. Ainda assim, você estará livre para deixar de participar em qualquer momento, sem precisar explicar as razões pelas quais você tomou esta decisão. Se você não está interessado(a) em participar, não e necessário explicar por quê. Por favor leia o que segue com a atenção antes de decidir.

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Ph: (604) 8224332, fax: (604) 8225599; veiga@apsc.ubc.ca

QUALIDADE DE VIDA DE TRABALHADORES EM COMUNIDADES REMOTAS: ESTUDOS DE CASO NA AMAZÔNIA BRASILEIRA

Esta pesquisa está sendo deselvolvida a partir de um colaboração entre a Universidade da Colúmbia Britânica (UBC), no Canadá, e a Companhia Vale do Rio Doce (CVRD) e é parte da tese de doutourado da aluna Silvana D. Costa. Os objetivos desta pesquisa são:

- Identificar os fatores de qualidade de vida que mais importantes para of funcionários da CVRD que vivem em Canaã dos Carajás, Parauapebas e no Núcleo Urbano de Carajás;
- Identificar oportunidades para melhorar a qualidade de vida nestas localidades
- Informar tomadores de decisões corporativas em relação a qualidade de vida em áreas remotas.

Esta pesquisa inclui entrevistas funcionários da CVRD que são moradores das comunidades acima além de um questionário de Qualidade de Vida. Por motivos de ética de pesquisa, somente maiores de 18 anos podem participar desta pesquisa.

Este projeto está sendo financiado pela Universidade da Colúmbia Britânica (UBC) e conta com a colaboração da CVRD.

Se você estiver interessado (a) em participar:

Solicitamos que você participe de uma entrevista com Silvana Costa. A entrevista durará aproximadamente 30 minutos, e será realizada no local de sua escolha (preferencialmente fora do seu local de trabalho)

Você receberá, se for do seu interesse, um resumo do relatório final da pesquisa. Favor indicar, na sua entrevista, se você tem interesse em receber tal resumo.

Sua participação é inteiramente voluntária. Se mais tarde você desistir de participar, você pode fazê-lo a qualquer momento sem precisar dar explicações. As informações já coletadas serão utilizadas para a pesquisa, a não ser que você tenha objeções.

Os investigadores podem decidir terminar o trabalho a qualquer momento, ou retir a sua entrevista da amostra, se os eles acharem que isso é necessário para proteger os seus interesses.

Por favor note que:

Não haverá custo algum para a participação neste estudo.

Assinar este documento não limitará de forma alguma os seus direitos legais.

The University of British Columbia
Dept. Mining Engineering
6350 Stores Rd., Vancouver, BC, Canada, V6T 1Z4
Ph: (604) 8224332, fax: (604) 8225599; veiga@apsc.ubc.ca

A sua participação não será remunerada.

Sigilo e confidencialidade serão estritamente respeitados. Nenhum documneto que contenha o seu nome ou alguma informação que identifique o participante será distribuída ou publicada. Nenhum documento que o identifique pelo nome ou iniciais deixará, em hipótese alguma, a posse dos pesquisadores Silvana Costa e Marcello Veiga. Toda a informação coletada sera mantida em segurança por 5 anos. No final dos 5 anos, todo este material será destruído.

Se você tiver alguma pergunta sobre este trabalho por favor entre em contato com:

Marcello Veiga, Professor
Norman B. Keevil Instituto de Engenharia de Minas, UBC
veiga@mining.ubc.ca Telefone: 604 822 4332 (Canadá)

O Professor Veiga é brasileiro e fala Portugues.

Por favor assine na próxima página se você gostaria de participar da entrevista e nos dá consentimento para usar as informações da entrevista para o nosso trabalho.

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Dept. Mining Engineering
6350 Stores Rd., Vancouver, BC, Canada, V6T 1Z4
Ph: (604) 8224332, fax: (604) 8225599; veiga@apsc.ubc.ca

Consentimento
Projeto Bem Viver

QUALIDADE DE VIDA DE TRABALHADORES EM COMUNIDADES REMOTAS: ESTUDOS DE CASO NA AMAZÔNIA BRASILEIRA

Este documento não é um contrato. Ao assinar este documento você não abre mão de nenhum direito legal. Ao assinar, você estará confirmando que leu, entendeu e concorda com as informações neste documento.

Favor assinar abaixo se você concorda com as afirmações abaixo:

- Eu li e entendi as informações contidas neste documento
- Eu tive tempo suficiente para tomar a decisão de participar ou não
- Eu tive tempo suficiente para fazer perguntas sobre este trabalho e receber respostas satisfatórias
- Estou ciente de que todas as informações coletadas com a minha participação serão guardadas em sigilo, em caráter confidencial, e os resultados serão utilizados para uma tese de doutourado
- Estou ciente de que a minha participação neste estudo é voluntária e que eu posso a qualquer momento interromper a minha participação sem precisar dar explicações
- Estou ciente de que eu não estou abrindo mão de nehum direito legal ao assinar este documento
- Estou assinando este documento de livre e espontânea vontade
- Eu fui comunicado(a) de que receberei uma cópia deste documento assinado por um dos pesquisadores

_____	_____	_____
Nome do participante	Assinatura	Data

_____	_____	_____
Nome do entrevistador(a)	Assinatura	Data

The University of British Columbia
Dept. Mining Engineering
6350 Stores Rd., Vancouver, BC, Canada, V6T 1Z4
Ph: (604) 8224332, fax: (604) 8225599; veiga@apsc.ubc.ca

Interview Protocol

Questions:

- What is *quality of life* for you?
- What are the three best things about living in your community?
- What are the three worst things about living in your community?
- If you could do one thing to improve the quality of life in your community, what would you do?

Participant Characteristics	
Gender	
Age	
Length of employment	
Length of residence	
Job class	
Area of work	
Educational level	
Region of Origin	
Marital status	
Number of dependent children	

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QUALITY OF LIFE QUESTIONNAIRE

MINEWORKERS' QUALITY OF LIFE IN REMOTE MINING COMMUNITIES: A MULTIPLE CASE STUDY IN THE BRAZILIAN AMAZON

A research project for the Doctoral thesis of Silvana D. Costa, University of British Columbia

This questionnaire is part of an academic research project about quality of life in remote mining communities. The objectives of this project are to:

- To identify factors that most impact quality of life of CVRD employees in Canaã dos Carajás, Parauapebas or Núcleo Urbano de Carajás;
- To identify opportunities to improve the quality of life in these communities, and
- To determine the major quality of life factors that should be taken into account by both mining companies and policy makers when dealing with mine development in remote areas in Brazil and throughout the world.

You are invited to participate because:

- You are a full time employee of CVRD AND
- You are a permanent resident of Canaã dos Carajás, Parauapebas or Núcleo Urbano de Carajás, AND
- You are 18 years of age or older.

If you don't work for CVRD, do not live in one of the three communities above, or you are younger than 18 years of age, you are not eligible to participate.

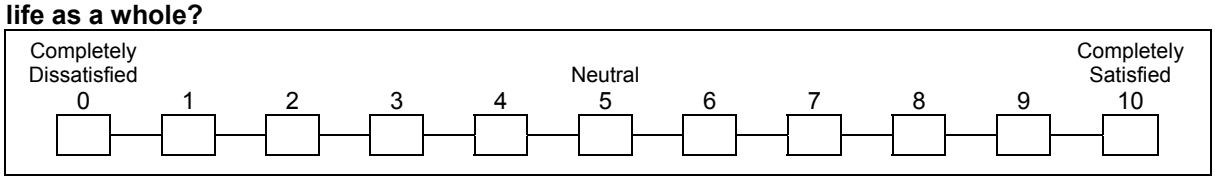
There are no known risks (e.g. psychological, cultural, privacy, confidentiality) associated with completing this questionnaire. You can be assured that your identity will be protected. Questionnaires are anonymous – please do not write your name on the questionnaire.

Participation is voluntary, so you are free to decline to complete this questionnaire or stop at any time, with no consequences to you. You will not be paid for your participation. It usually takes about 20 minutes to complete it, but please feel free to take much time as you need.

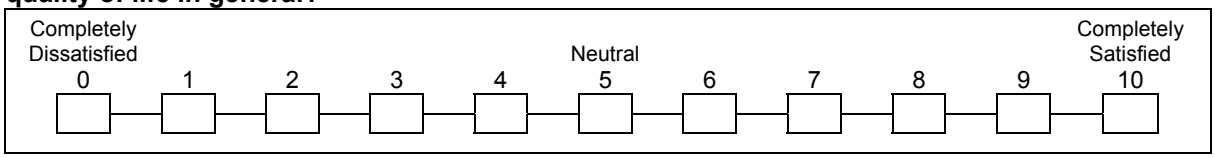
The answers are anonymous and confidential. By answering the questionnaire, you are giving consent to its use for the project purposes only. The information collected here will be kept confidential, and only the Principal Investigator and co-investigator will have access to the completed questionnaires.

Part 1 – This section includes 7 questions about your level of satisfaction with general things in your life. The following questions ask how **satisfied** you feel about general things in your life, on a scale from zero to 10. **Zero** means you feel completely dissatisfied. **10** mean you feel completely satisfied. And the **middle of the scale is 5**, which means you feel neutral, neither satisfied nor dissatisfied. **Thinking about your own current life and personal circumstances, how satisfied are you with:**

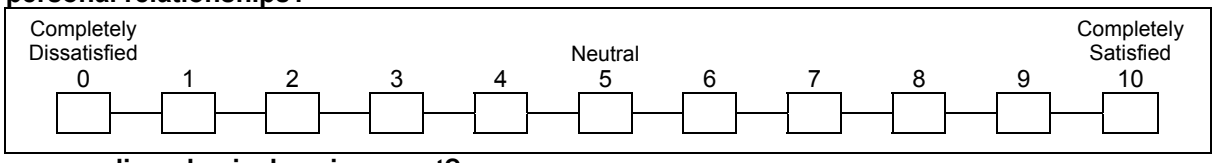
Your life as a whole?



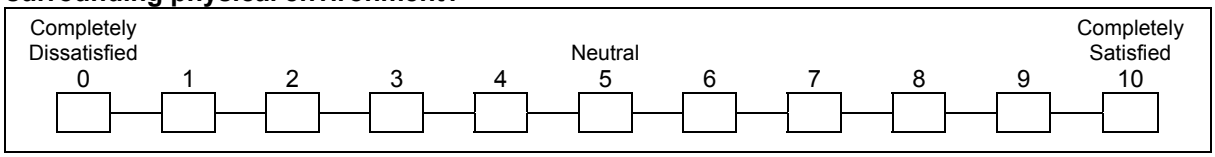
Your quality of life in general?



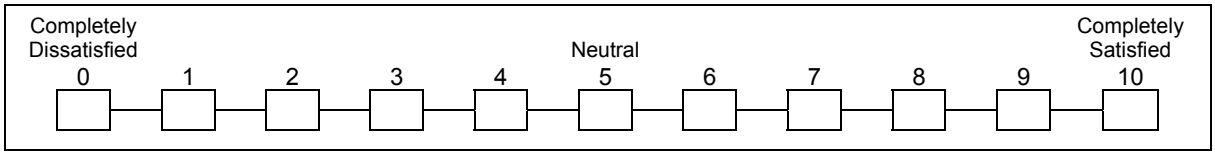
Your personal relationships?



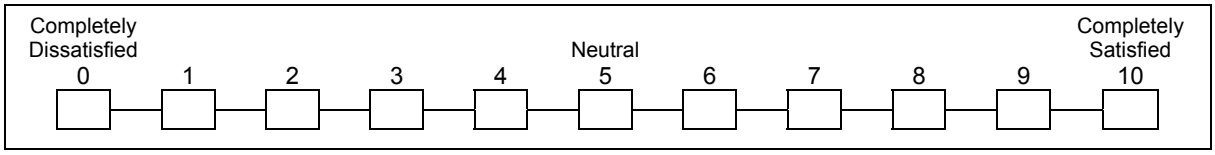
Your surrounding physical environment?



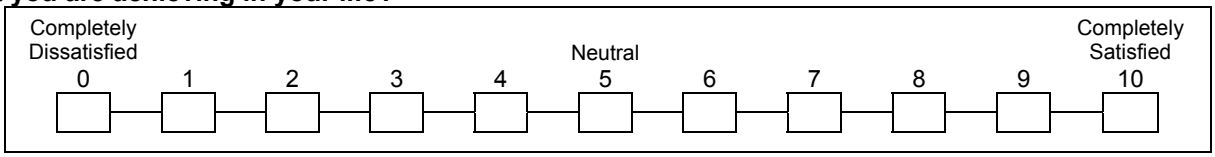
Your work?



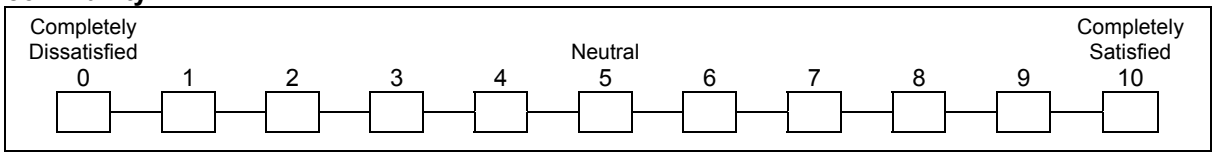
Your economic situation?



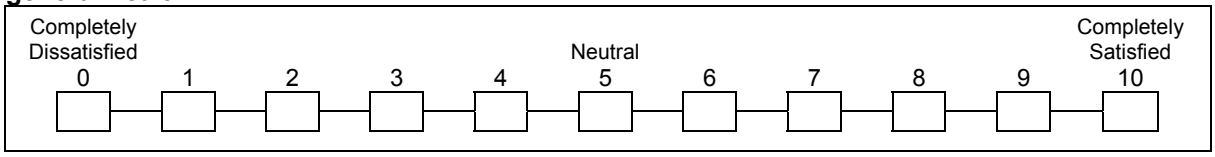
What you are achieving in your life?



Your community?



Your general health?



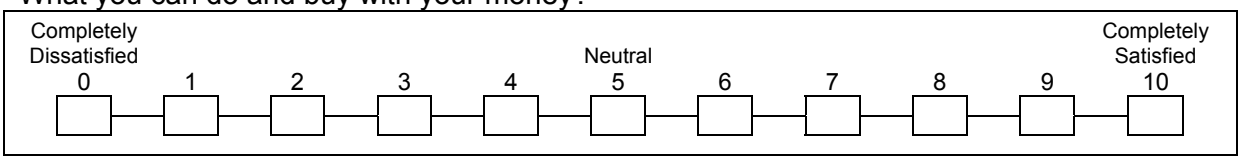
Part 2 –The questions in Part 2 are about how satisfied you are with things in your life and in your community. The following questions ask how satisfied you feel with more specific aspects of your life. **The questions are in five different domains:**

1. **Economic**
2. **Work**
3. **Environment**
4. **Health**
5. **Social**

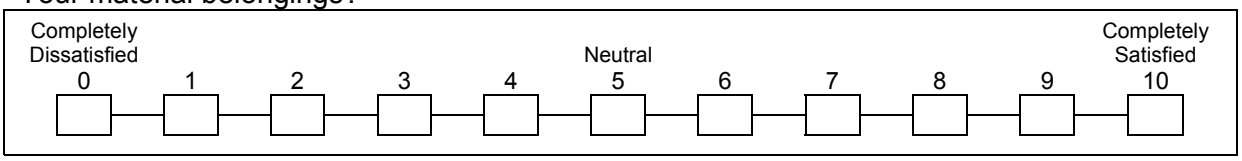
ECONOMIC

Thinking about your own current life and personal circumstances, how satisfied are you with:

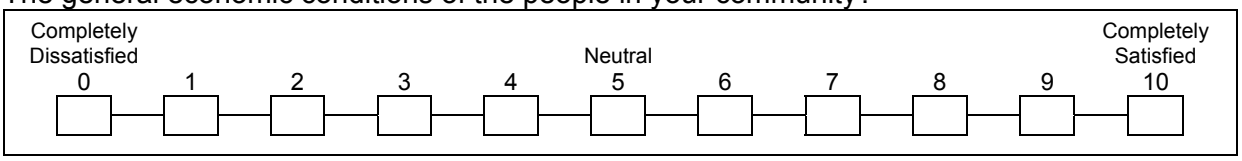
What you can do and buy with your money?



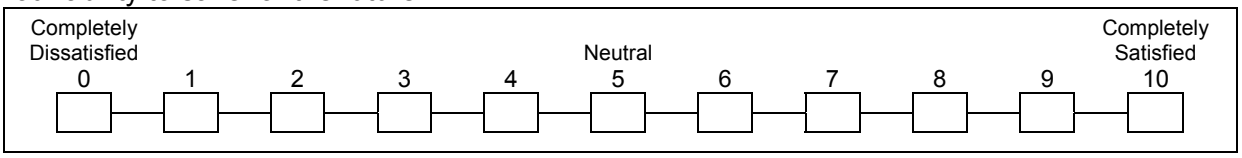
Your material belongings?



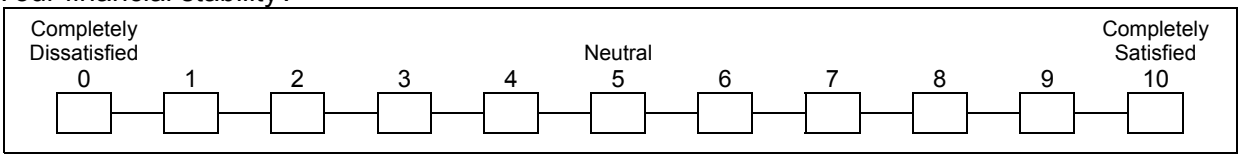
The general economic conditions of the people in your community?



Your ability to save for the future?



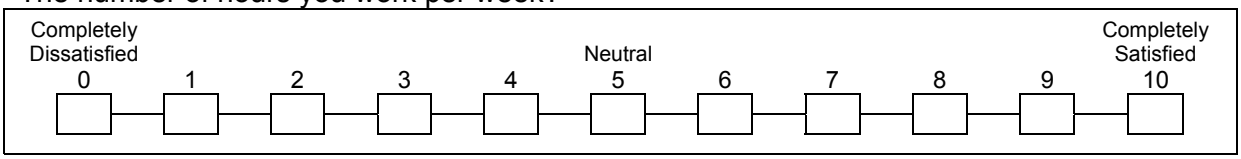
Your financial stability?



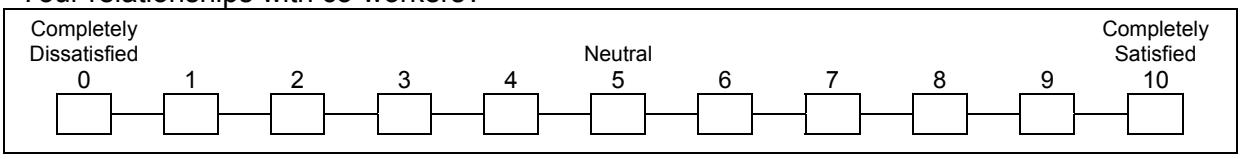
WORK

Thinking about your own current life and personal circumstances, how satisfied are you with:

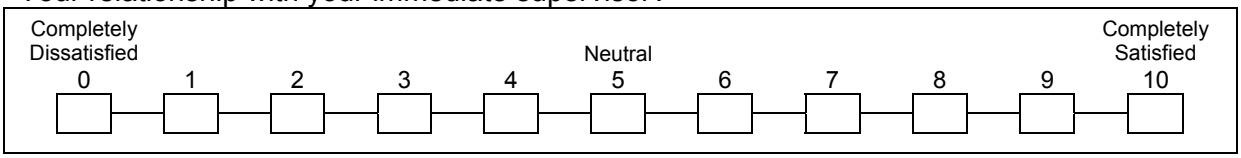
The number of hours you work per week?



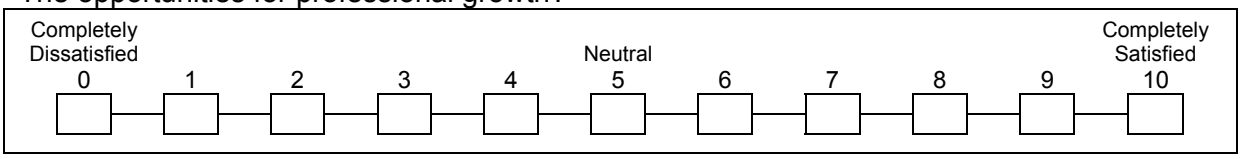
Your relationships with co-workers?



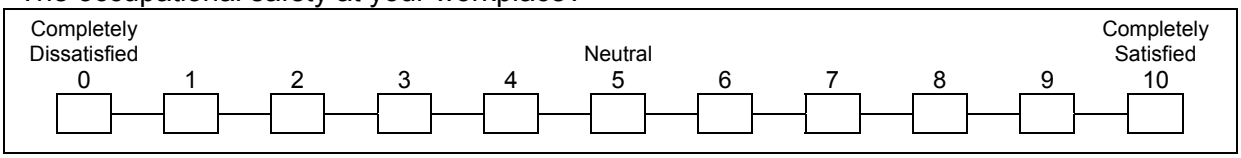
Your relationship with your immediate supervisor?



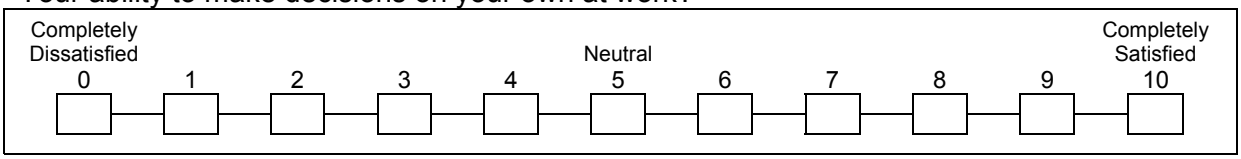
The opportunities for professional growth?



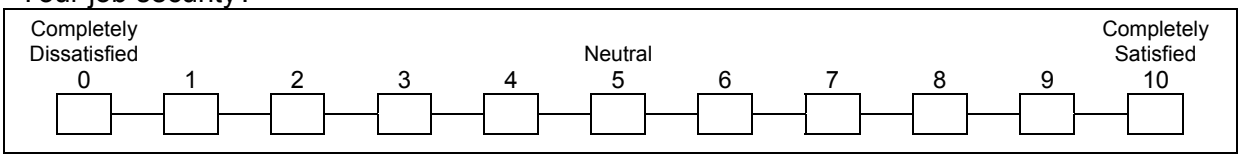
The occupational safety at your workplace?



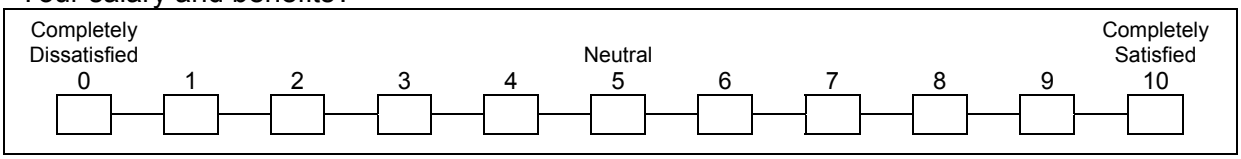
Your ability to make decisions on your own at work?



Your job security?



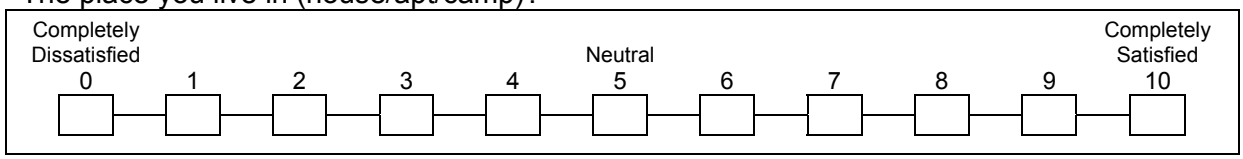
Your salary and benefits?



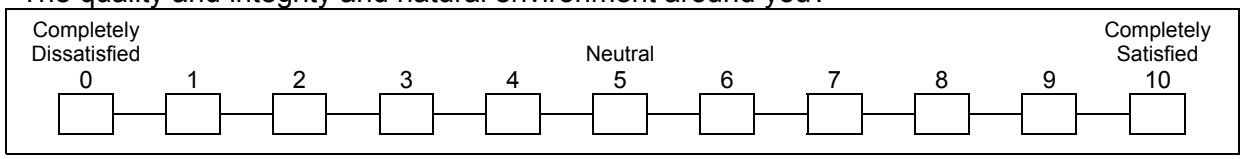
ENVIRONMENT

Thinking about your own current life and personal circumstances, how satisfied are you with:

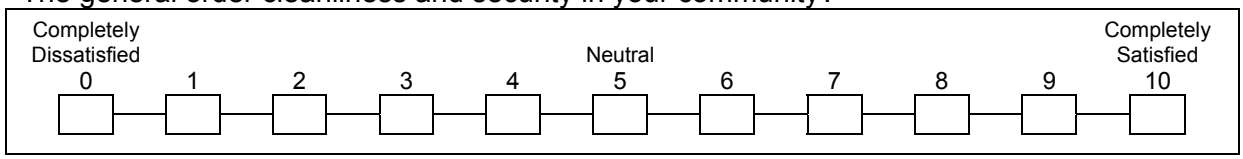
The place you live in (house/apt/camp)?



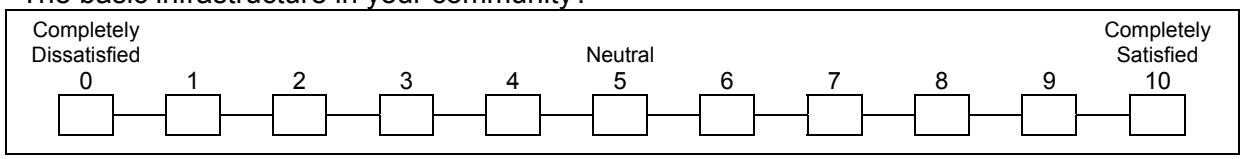
The quality and integrity and natural environment around you?



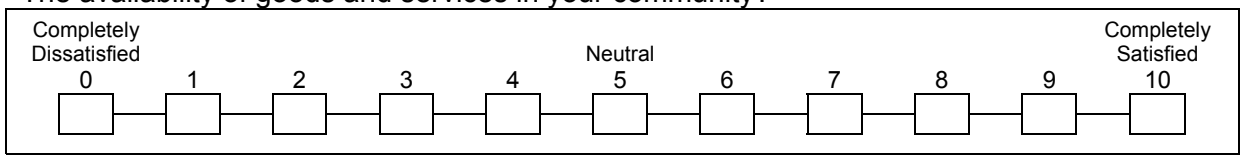
The general order cleanliness and security in your community?



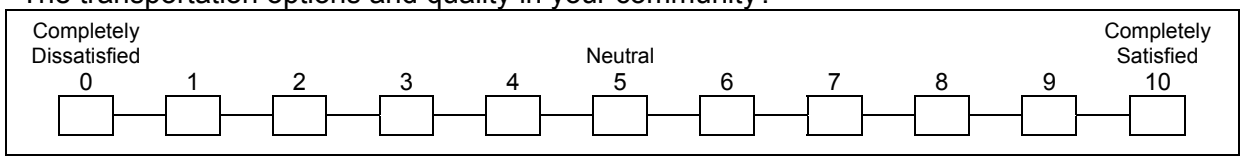
The basic infrastructure in your community?



The availability of goods and services in your community?



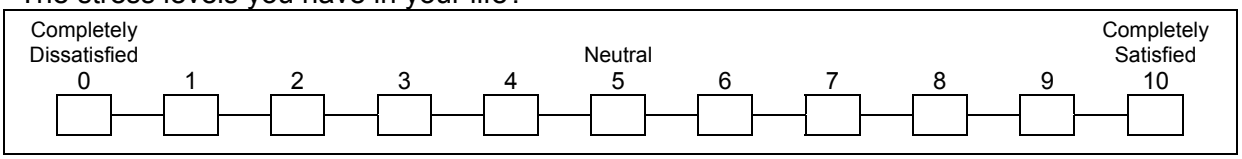
The transportation options and quality in your community?



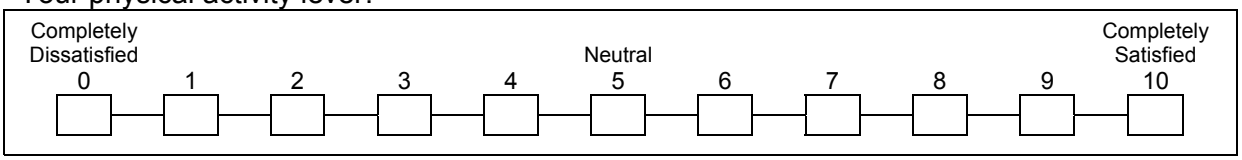
HEALTH

Thinking about your own current life and personal circumstances, how satisfied are you with:

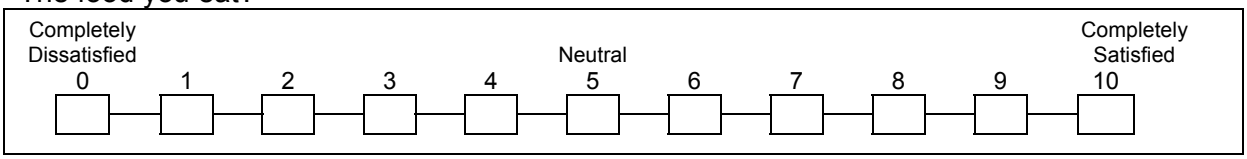
The stress levels you have in your life?



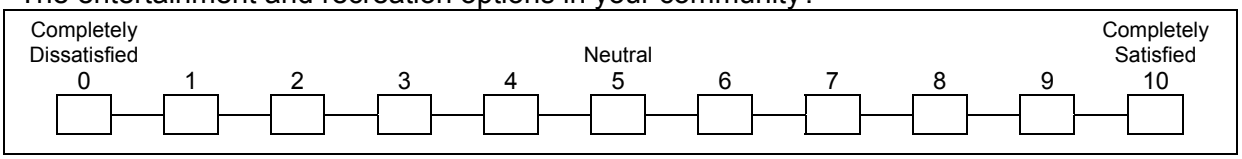
Your physical activity level?



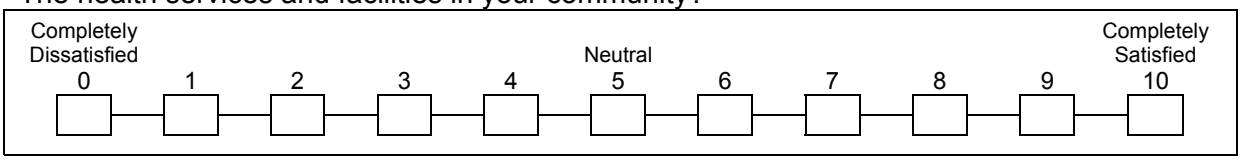
The food you eat?



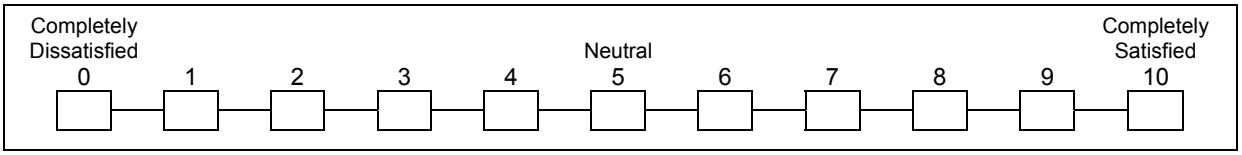
The entertainment and recreation options in your community?



The health services and facilities in your community?



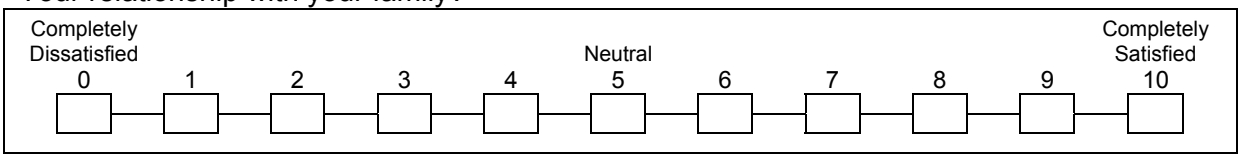
Your work-life balance?



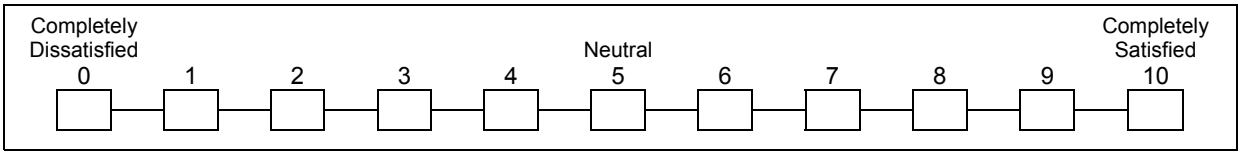
SOCIAL

Thinking about your own current life and personal circumstances, how satisfied are you with:

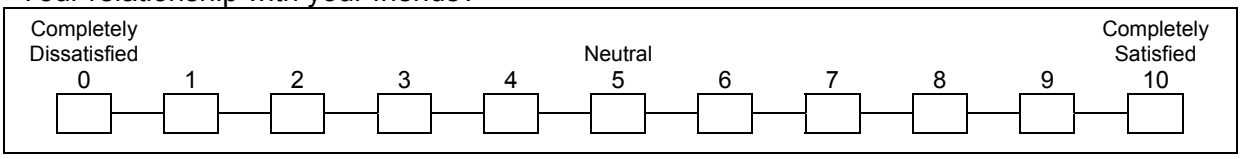
Your relationship with your family?



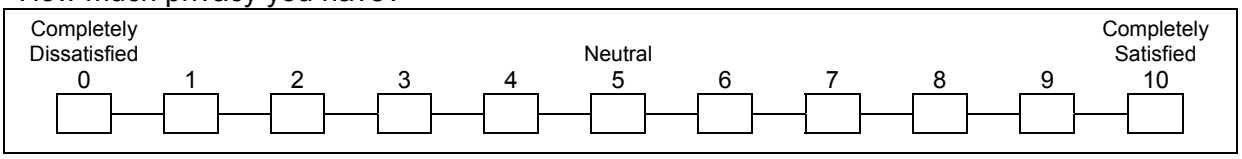
Your love life?



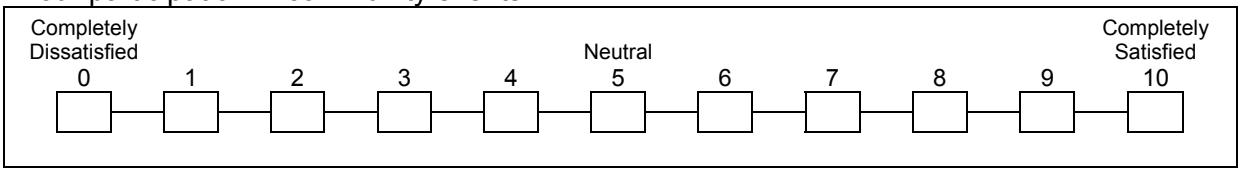
Your relationship with your friends?



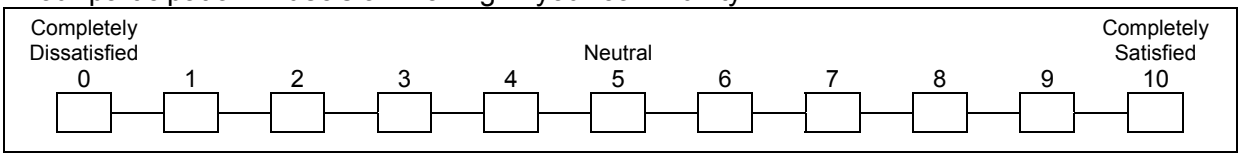
How much privacy you have?



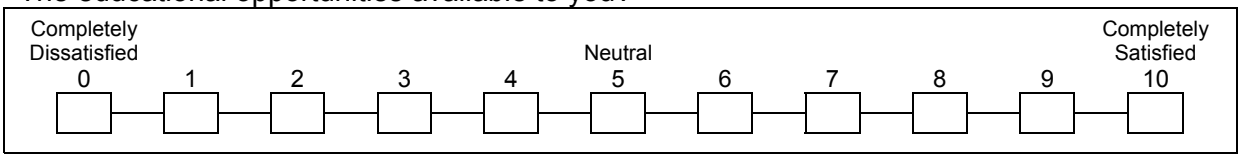
Your participation in community events?



Your participation in decision making in your community?



The educational opportunities available to you?



Part 3 - We would like to know a bit about …

Your home and community:

1. **In which of the three communities do you currently live in?**

__Nucleo Urbano de Carajás
__Canaã dos Carajás (including Vilas)
__Parauapebas, outside of the Núcleo Urbano de Carajás
__ Other

2. **How long have you lived in this community?**

__Less than 6 months
__Between 6 months and 1 year
__More than 1 year and less than 3 years
__Between 3 and 6 years
__More than 6 and less than 10 years
__Between 10 and 15 years
__More than 15 years

3. **Which is your housing status?**

__A rental house or apartment (living alone or with your family)
__Your own home
__Company house
__Shared company house
__ Camp
__ Hotel
__Other: _____

4. **Which Brazilian region are you from?**

__North
__Northeast
__Southeast
__West-central
__South

About your work…

5. **What is your position?**

__Manager
__Engineer or geologist
__Analyst
__Technician
__Trades
__Supervisor
__Trainee
__ Intern
__Other: _____

6. How long have you worked for CVRD?
__ 6 months or less
__More than 6 months and less than 1 year
__Between 1 year and 3 years
__More than 3 years and less than 8 years
__Between 8 years and 15 years
__More than 15 years and less than 20 years
__ 20 years or more

7. Which area do you work for?
__Operations
__Support
__Other:_____

About you and your family…

8. How old are you?
__18-25
__26-30
__31-40
__41-50
__51-60
__Over 60

9. Your gender
__Female
__Male

10. What is your educational level (completed)?
__Elementary school
__High school (with no specific technical or trades training)
__Technical or trades training
__University degree
__Maters or PhD degree
__Other: _____

11. What is your current marital status?
__Single
__Married
__Second marriage
__Common law
__Divorced
__Separated
__Widow

12. How many dependent children/youth (under 18) live with you?
__None
__1-2
__3 or more

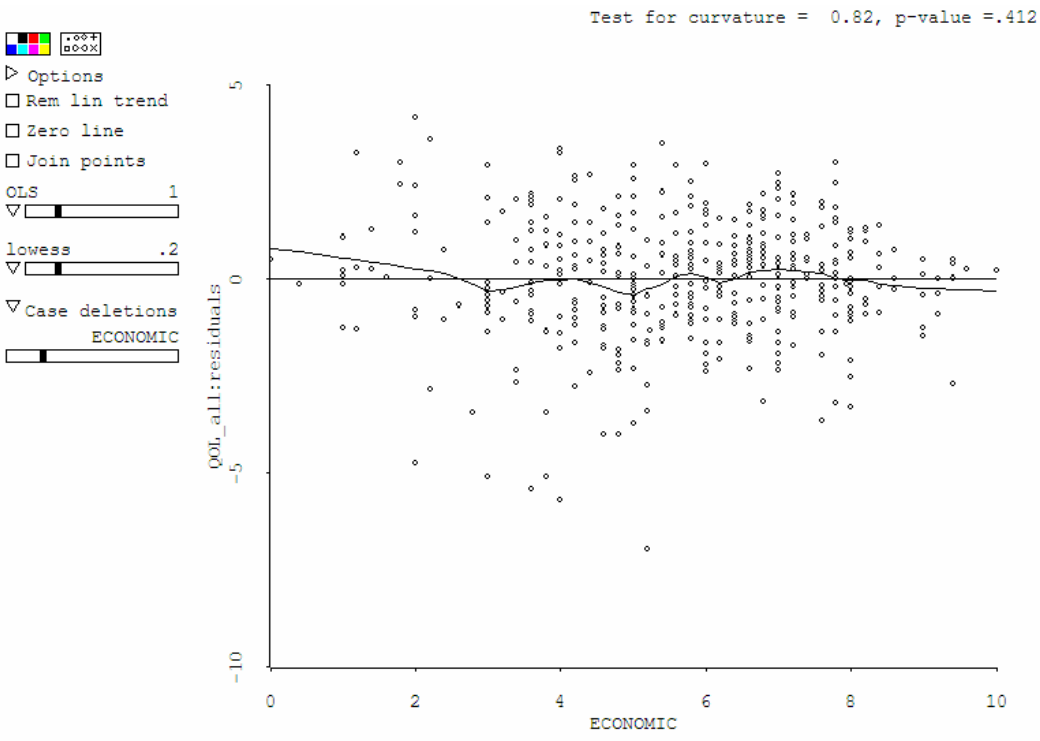
APPENDIX C

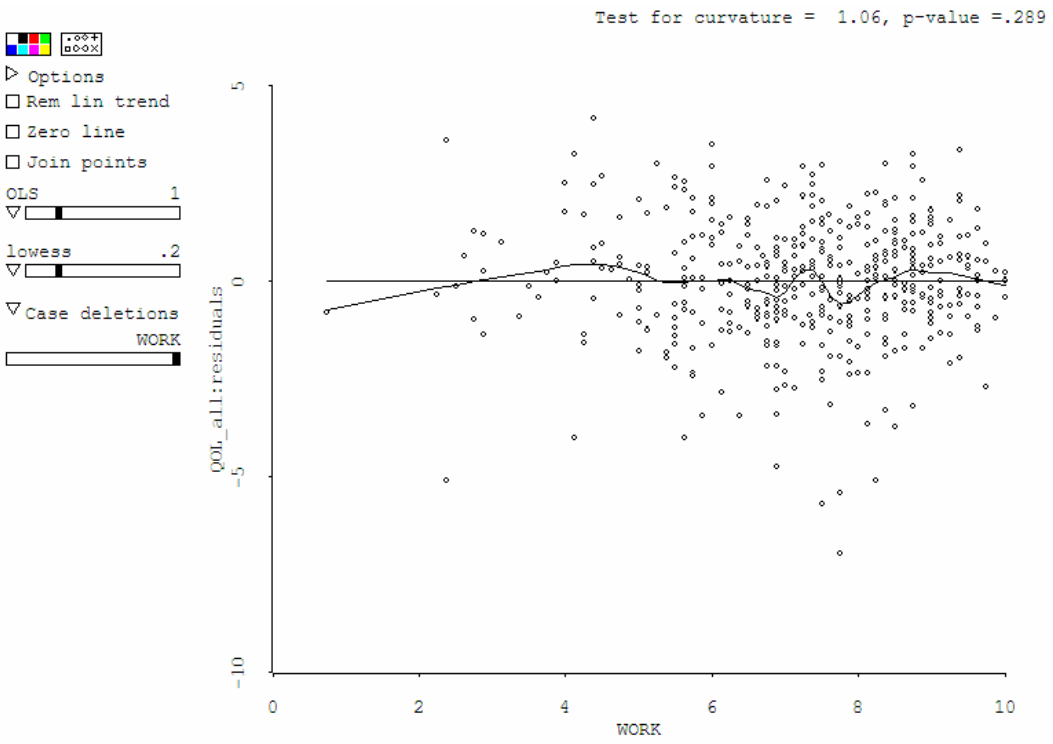
TESTING THE ASSUMPTION OF CORRECTLY SPECIFIED FORM

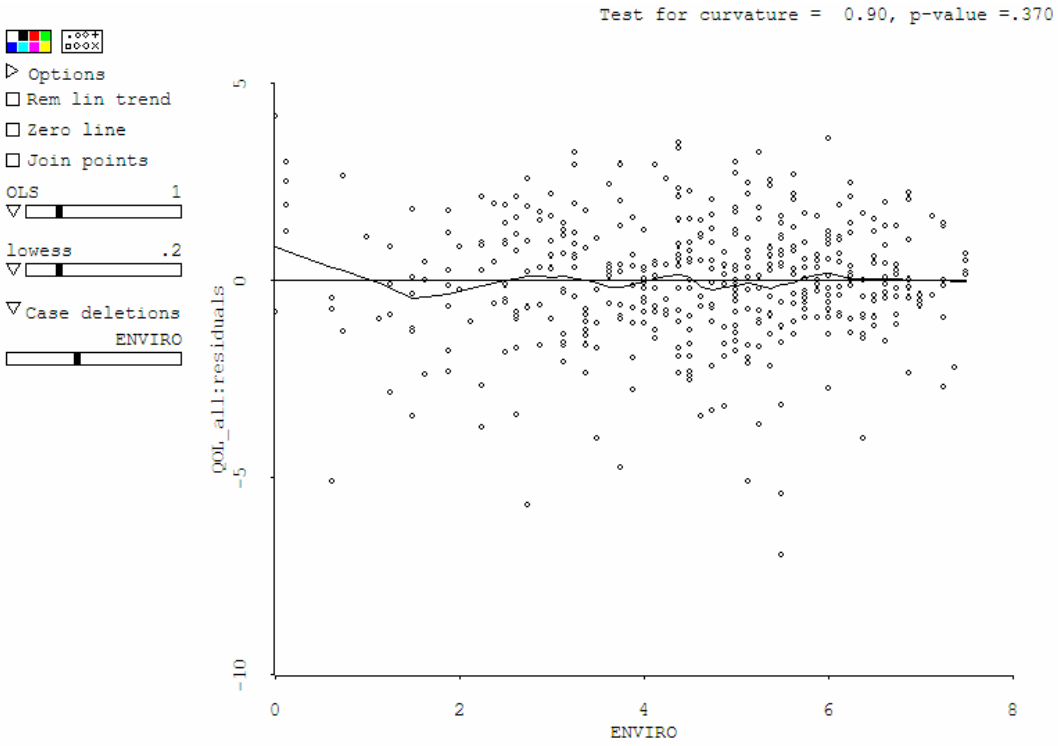
The regressions conducted assume that our variables are linearly related to the dependent variable. In other words, it is assumed that the functional relationship between predictors and criterion is correctly specified. The following model is examined:

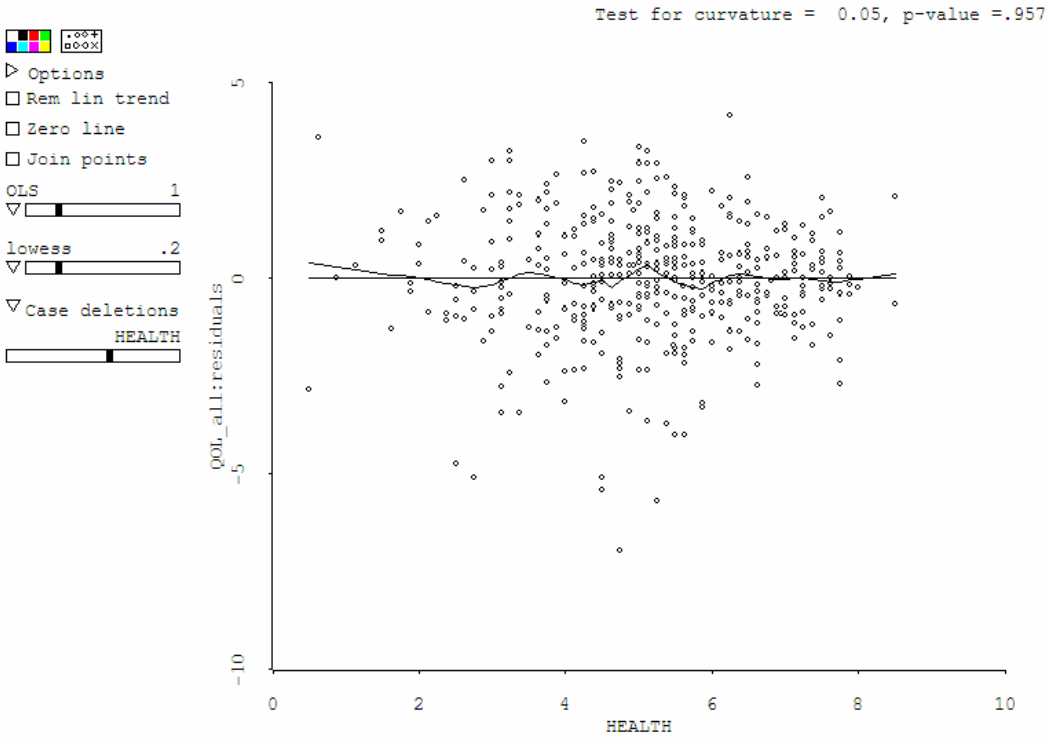
Quality of Life (1 item) = Economic + Work + Environment + Health + Social

In order to examine whether these relationships have been correctly specified as linear, the residual scores against each predictor and the predicted value of QOL was graphed using ARC software. There is a test of model fit accompanying each graph, which tests the assumption of linearity. Non-significant values indicate that we have correctly specified the form as linear (i.e., there is not a significant non-linear component). Below are the graphs with fit tests. All tests indicate that we have correctly specified the form as linear.




Test for curvature = 1.06, p-value =.289
Options
Rem lin trend
Zero line
Join points
OLS 1
lowess .2
Case deletions
WORK
Q9L_all:residuals
WORK
5
0
-5
-10
0
2
4
6
8
10


Test for curvature = 0.90, p-value =.370
Options
Rem lin trend
Zero line
Join points
OLS 1
lowess .2
Case deletions
ENVIRO
Q9L_all:residuals
ENVIRO
5
0
-5
-10
0
2
4
6
8


Test for curvature = 0.05, p-value =.957
Options
Rem lin trend
Zero line
Join points
OLS 1
lowess .2
Case deletions
HEALTH
qol_all:residuals
HEALTH
5
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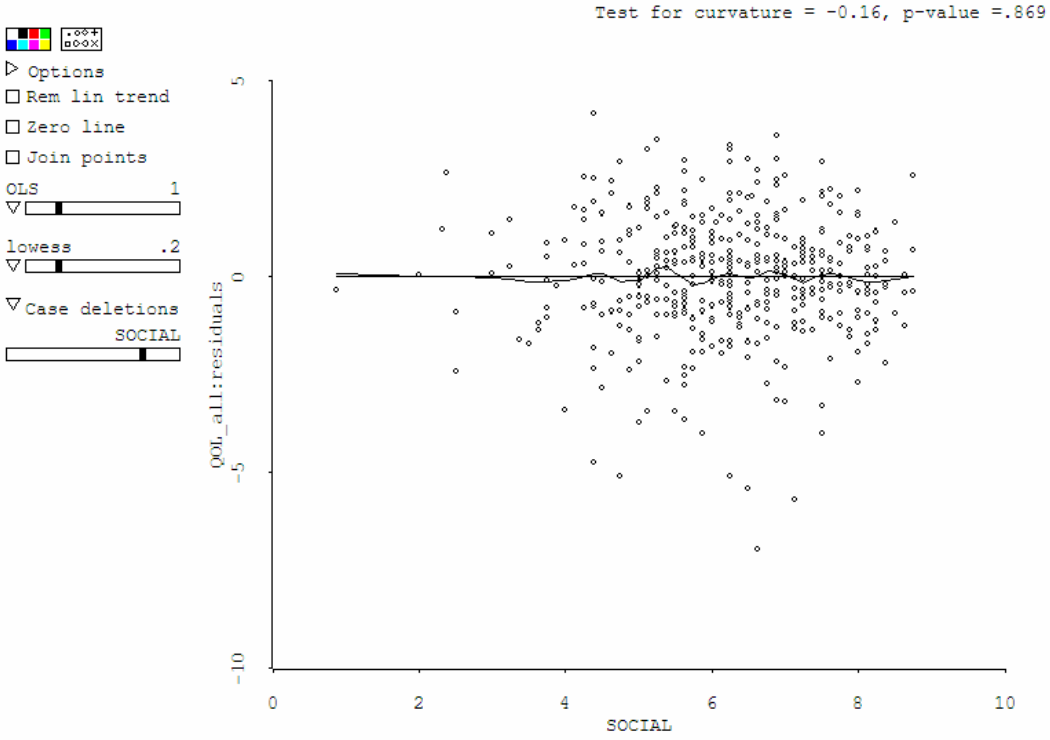
-5
-10
0
2
4
6
8
10


Test for curvature = -0.16, p-value =.869
Options
Rem lin trend
Zero line
Join points
OLS 1
lowess .2
Case deletions
SOCIAL
qol_all:residuals
SOCIAL
5
0
-5
-10
0
2
4
6
8
10

STATISTICAL ANALYSIS – SPSS OUTPUTS

COMPARING MEANS – GENDER

Independent Samples Test
(Confidence level = 97.5%)

Domain		Levene's Test for Equality of Variances		T-test		
		F	Sig.	t	df	Sig. (2-tailed)
Economic	Equal variances assumed	0.089	0.766	-1.035	451	0.301
	Equal variances not assumed			-1.015	105.494	0.312
Work	Equal variances assumed	1.008	0.316	-.284	448	0.777
	Equal variances not assumed			-.307	116.975	0.760
Environment	Equal variances assumed	0.073	0.787	-1.694	451	0.091
	Equal variances not assumed			-1.697	107.568	0.093
Social	Equal variances assumed	0.008	0.931	-1.766	450	0.078
	Equal variances not assumed			-1.804	107.749	0.074
Health	Equal variances assumed	3.510	0.062	-2.549	445	0.011
	Equal variances not assumed			-2.910	123.076	0.004

Domains: Means by Gender

Domain	Gender	N	Mean	Std. Deviation
Economic	Female	76	5.40	1.97
	Male	377	5.65	1.91
Work	Female	76	7.19	1.48
	Male	374	7.25	1.66
Environment	Female	76	4.26	1.62
	Male	377	4.60	1.63
Social	Female	75	5.93	1.27
	Male	377	6.22	1.31
Health	Female	75	4.55	1.23
	Male	372	5.02	1.50

Indexes: SWI and AQOL

Indexes: Means by Gender

Indexes	Gender	N	Mean	Std. Deviation
SWI	Female	76	7.01	1.36
	Male	370	7.21	1.30
AQOL	Female	75	5.46	1.12
	Male	370	5.75	1.24

Independent Samples Test
(Confidence level = 97.5%)

Indexes		Levene's Test for Equality of Variances		T-test		
		F	Sig.	t	df	Sig. (2-tailed)
SWI	Equal variances assumed	0.51	0.476	-1.208	444	0.228
	Equal variances not assumed			-1.171	104.858	0.244
AQOL	Equal variances assumed	0.93	0.335	-1.873	443	0.062
	Equal variances not assumed			-2.005	114.017	0.047

LAW and Single Question QOL

Single Questions: Means by Gender

Single Questions	Gender	N	Mean	Std. Deviation
Life as a whole (LAW)	Female	76	7.82	1.69
	Male	375	7.77	1.81
Single question QOL	Female	76	6.96	2.04
	Male	375	7.13	1.93

Independent Samples Test

Single items		Levene's Test for Equality of Variances		T-test		
		F	Sig.	t	df	Sig. (2-tailed)
Life as a whole	Equal variances assumed	0.635	0.426	0.189	449	0.851
	Equal variances not assumed			0.198	112.865	0.844
Single question QOL	Equal variances assumed	0.113	0.737	-0.671	449	0.502
	Equal variances not assumed			-0.648	104.136	0.518

APPENDIX D

Job Class of Questionnaire Respondents

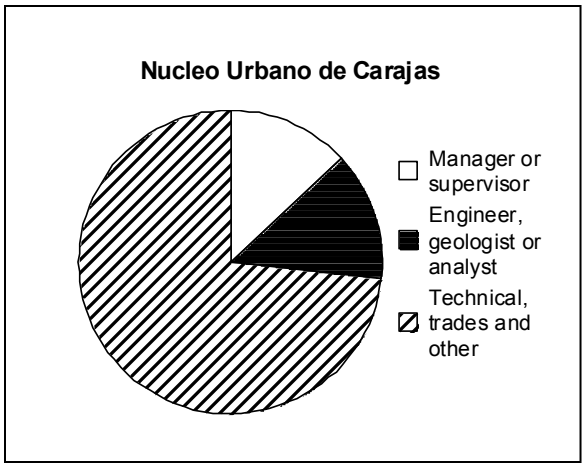


Figure A: Job class in the Núcleo's Sample Population

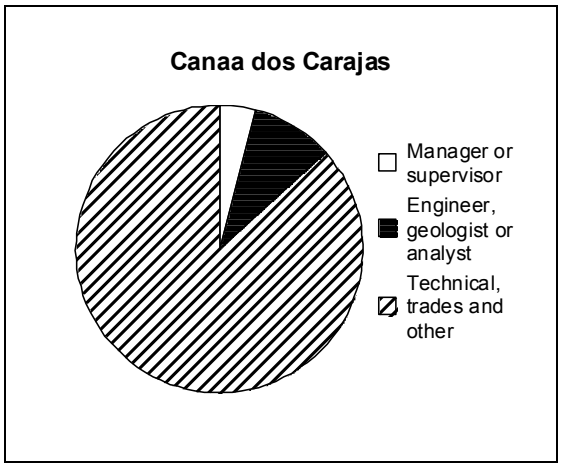


Figure B: Job class in the Canaã's Sample Population

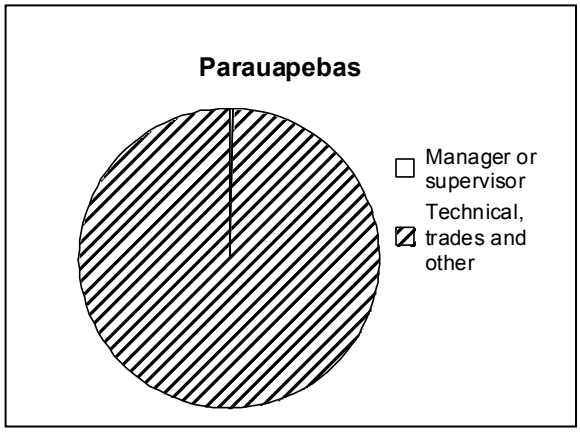


Figure C: Job class in the Parauapebas' Sample Population

Housing Status of Questionnaire Respondents

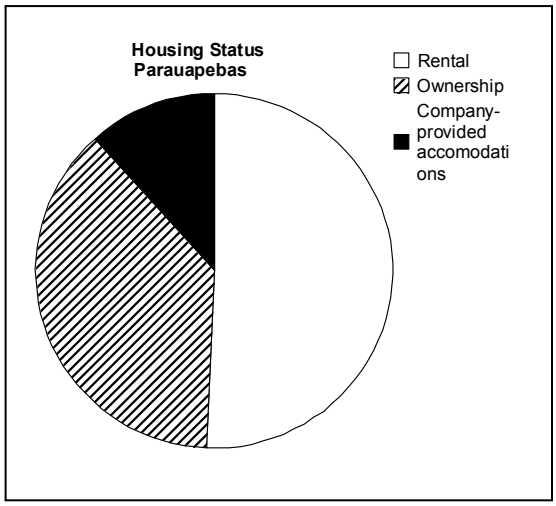


Figure D: Housing Status in the Parauapebas' Population Sample

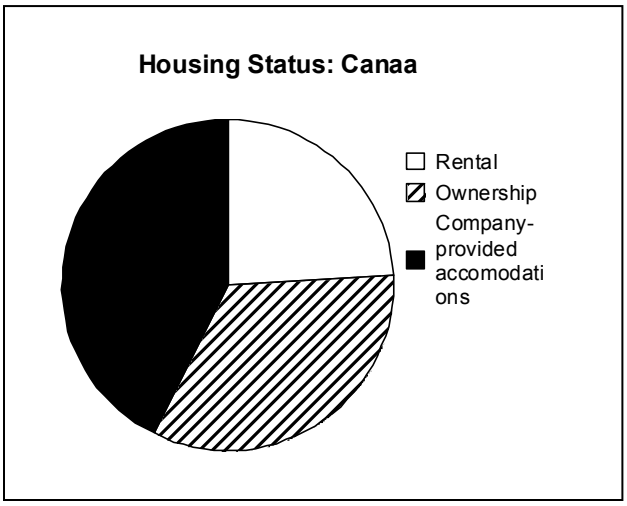


Figure E: Housing Status in the Canaã dos Carajás' Population Sample

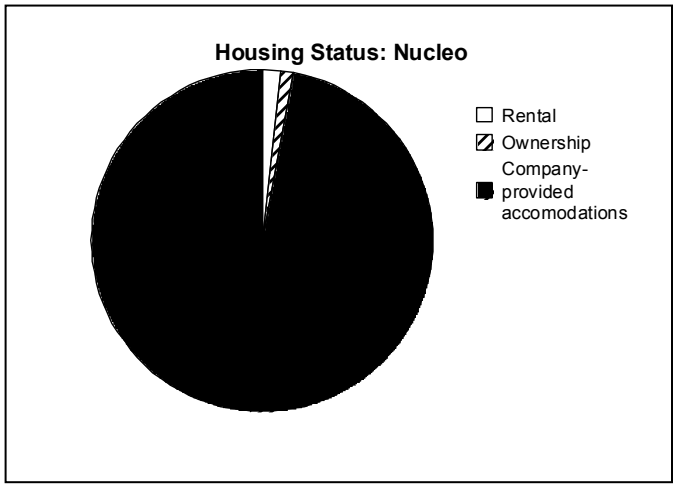


Figure F: Housing Status in the Núcleo's Population Sample