The Establishment of a Sustainable School Information System in Vanuatu: A Case Study of Secondary Schools in the Republic of Vanuatu

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Abstract

Schools in the Republic of Vanuatu began using Information and Communication Technologies (ICT) in the mid-1990s for learning and teaching. The rationale given then for using ICT was that it would improve learning and prepare students for the future work force. Over the years however, it was observed that the practice of integrating ICT into schools was not systematic and this led to the implementation of many school information systems (SIS) that could not be sustained over the long term. This research set out to explore factors that had an impact on the sustainable integration of ICT into schools in Vanuatu. The research used an exploratory case study methodology to examine ICT implementation practices in schools and factors in the school external context that had an impact on ICT implementation in schools. Sustainability literature was used to explore ICT integration into schools in other settings and to examine factors identified in these settings that were considered important to SIS sustainability in the Vanuatu school setting.

The findings of the research revealed three broad categories of factors that impacted on SIS sustainability in Vanuatu schools: the first category was concerned with the importance of using standard information systems development methodologies and practices to implement and operate the SIS; the second was concerned with the importance of the school as an organisation within the Vanuatu school system to align the SIS's functions to its strategic school objectives while at the same time adapting itself to accommodate the SIS; and the third category was concerned with the importance of taking into account the impact of external factors on the integration of ICT to schools. These include such physical factors as the remoteness of small islands, the contributions of the school stakeholder community to SIS development and support and the influence of Vanuatu traditional culture. The findings of the research have been used to develop a set of guidelines for the establishment of a sustainable school information system (SIS) in Vanuatu.

RHD Thesis Declaration

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List of Abbreviations

ASEAN	Association of Southeast Asian Nations
AUD	Australian Dollar
AUSAID	Australian Agency for International Development
BECTA	British Educational Communications and Technology Agency
CQU	Central Queensland University
DFAT	Department of Foreign Affairs and Trade
EdNA	Education Network Australia
EEZ	Exclusive Economic Zone
GNI	Gross National Income
ICT	Information and Communication Technology
IT	Information Technology
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteers
LMS	Learning Management System
MCEETYA	Ministerial Council on Education, Employment, Training and Youth Affairs
MoET	Ministry of Education and Training
NPSO	National Planning and Statistics Office
SDLC	Systems Development Life Cycle
SIS	School Information System
SPC	Secretariat of the Pacific Community
TPACK	Technological Pedagogical Content Knowledge
TVL	Telecom Vanuatu Limited
UNDP	United Nations Development Programme
UNESCO	United Nations Education, Scientific and Cultural Organisation.
USD	U.S Dollar
USP	University of the South Pacific

Chapter 1

INTRODUCTION

1.1 Introduction

Over the last three decades there have been rapid global developments in Information and Communication Technologies (ICT) particularly the global expansion of the Internet in the mid-1990s. These rapid technological developments also fuelled rapid global economic developments which in turn placed greater demands on education systems to be more responsive to the changing environment and to play a leading role in creating knowledge societies. The integration of ICT into education in many nations can thus be seen as facilitating this change. Examples of this include the expanding accessibility of education to a wider community, preparing individuals for the workplace and improving the quality of education.

Globally, the rate of ICT integration into education has varied from nation to nation. In general, more affluent nations such as Australia and New Zealand have made early investments in terms of developing school ICT infrastructures and putting in place fully funded programs for ICT integration into schools. These countries are now more focussed on advanced uses of ICT for teaching and learning. Nations in Asia, many of which were participants of UNESCO's Schoolnet project, have been progressing at varying rates over the last two decades but most already have policies and strategies

in place to integrate ICT into education as well as fully-funded and operating programs (UNESCO, 2004a; UNESCO, 2004b). Schoolnet projects according to UNESCO are "country-level programmes, government or non-profit, that have the objective of developing and supporting the use of ICTs in schools in a developmental rather than market-driven way" (UNESCO, 2004a, p. 16).

In the Pacific region, most small island nations recognised the importance for ICT in schools and started using ICT in classrooms since the mid-1990s. Reports on their experiences in this respect indicate that these nations face many challenges in integrating ICT into schools (USP Capacity Building Program, 2005; Va'a, 2015). Among the main challenges are the nature of small and remote islands, low national economic status, lack of access to advanced ICT infrastructures and a dearth of ICT expertise (Chan Mow, 2014; Va'a, 2015).

The Republic of Vanuatu is typical of many Pacific Island nations in terms of the challenges it faces. It has been integrating ICT into schools since the mid-1990s. While there have been success stories in some schools, there is a general concern about sustaining these systems over the long term especially given the challenges of small island nations as mentioned above. Research concerning the integration of ICT into schools in Vanuatu is limited, thus there is little evidence-based guidance for schools, government and other stakeholders of education on how best to utilise ICT in schools and to identify ICT issues that need resolving.

This thesis documents research that was carried out on the integration of ICT in secondary schools in Vanuatu. The focus of this research was on the sustainable use of ICT in schools over the long term. As such, it explored issues that were considered important in these areas including current practices of implementing ICT systems in schools, the schooling system in Vanuatu and issues that relate to the broader islands

context in which ICT integration into schools is taking place. The research has used an interpretivist approach to investigate issues that were considered significant in the integration and sustainable use of ICT in schools. From these issues, a set of guidelines for the sustainable use of ICT was developed.

This chapter provides an overview of the research. After describing the research background, it explains the rationale and significance of the research and then poses the research questions that were central to the investigation. A brief discussion of the limitations and assumptions follows, and the chapter ends with an outline of how the rest of the thesis is organised.

1.2 Research Background

This section provides an overview of the trends in integrating ICT into schools in the broader context over the last few decades. As well it provides a brief overview of the Vanuatu physical, socio-economic and cultural context in which the integration of ICT into schools over the last three decades has been taking place. This is to provide the background and context in which the research investigation was undertaken.

Advances in Information and Communication Technologies (ICT) and the rapid growth and expansion of the global Internet since the mid-1990s have influenced and transformed the way schools operate and conduct teaching and learning worldwide (Power, 2000). This transformation is also driven in part by the perception of educational institutions and governments on the benefits that ICT can bring about. Three key benefits of integrating ICT into education include the following (Edwin, 2001; UNESCO, 2004a). First, there is a need to develop knowledge-society skills in students such as higher-order thinking skills and life-long learning habits. Secondly,

students need to develop skills and competencies for an ICT rich workplace and thirdly, ICT can address structural problems and deficits in an education system.

A preliminary review of the literature concerning the integration of ICT into education reveals that the rate of integrating ICT into schools vary from nation to nation. More affluent nations typically have more developed ICT infrastructures to support ICT in education as well as better access to technical support (Finance Department, Australia, 2016; Johnson,Wood, & Sutton, 2014). As well, in those nation, national ICT for education policies were also implemented early on and the focus of ICT integration has shifted to the application of ICT for teaching and learning and less on technical aspects (DeBortoli, Buckley, Underwood, O'Grady & Gebhardt, 2014).

In developing nations such as some in Asia and the Pacific region, there have been varying rates of progress in the integration of ICT into schools. In these nations, a number of models and practices for integrating ICT into schools have been tried. UNESCO for instance actively promoted the Schoolnet model 'ICT for Education' in several Asia and Pacific nations (UNESCO, 2004b). In this model, each Schoolnet project involved UNESCO working in partnership with the target nation in which the nation planned, resourced, trialled and rolled out the project. The main aim of a Schoolnet project is to facilitate and support the use of ICT in schools. It enables schools to connect to the Internet, build connections between students, teachers and schools and enables the sharing of resources in an online environment. The following nations participated in the Schoolnet project: Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, Viet Nam.

Since the conclusion of the Schoolnet project in 2004, most of the participating nations have used their experience to develop, fund and implement their

own national ICT integration into school programs. The experience of implementing ICT in schools in the South Pacific region has been different to that of the described UNESCO model above. By the mid-90s, most schools took the initiative of implementing ICT on their own. The central government assisted but had no control or direct support over the school systems (USP, 2005). As information and communication technologies became more advanced, more accessible and less costly, ICT for schools projects that involved partnerships between governments and regional organisations began to be developed. The One Laptop per Child (OLPC) program which began in 2008 is an example of such a project. This is discussed in more detail in Chapter 2. The Samoa SchoolNet project which involved partnership between the government and the Asian Development Bank is another example (Samoa SchoolNet, 2007)

Irrespective of the differences in experience or rate of integration of ICT into schools among nations, there are some common issues and challenges faced by everyone. These issues and challenges will be further considered in Chapter 2, but an overview is provided here. The issues and challenges as identified in the literature include the following:

- the importance of ICT for education policies and strategies to provide the road map that will guide the planning and implementation of ICT integration
- the availability and cost of access to ICT infrastructures as these determine accessibility and affordability of ICT services to schools,
- the importance of ICT leadership in ensuring the successful integration of ICT into schools,
- ICT operation and technical support for the system that is implemented,
- teachers' roles and responsibilities in ICT integration into schools, and

- the importance of partnerships between schools and stakeholder communities in order to leverage resources, skills and expertise to bring about successful integration of ICT into schools.

Much of the literature on ICT integration into schools discuss the issues from an organisational perspective, that is, schools adapting to accommodate and use ICT. This is important, but also important is the technical perspective of setting up ICT systems for the school as an application domain. So, an important focus of this research was on technical aspects of setting up an ICT system in a school. Also absent from much of the literature is research on the influence that traditional culture might have on ICT integration into schools. It seemed to the researcher that in a small island nation such as Vanuatu where most people live in traditional communities that perhaps traditional culture could influence the integration of ICT into schools. So, another important focus of this research was the extent to which traditional culture had an influence on ICT integration into schools.

1.2.1 The Vanuatu Context

A major focus of this investigation is about the extent to which the broader Vanuatu context has an impact on the adoption of ICT in Vanuatu schools. This broader context includes the physical climate, socio-economic and cultural context. This section provides an overview of this broader context. It begins with a brief profile of the nation and then proceeds to describe salient features of the physical, socio-economic and cultural context.

Nation Profile

A brief profile of Vanuatu is presented in Table 1.1 and provides some basic statistics that are relevant to the research (Vanuatu National Statistics Office, 2016; World Bank, 2018a; Vanuatu Ministry of Education and Training, 2018).

Table 1. 1: Brief profile of the Republic of Vanuatu

Statistical attribute	Description/value
Name of Country	The Republic of Vanuatu
Capital	Port Vila
Population (2016)	272,500
Population growth rate	2.3%
Ethnic groups	~ 98% Ni Vanuatu
School age children (6 – 20)	~ 40%
Population under 20 years of age	50%
Rural population	~ 80% (98% live a subsistence lifestyle)
Literacy level	74%
Languages	Native languages: Over 100 Official languages: Bislama, English, French National Language: Bislama
School life expectancy	~ 11.3 years
GNI (2018)	US$870million
GNI per capita (2018)	US$2,970
Education budget	26% of national recurrent budget
Public expenditure on Education	9.6% of GDP
Current annual economic growth	3.2%

As can be gleaned from the above figures, 98% of the national population is Indigenous. Around eighty percent live in the rural areas and live a subsistence way of life. Vanuatu has a young population with over 40% that are of school age. The gross national income (GNI) per capita of $US2,970 compares with a GNI per capita of US$53,190 and US$40,820 for Australia and New Zealand respectively (World Bank, 2018b; World Bank, 2018c)

The physical geography

Like other Pacific Island nations, the Republic of Vanuatu consists of many small islands, in this case over 80 islands spread over 1,600 kilometres in a south-north orientation as illustrated in Figure 1.1 below.

Figure 1. 1 Map of the Republic of Vanuatu.

(Adapted from Nations Online, URL: https://www.nationsonline.org/oneworld/map/vanuatu-map.htm)

The total land area is about 12,000 square kilometres but including its exclusive economic zone (EEZ), it spans a total area of roughly 710,000 square kilometres. The nation is divided geographically into six regional provinces with each province having a provincial government centre that administers the affairs of the national government in the province.

1.2.2 Overview of the Vanuatu cultural and socio-economic context

This section highlights some salient features of the culture of the Indigenous people that were considered important in analysing the activities of integrating ICT into schools.

Vanuatu Indigenous people like many Pacific Island peoples live in village communities. A village community usually consists of a number of extended families living in geographical proximity. Village community members have a strong sense of attachment to the land, their geographic territory and their customs and culture. As well, they value the traditional relationships and alliances they have with neighbouring communities.

Life in the village community is lived at a more leisurely pace than in the towns; a way of life often referred to as the 'Pacific Way' (Mara, 1997). In this way of life, the business of conducting individual and community affairs is done at a slower but more convenient and leisurely pace. The slower pace of living is in harmony with the basic rhythm of life in the islands. Most activities focus on the present and on relating with other people rather than on long term strategic thinking and planning. Today, about 80% of Indigenous people live in village communities often in groups of extended families – the extended family provides security and a sense of identity for members. Social order is maintained through the authority of chiefs and the law. There is respect for authority in the communities and there is also strong conformity to social norms. Schools in the regional provinces serve the local communities who have adopted these types of traditional living arrangements.

1.3 Rationale and Significance of Research

Anecdotal evidence indicates that the current practices of integrating ICT into schools in Vanuatu result in systems that are unsustainable over the long term. As well, a preliminary review of the literature revealed that there is limited research on how to develop, operate and sustain ICT systems in small island developing nations of the Pacific region. Furthermore, there is also limited research that have used the case study methodology to identify factors that are critical to the sustainability of ICT systems in schools in Vanuatu and among Pacific nations. Therefore, the main motivation for conducting this research investigation was to identify those critical factors that impact the sustainability of ICT systems in Vanuatu schools. It is hoped that results of this research would provide further insight into issues concerning the sustainable use of ICT in schools and add to the body of knowledge in this area. As well the results of this research can be used to develop a set of guidelines for developing sustainable ICT systems for schools in Vanuatu. These guidelines could aid the government in making decisions about ICT policies for schools and would be useful for schools in setting up and operating ICT systems that are sustainable. They would also be helpful for the school stakeholder community, in particular the aid donor agencies, in focussing their assistance to ICT related project in schools.

1.4 Research Aims, Questions and Objectives

This research was conducted in the context of emerging trends of ICT use in the education sector in Vanuatu and in other Pacific Island countries and it explores factors influencing the use of ICT in Vanuatu schools. The overriding aim of the

research was to identify those factors that can have a significant impact on long term sustainability of information systems in Vanuatu schools.

To identify factors that were critical to the sustainable use of ICT in Vanuatu schools, the following research questions were used.

RQ1. What are the current practices for integrating the use of ICT into secondary schools in Vanuatu?

RQ2. In what ways have Vanuatu schools adapted to enable the integration of ICT into the school?

RQ3. How does the context in which ICT is implemented influence the use of ICT in schools?

This research question is broken down to the following sub-questions:

- SQ3.1 In what ways do the physical climate and socio-economic contexts of Vanuatu influence the use of ICT in schools?
- SQ3.2 In what ways does the Vanuatu cultural context influence the use of ICT in schools?
- SQ3.3 In what ways does the school stakeholder community assist in the integration of ICT into schools?

RQ4. What do the school ICT practices, school adaptation experiences and Vanuatu contextual factors elucidated in RQ1, RQ2 and RQ3 reveal about guidelines for integrating sustainable ICT systems in Vanuatu schools?

Research question 1, focusses the investigation on issues concerning the type of ICT system that a school chooses to implement, and any systems development, operation and support strategies used. Research question 2 is focussed on issues concerning the readiness of schools to operate an ICT system. This is in terms of the alignment of school business activities which benefit from the services provided by the ICT system, funding sources, staff ICT capacity levels and long-term planning.

Research question 3 focusses on issues concerning the broader Vanuatu context in which ICT is being implemented. Finally, research question 4 analyses and synthesises results obtained in the first 3 research questions in order to develop a set of guidelines for the sustainable use of ICT in schools.

1.5 Research objectives

The following objectives address the research questions posed:

1. Undertake a literature review to:

   a. Identify research and documentation concerning the practice of using of ICT in schools in several developing countries to identify a range of critical success factors.

   b. Identify research focussing on the broader issues of using ICT systems in a sustainable manner in a given context and identify the range of critical success factors that contribute to sustainability

2. Use case study methodology in a sample of schools in Vanuatu to examine:

   a. the current practices of developing, operating, managing and using ICT in schools (RQ-1)

   b. the ways in which schools are adapting so they are ready and equipped to operate an ICT system (RQ-2)

   c. the broader Vanuatu context in which ICT is implemented and how this influences the use of ICT in schools (RQ3)

3. Use the results of the research to develop a set of guidelines for the sustainable use of ICT in Vanuatu schools (RQ4).

1.6 Limitations and assumptions

Four limitations apply in this case study research. Firstly, the research is confined to a small Pacific Island country that is Vanuatu. Thus, the findings may only apply to Vanuatu. However, the findings may be applied to other small island nations in the Pacific region where the context and ICT issues are similar to those of Vanuatu. Secondly, the research concentrates only on ICT use in secondary schools as this is the level where more schools are using ICT and therefore the level where a more representative sample of cases were investigated. Thus, the results of the investigation may only apply to the use of ICT in secondary schools. Thirdly, the data collected represents only the perception of participants in schools and from a selected number of staff members from the Ministry of Education and Training (MoET). Due to time constraints, the perceptions of other school stakeholders such as aid donor agencies and non-governmental organisations which have participated in integration of ICT into schools in Vanuatu were not sought. Thus, the results concerning stakeholder participation in the integration of ICT into schools may reflect only the views of staff from schools and the Ministry of Education. Finally, although ICT components includes Television and Radio broadcast technologies, this research has concentrated on the use of computers in schools. The reason for this, was that at the time of the investigation there were no national educational television programs or educational radio programs in Vanuatu. Thus, the results may apply only to one aspect of the application of ICT in schools, namely the use of computers in schools.

1.7 Definition of Terms used in this thesis

This section presents the definitions and terminologies most commonly used in this research as definitions of terms used in this area are not uniform. It is therefore important to define commonly used terms to avoid ambiguity.

Anglophone secondary schools These are schools where the medium of instruction is in English.

Information and Communications Technology (ICT). This term refers to the integration of computer networks with audio-visual and telecommunication networks which enable users to access, store, transmit and manipulate information electronically in a digital form.

Information technology (IT) IT is the term used for "any equipment or interconnected system or subsystem of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency." (National Institute of Standards and Technology, n.d.)

Francophone secondary schools These are schools in which the medium of instruction is French. English is taught as a subject

Secondary school Secondary school level in Vanuatu is currently from year 7 to year 12. Junior secondary school level runs from year 7 to year 10.

School Information System (SIS) A particular implementation of ICT for a school.

Stakeholders In the context of this study, stakeholders include all those organisations, associations or groups that have an interest in schooling in Vanuatu.

Teaching Service Commission This is the national body that is responsible for recruiting teachers and dealing with staff personal matters.

Village communities These are communities of people in the islands. Today, they are a mix of people from different tribes, religious and political affiliation but before the colonial era all members of a community belonged to one tribe.

1.8 Organisation of the Thesis

This section outlines the structure of the thesis.

Chapter 1 – Introduction

This chapter introduces the research topic and discusses the research background which include the context in which the use of ICT in schools is occurring. The chapter explains the rationale for carrying out the research and states the research aims and objectives, the research questions and the limitations and assumptions. It concludes with an outline of the structure of the thesis.

Chapter 2 – Literature informing the research

This chapter contextualises the research through a discussion of the literature covering the practice of using ICT in schools and issues that are important to the sustainable use of ICT in the broader context. The issues are assembled as components of a framework within which the research was designed and implemented. This chapter will synthesis the literature to in order to highlight the gaps in the research.

Chapter 3 – Research Design and Methodology

This chapter discusses the research methodology adopted. It begins by discussing the philosophical framework to situate the research. It then discusses the Case Study research method and how it is used in the research. It discusses the design methods, the selection of samples and the data collection methods chosen.

Chapter 4 – Instrument Design, Data Collection and Analysis

This chapter focuses on the design and development of the data collection instruments, the data collection process and data analysis. First the design and development of the data collection instruments are discussed. This is followed by a discussion of the data collection process and finally an explanation of the method used to analyse the data is discussed.

Chapter 5 – Results

This chapter presents the results of the research. First an explanation is given of the methods used to present the results from each of the data sources. The results are then presented, followed by a summary that highlights the key findings.

Chapter 6 – Discussion of Results

This chapter discusses the results presented in Chapter 5. The results are discussed in the context of the research questions proposed in Chapter 1. The discussion is informed by the Vanuatu context covered in Chapter 1 and literature covered in Chapter 2. The chapter concludes with a list summarising the main findings of the research.

Chapter 7 – Conclusions and Recommendations

The final chapter draws together conclusions from the study and presents a set of recommendations. The research findings, in combination with the literature presented in Chapter 2, are summarised and used in the development of a set of guidelines for the sustainable use of ICT in Vanuatu schools. The chapter also highlights the contribution of this investigation to research in the use of ICT in schools.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

This research investigated the sustainable use of Information and Communication Technologies in schools in the Republic of Vanuatu. The research questions posed in Chapter 1 set the focus of the investigation on three central issues namely, the practice of integrating ICT into Vanuatu schools, the readiness of schools to adopt ICT and issues relating to the context in which ICT in schools are used. The key aim of the investigation was to highlight factors that were relevant to the sustainable use of ICT in schools in the Republic of Vanuatu. The purpose of this literature review is to both present and critique relevant literature sources that inform the research concerning the three issues. Accordingly, it examines:

- the extent to which the physical, economic and socio-cultural context in which schools using ICT are located have an influence on the sustainable use of ICT,
- practices used for integrating ICT into schools in different contexts including both, the successful approaches that schools in different contexts are utilising ICT and the challenges they face,
- the various standards, technologies and principles for developing, implementing, using and sustaining information systems, and
- sustainability theories and practices.

The literature presented is used to inform the discussion of the results in Chapter 6 and for formulating the guidelines for the sustainable use of ICT in Vanuatu schools presented in Chapter 7.

A preliminary review of the literature reveals several issues. It firstly reveals that while substantial research has been undertaken on ICT in schools, most of the research has been conducted in schools in developed nations with less research carried out in developing nations and in the Pacific region in particular. The literature also reveals that nations are at different stages in their projects of integrating ICT into schools, and thirdly it reveals that the focus and priorities for integrating ICT into education in poorer nations are often different from those in affluent nations (UNESCO, 2004b; BECTA, 2006).

Although the focus of this research is on the sustainable use of ICT in Vanuatu secondary schools, there is little literature directly related to this research topic. Therefore, it was necessary to broaden the scope of this review to also focus on the integration of ICT in schools and other educational institutions in other nations. As such, four themes are identified and discussed in this literature review: the Vanuatu external context that could influence the integration of ICT into schools; documented experience of ICT integration to schools in different parts of the world; standards and models for developing and operating information systems in general; and sustainability theories that are applicable to this research. The literature reviewed in this chapter includes published research, government reports, and reports from regional and international organisations. An overview of the Vanuatu external context follows in order to place the study in context.

2.2 The Vanuatu school external context

As alluded to in Chapter 1, several factors in the Vanuatu external context were considered to have an influence on the integration of ICT into schools. These include the physical geography and climate of the islands, the socio-economic status of the nation, its traditional culture, ICT infrastructure and national school system. Thus, this

research took these factors and their influences into account during the investigation. An overview of the Vanuatu geographic, socio-economic and cultural context was provided in Chapter 1. The next two sections provide an overview of the Vanuatu education system and national ICT infrastructure.

2.2.1 Education System background

In order to understand the secondary school in Vanuatu as an organisation hosting a School Information System (SIS) and the issues and challenges it faces in this respect, it is important to understand the system in which the school is embedded, namely the national education system.

Vanuatu has an education system it inherited from Britain and France, the former colonial powers that governed the country in the 20th century. Thus, it has English medium (Anglophone) schools as well as French medium (Francophone) schools. Currently, the split between Anglophone and Francophone schools is in the ratio of 70 to 30 percent respectively (MoET, 2018). The bilingual nature of the education system carries with it significant costs as it requires the duplication of many components of the education service, including the national curriculum, teaching resources, translation services and administration.

The education sector's budget is about 24% of the national budget (Vanuatu National Statistics Office, 2016) and virtually all of it is allocated to the sector's recurrent budget. On the other hand, almost the entire education development budget is sourced from external aid donor governments in the form of bilateral and multilateral aid (MoET, 2018). External aid is thus vital to the national education development process.

Education Organisational structure

The Vanuatu education system like other government sectors in the nation is hierarchically structured with the Ministry of Education and Training (MoET) as the central education authority. Within it are departments, sections and units. In addition, each of the six provinces in the nation has a Provincial Education Office (PEO) which administers the affairs of the MoET at the provincial level. Thus, for most educational administration matters, schools interact with the Provincial Education Office in the first instance. It is a policy designed to decentralise the education system and devolve more powers and responsibilities for the administration of schools to the provinces.

The national school system

The Vanuatu national school system, like in many other Pacific nations, has primary, junior secondary and senior secondary levels. The years of progression and student age ranges are shown in Table 2.1 below. The school enrolments are for the year 2018 (MoET, 2018).

Table 2. 1 Years of progression and age ranges in Vanuatu schools**.**

Level	Years	Ages	Total enrolments
Primary	1 - 6	5 - 10	53,000
Junior secondary	7 - 10	11 - 14	20,000
Senior secondary	11- 13	15 - 17	

English is the main language of instruction in Anglophone schools and post-secondary institutions and French in Francophone schools and post-secondary institutions.

Administration in a typical secondary school

The set up and administration of a typical secondary school is important for understanding the issues in deploying and operating a school information system. In a

typical full boarding secondary school (Years 7 to 13), the school administration would consist of a Principal, a Deputy Principal, up to six members in the administration and a similar number of general staff. The number of teaching staff varies depending on the size of the school in terms of student enrolments and the type and number of subjects it offers. The staff to student ratio in secondary schools in 2018 was 1 to 20.4 (MoET, 2018).

A school typically has a school board whose members are selected from members of the local community. The function of this body is of an advisory nature, but it has influence on the appointment of some categories of staff and this is particularly true of many church-owned schools. The school board is a further way of involving the local communities in a local secondary school. In terms of school infrastructure, a typical secondary school will have building facilities including classrooms, an administration building, a staffroom, a library and computer laboratories all of which can have a computer system be extended to them.

School Statistics

In 2018 the Ministry of Education and Training (MoET, 2018) published the following statistics about secondary schools in Vanuatu:

- There were 104 registered secondary schools in the nation. These were distributed over the six provinces of the nation.
- Of these 49% were government owned, 44% were church owned and government assisted, and 7% private.
- Of the 104 secondary schools, 70% were Anglophone and 30% Francophone.
- 70% of the secondary schools were classified as rural meaning that they were outside of Port Vila and Luganville, the two main urban centres in the nation.

In terms of school size, the church run schools are on average smaller than government owned schools and staffing levels are lower as well. Before Vanuatu got its independence in 1980, there were as many Francophone schools as there were Anglophone. The number of Francophone schools have since declined due to a policy shift in government which favoured Anglophone schools. These schools face many challenges in carrying out their operations such as the high costs of transportation of equipment and services between islands.

2.2.2 Telecommunication Infrastructure in Vanuatu

Telecommunication services are an important component of ICT in schools as they enable internet access and other electronic forms of communication and interactions within a school, and between schools and the stakeholder community. This section highlights important features of the national telecommunication infrastructure that are relevant to this research.

First it is important to make the point that new ICT component technologies are increasingly becoming more available in Vanuatu. As they do so, they are likely to impact on the way schools implement, expand and upgrade their school information systems. Two main telecommunication service providers currently operate in Vanuatu: Telecom Vanuatu Limited and Digicel. Both provide land-based as well as mobile-based telephony services. As well, they provide internet services throughout the islands via microwave-based communication networks. The basic services cover all the islands but the higher bandwidth services, for example fourth generation (4G) mobile services, only cover the main urban centres. Since 2014, Interchange Cable Network (Interchange Cable, n.d), a national telecommunication carrier company, has provided an under-sea fibre optic cable connection from Vanuatu to Fiji where a hub

of the high speed Southern Cross cable (Southern Cross Cable Network, n.d), linking Australia and the US, is located. The Vanuatu fibre optic link has a capacity of 20Gbit/sec which is 200 times faster than the previous telecommunication links provided via satellite technology and is expected to be upgraded to 1280Gbit/sec (Interchange Cable, n.d)This high-speed link to the outside world has made it possible for Vanuatu schools to obtain high speed access to the Internet.

2.3 Literature on the use of ICT in schools

The basis of this research study was to discover factors that are important for the sustainable use of ICT in Vanuatu schools. This section reviews the literature on the integration of ICT into schools and other educational institutions in general. Much of the review focuses on the experiences of nations in the Asia-Pacific region. The purpose of the review is to highlight those aspects of ICT integration that the literature considers significant and which can be used to inform this research investigation. The review is organized in terms of the following aspects: the school and ICT, global trends in the integration of ICT into schools, factors that influence ICT integration into schools, theories for the sustainable use of ICT, and standard methodologies for developing and operating information systems.

2.3.1 The school and information and communication technologies.

Although many aspects of the integration of ICT in schools are discussed in the literature, the two main components are the school as an organisation on the one hand and ICT on the other. Understanding the characteristics of these assists in understanding the issues that are involved in the process of integration ITC into schools. This section provides some definitions and salient characteristics of schools and information and communication technologies.

2.3.1.1 The school as an organisation

The school is an organisation with several characteristics that are relevant when investigating the integration of ICT into schools. In many nations, the school is part of the wider schooling system operated by the national government. In this respect, the basic school organisational structure, its policies and its functions are framed and regulated by national education authority. This includes schools that are owned and operated by government as well as privately-owned ones. Thus, a school's organisational structure and functions are generally well known, they are stable and change relatively slowly over time. A school's core business is about imparting knowledge to young people in a certain age range through a teaching and learning process. These aspects describe the type of application domain into which ICT is to be integrated and thus is important to consider in the strategic planning stage of a school information system. Like other stable organisations, over time, a school usually develops a strong organisational culture which can be identified by its values, beliefs, traditions and practices (Divaharan & Ping, 2010; Tondeur, Devos, Van Houtte,Van Braak & Valcke, 2009). As an organisation with a strong administrative culture, a school's operations are usually highly organised, members of the school staff hold a widely shared set of values, staff are committed and work as a team. The effects of a strong school organisational culture can impact the integration of ICT into school in several ways and these need to be considered in the planning stage of the ICT system.

2.3.1.2 Information and Communication Technology (ICT)

The term ICT is used a lot in the literature without definition and it is assumed readers know what is being referred to. It is also sometimes used synonymously with other terms like Information Technology (IT). Although there are similarities and there is a blurring in the definitions as technologies evolve, there are distinctions between them,

and these are explained in this section in order to contextualize the discussions in the rest of this chapter.

There is no universally accepted definition for information and communication technologies (ICT) and the reason for this is that components of ICT and concepts associated with ICT are evolving all the time (Zuppo, 2012; Techterms, 2010). However, as the term implies, ICT consists of the use of components of computer-based technologies and digital communication technologies for a defined purpose or set of purposes. Traditionally this was understood to include disparate components of computer and network hardware and software, radio, television, cellular phones, satellite systems and so forth. With recent technology advances however, both information technologies and communication technologies are increasingly converging, becoming more integrated and in many cases becoming more miniaturized so that it is possible, for instance, to have digital communication components as tools or applications operating from within a computer-based system (Hennessy et al., 2005; Kumar, 2008). An Information System (IS) is a particular implementation of ICT components for a given application domain for the purpose of collecting, processing, storing and outputting data (Satzinger, Jackson & Burd, 2012).

2.3.2 Global trends on the uptake of ICT in education

This section reviews the literature on some global trends on the integration of ICT into education over the last three decades. This is to provide a historical perspective on how the integration of ICT in education has evolved over the years and to highlight some common trends experienced by schools, stakeholders and governments in the integration process. This background will provide the context for discussing particular issues in the next section.

Many initiatives for integrating ICT into schools that are discussed in the literature can be described as top-down national programs in which the planning, funding and implementation was carried out by the national government and then rolled out across the schools over a project period. This is perhaps to be expected since the school system in a nation is an integral part of the broader national education system so that any reforms carried out in schools has to be done at a national level. In Asia, UNESCO has been instrumental in trialling and promoting the integration of ICT into schools at the national level through its Schoolnet project. UNESCO defines *Schoolnets* as country level programmes, that have the objective of developing and supporting the use of ICTs in schools in a "developmental rather than market-driven way" (UNESCO, 2004a). The Schoolnet project has three broad aims as follows:

a) explore and demonstrate how ICT can be used in schools to improve the quality of education and better prepare youth for the demands of the Knowledge Society;
b) test innovative models of ICT use in schools and in other places of learning; and
c) improve connectivity and access to educational resources through the establishment of Schoolnets in Southeast Asia. (UNESCO, 2007, p. 14).

Participating nations were members of Association of Southeast Asian Nations (ASEAN) and included Cambodia, Indonesia, Lao, Malaysia, Myanmar, Philippines, Thailand and Vietnam. The lessons learned from UNESCO's Schoolnet project provided guidance and a framework for integrating ICT into schools in these nations. By the conclusion of UNESCO's Schoolnet project in 2006, most participating nations had already committed to establishing and funding national programmes for integrating ICT into schools. In Thailand for instance, responsibility for Schoolnet

was transferred to the Ministry of Education and Training (MoET) in 2003 as part of the effort to develop the national education network (known as EdNet) (Rattanakhamfu, 2016).

In Latin America, Chile's Enlaces program which began in the 1990s has been one of the success stories for integrating ICT in schools. In this project, the government committed to funding and providing ICT resources to schools. By 2005, 88% of primary and 85% of secondary schools participated in Enlaces, covering 93% of the student population (Hinostroza, Labbé, & Claro, 2005). In more affluent nations like, Australia and New Zealand ICT integration into schools began in the early 1990s and progress has been more advanced than in poorer nations like small island nations of the Pacific region. In these nations "almost all classrooms are well equipped with computers and other ICT tools; the student/computer ratio is high; internet access is available in all schools; curriculum revision ensures nationwide ICT integration; and delivery of education is increasingly online" (UNESCO, 2004b, p.9). In Australia for instance, White (2008), noted that by 2004 there was least one computer for every five students.

In Pacific Island nations, ICT integration in schools has lagged somewhat behind those in Asia and Australia and New Zealand. A number of challenges face Pacific Island nations including the lack of relevant ICT policies in some nations, insufficient funding to implement the policies and poor ICT infrastructure penetration (Chan Mow, 2014). As well, the challenge of many small and scattered islands presents physical barriers to integrating ICT into schools.

2.3.2.1 Global Trends in ICT integration into schools.

The literature on the integration of ICT into schools at a national level as highlighted above, sheds light on some general trends in the process of integrating ICT into

schools. First, as more nations become aware of the power of ICT to transition societies to the information age (UNESCO, 2004b; Collins & Halverson, 2010), ICT integration into schools is becoming a global phenomenon. Second, the evolution of new information and communication technologies particularly the Internet and the availability of portable mobile devices such as smart phones, has a global influence on the integration process similar to the way an ebbing sea affects boats floating on it. Thirdly, integrating ICT into schools at national level is a long-term undertaking requiring continuing commitment by government. And fourthly, the rate of progress in integrating ICT into schools differs from nation to nation depending on many factors but among them the availability of resources, relevant policies, the actual education system and physical constraints. Because of the foregoing, nations will have their own unique challenges in the integration process. This implies that some nations or institutions can learn from those that have progressed further in the integration process but must frame the solutions to the challenges they face according to their contexts. Over the last two decades, these experiences have been documented by global organisations such as UNESCO (2004a & 2004b), BECTA (2006) and OECD (2001).

In the Pacific region there have been a number of projects to integrate ICT into schools over the years. The People First Network (PFNet) in the Solomon Islands is an example. The aim of this rural connectivity project was to promote sustainable rural development and to connect schools and students (Leeming, 2003). The One Laptop Per Child (OLPC) is another one and is discussed in more detail in section 2.3.3.9. However Pacific Island Nations face many challenges among them a lack of financial resources, high telecommunication costs, lack of technical expertise (USP, 2005). Also as pointed out by Lingam, Rauri and Finau (2015, p. 342) “these

challenges are further compounded by the lack of government initiatives and concerted effort in formulating policies for promoting and sustaining development."

In Vanuatu, schools have been adopting ICT since the mid-1990s. ICT was first used in a couple of schools in Port Vila and Luganville, the two main urban centres of the nation, and then gradually spread to schools in the more rural and remote islands in the provinces. By 2006 around thirty secondary schools had implemented a SIS in some form. Typically, this implementation consisted of the installation of computers in laboratories for teaching and in the administration departments for administration type of work. A survey by the University of the South Pacific's ICT Capacity building project (USP (2005, p. 75) showed that access to technical expertise was lacking and there was no official government support in terms of national policies for ICT in schools and funding. With respect to ICT use, at the time of this research, productivity software tools such as those of the Microsoft Office suite and others were the typically used software both for administration and teaching and learning. No specific Learning Management Systems (LMS) such as Moodle or Blackboard were used, and neither were there any specialised human resource software systems or packages.

Since ICTs were relatively new in Vanuatu and technologies were changing at a fast pace, there were bound to be issues about how schools would adapt in terms of changing their business processes to accommodate the introduction of ICTs. Of particular interest in this research were SIS issues relating to:

- access to technical expertise for SIS development, operation and staff support,
- funding sources to support SIS development and ongoing operation,
- the involvement of staff in SIS development, operation and use,
- access to relevant ICT infrastructures, and
- the role of government in supporting ICT for schools.

2.3.3 Factors affecting the integration of ICT into schools

This section reviews the literature on the experiences of schools in different settings in integrating ICT into schools. Issues highlighted will assist in trying to understand current practices of integrating ICT into schools in Vanuatu.

2.3.3.1 Rationale for the use of ICT in education

Some broad rationales can be identified to justify and promote investment on ICT in schools. At the global level ICT in schools can contribute in transitioning societies to the information age (UNESCO, 2004b; Guttman, 2003; Litz, 2011; Wadi & Sonia, 2002). Assar, Amrani and Watson (2010) claim that ICT in education systems will, in the end, improve society's overall capacity to engage its citizens to contribute to their personal development as well as the development of society as a whole. UNESCO (2004a & 2004b) list the following as some of the main rationale for integrating ICT into schools:

- ICT can assist in developing knowledge-society attributes in students such as higher-order thinking skill, life-long learning habits and critical thinking skills,
- ICT skills and competencies can prepare students to operate in an ICT-rich workplace, and
- ICT can assist in addressing structural problems and deficits in education systems.

Furthermore, Mellar, Kambouri, Logan, Betts, Nance and Moriarty (2007) claim that if ICT is appropriately and effectively integrated into the school curriculum, it can lead to improvement in students' literacy, confidence, and ICT skills. Other researchers claim that if integrated appropriately, ICT has the potential to shift traditional approaches to learning and teaching towards constructivist methods (Pelgrum & Anderson, 1999). The foregoing intimates that ICT tools and techniques

can mediate and enhance the learning process through the sharing of ideas and opinions with others and then reflecting on the sharing of these (Orlando, 2013). In the 1990s when ICT was seen as a potential vehicle for progressing economic development, there was a belief among developing countries that ICT could be used as a means for fast-tracking their transformation to developed countries (Warschauer, 2003). In this respect, a number of countries in Latin America, Asia and Africa did invest in ICT generally and specifically ICT in schools. For instance, Hinostroza, Labbé and Claro (2005) reported on the success of Enlaces - Chile's ICT for schools project, and Evoh (2007) has reported on policies for ICT in schools in Africa. According to Tinio (2002) and Gutterman, Rahman, Supelano, Thies and Yang (2009), ICTs help expand access to education. A reason for this is that it can enable anytime, anywhere learning because it increases access to remote learning resources. In this respect, ICT access can transcend geographic distances and extend educational opportunities to marginalized and vulnerable groups.

2.3.3.2 Education and External context

There are several factors in the environment in which a school operates an ICT system that are important because they influence the operation of the system. These include the education system in which the school is part, the ICT infrastructure in terms of telecommunication services and Internet services, the economic and socio-cultural context and the school stakeholders in the general community. These aspects are now briefly considered.

ICT for Education Policies

Although ICT has been used in schools for nearly five decades now, the development of national ICT for education policies is a more recent trend among nations. While some developed nations had comprehensive ICT for education policies early in the

1990s, many developing nations lagged behind in this respect, due to factors such as a different priority about integration of ICT into education, a lack of clear objectives and plans, a lack of resources to implement the policies and a lack of the necessary infrastructures (Pelgrum, 2001; Pelgrum & Law, 2003; Younie, 2006). Educational ICT policies are required so that the right set of conditions are put in place in order for the full benefits of ICT to be realised (Kozma, 2008; Trucano, 2016). A lack of ICT educational policies often leads to the misallocation of resources which in turn leads to a further lack of resources. For instance, with a lack of such policies, there is a tendency to be technocentric and emphasise the installation of hardware and software rather than focussing on the learning benefits (Ng, Miao & Lee, 2009). As Guttman (2003) and Haddad (2007) point out, in developing ICT for education policies, policy makers should first determine the educational purposes that ICT will serve. It means clarifying its purpose in the context of the overall education policy. This serves as both the rationale and road map for integrating ICT into schools. With the ICT for education purpose in place, the policy makers can then determine what approach to use in integrating ICT into schools. Three approaches that have been suggested (Farrell & Wachholz, 2003; Pelgrum & Law, 2003) and used in some Asia Pacific nations are:

- teaching ICT as a subject in its own right, usually beginning at the upper secondary level, to develop a labour force with ICT skills,
- integrating ICTs across the curriculum to enhance teaching and learning process, and
- using ICTs to foster learning anywhere and anytime as part of the development of a knowledge society in which all citizens are ICT literate.

Understanding how this ICT integration into school process evolves over time helps policy makers make the right decisions. Pelgrum and Law (2003) identify five areas that ICT for education policies typically focus on. These are:

1. the need to train ICT professional staff; ICT staff as well as teaching and school administration staff need training,
2. delivering an IT-literate work force for national development,
3. enhancing education effectiveness,
4. enhancing access and equity, and
5. education reform to prepare for the challenges of the twenty-first century.

Vanderlinde, van Braak & Dexter (2013), suggest that an ICT policy has the following five dimensions: vision development, financial policy, infra-structural policy, continuing professional development policy, and curriculum policy. These should be put in place so that they can guide the process of ICT integration into schools.

Nowadays, many nations have a national policy supporting the use of ICTs in education which is usually aligned with the national ICT policy and other policies including those for ICTs in economic and social development (Kozma, 2008; Trucano, 2016). The alignment of these policies supported by funding commitments, makes it easier for schools to implement their information systems.

In the Pacific region, as more advanced information and communication technologies have emerged over the last decade, small island nations are realising the need to develop formal ICT for education policies. In Fiji for instance, the national ICT for education policy focusses on improving quality ICT education programmes and includes strengthening distance education learning, support for the delivery of e-learning technology and resources, enhancement to the learning teaching process and

the harnessing of education through ICT (Government of Fiji, n.d). In Samoa, the national ICT for education policy focusses on standardising technical resources across educational institutions, providing sustainable technical support, providing reliable communication services across all levels of education and taking a more strategic approach to the management of ICT services for education (Va'a, 2015). Vanuatu launched its national ICT policy in 2013 (Vanuatu ICT policy, 2013) with a strong focus on ICT for Education. Similarly, the Solomon Islands implemented its national ICT policy (SI ICT policy, 2015) with a focus on ICT for Learning. Kiribati implemented its national ICT policy in 2019 (Kiribati ICT policy, 2019) which included a focus on e-learning.

ICT Infrastructure

With respect to national ICT infrastructure, a school ICT system can only be operational insofar as the available ICT infrastructure components and services enables it. Some of these infrastructure components include electricity, computer and network hardware and software, telecommunications services, Internet connectivity and a strong technical support base in the community. In Pacific Island nations, there have been recent increases in telecommunication bandwidth between countries with the introduction of undersea cables to replace the older satellite telecommunication systems. For example, the Southern Cross undersea cable running between Australia and the US passes through a node in Fiji which increases Fiji's telecommunication bandwidth by several orders of magnitude (Southern Cross Cable Network, n.d). A branch of this cable connects from Fiji to Vanuatu and then to Samoa which also increases the bandwidth in those two countries (Interchange, 2017). Within these nations, new wireless technologies have been recently commissioned to connect the islands and take advantage of the new undersea cable network. In this way, the islands

have better Internet access. In other Pacific island nations, Va'a (2015) highlights Kiribati, the Solomon Islands and Papua New Guinea as experiencing limited telecommunication bandwidth which has an impact on Internet access by schools in those nations. Kiribati because of its remoteness in the Pacific, and with islands far-flung across the Pacific Ocean, has up to now been serviced by satellite telecommunication technology, which is slower than cable telecommunication technology and this impacts on its efforts in the integration of ICT into education. Papua New Guinea and the Solomon Islands are in the same situation although there are now plans for a high-speed undersea telecommunication cable connecting Australia and those two nations (DFAT, 2018).

These projects will increase telecommunication bandwidths to Papua New Guinea and the Solomon Islands however, access costs will still be relatively higher in those nations because people have low disposable incomes. In comparison to Pacific Island nations, other nations like Australia, New Zealand, Malaysia and Singapore enjoy telecommunication systems with very high bandwidth.

An education system's openness to change is another important factor to consider when implementing a school ICT system. Those nations in the Asia Pacific region which have more advanced ICT infrastructures and economies have been able to undertake curriculum review processes that are open to incorporating ICT into schools. These include Australia, New Zealand, Malaysia, Singapore (UNESCO, 2004b). Many of these nations consider ICT as a driver for making changes that address some existing problems in the education system (UNESCO, 2004b).

2.3.3.3 ICT Leadership, Management and Planning

The importance of school leaders to have strong leadership and management skills in the integration of ICT into schools is widely documented in the literature (for

example, Schiller, 2003; Dawon & Rakes, 2003; Afshari, Abu Bakar, Luan, Abu Samah & Fooi, 2008; Betz, 2000; Anderson & Dexter, 2005; Neufeld, Dong & Higgins, 2007; Dinham, 2005; Flanagan & Jacobsen, 2003). Strong leadership and management skills are required in setting up a school ICT system and rallying the staff around the new initiative. It is thus important to understand what aspects of leadership are important for school leaders to possess in order to make a positive impact on ICT integration into schools. According to Afshari et al, (2008), ICT integration will be more effective if school leaders support them, use them for teaching and administration, actively support and encourage their staff to use them, and provide ICT training opportunities for staff.

The idea of leaders as champions of ICT has been used to encourage and motivate school staff to take leading roles in assisting with the operations and support of a SIS (Howell & Higgins, 1990; Neufeld et al., 2007; Rogers, 2005). A champion is a "charismatic individual who throws his or her weight behind an innovation, thus overcoming indifference or resistance that the new idea may provoke in an organisation" (Rogers, 2005, p. 414). There is a recognition of the fact that in a school, some staff have either ICT skills or skills that can be used to provide some aspect of support for the SIS. In nations or regions where ICT technical experts are scarce such champion roles can be very useful. Confidence, persistence, energy and risk-taking are key characteristics of champions (Howell & Higgins, 1990). In order to be a successful champion, Stuart, Mills and Remus (2009) found that a necessary requisite skill is a certain level competence in ICT. A study by Schiller (2003) in Australian schools found that although about 60% of principals surveyed said they had some knowledge of ICT they did not see themselves as technology leaders. In another study Hu, Clark and Ma (2003) found that teachers' perception of their

competence in using ICT affected their willingness to adopt new technology, thus the more confidence they have in using ICT tools, the more likely they are to advocate and promote the use of ICT in schools. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) with its wide experience in coordinating its Schoolnet project in ASEAN nations concluded that school leaders need a minimum level of competence in using ICT in order to lead and manage the adoption of technology in schools (UNESCO, 2007).

Much of the literature on ICT leadership in schools focusses on leadership qualities; about leaders who can be trusted, who have vision a for the future of the organisation which they communicate with the staff, leaders who are able to inspire staff and not afraid to challenge the status quo and do things differently (UNESCO, 2004b; Afshari et al, 2010; Dexter, 2008; Stuart, Mills, & Remus, 2009). These of course are needed, but there are technical aspects of integrating ICT into schools that require good management skills too; skills to execute the organisation's vision, direct work efforts and review resources, establish standard rules for work and processes and look after the needs of the staff. For instance, in its Schoolnet guide, UNESCO (2004b) points out that a school ICT system requires a strategic plan which describes the environment in which it will operate, its vision, mission and objectives. These need to be translated into concrete elements in the form of a business plan. This plan includes such elements as the main system components to be implemented, the core infrastructure of the system, funding requirements, how many users to accommodate and any potential risks. Project planning techniques are normally applied to implement the system. A budget is required for this to be completed as planned and according to schedule. As well, an estimation of the project resources is also required. All the above activities require school management to provide appropriate leadership

as well as management skills. They must be leaders who are committed to the full use of technology for integrating ICT into school (Granger, Morbey, Lotherington, Owston & Wideman, 2002). Afshari et al (2008) even suggests that schools need to hire leaders with a strong commitment to productive use of technology for both managerial and instructional purposes. In South Korea, the Korea Education and Research Information Service (KERIS) which was instrumental in the integration of ICT in schools in that nation, was run for a decade by the presidents who majored in computer science or were ICT experts, rather than by those who majored in pedagogy. It was realised that ICT experts were more important in the ICT integration process "especially in the early stage of ICT infrastructure building for education, and that those who understand ICT ecology should lead the institution for innovation in education by using ICTs" (Kwon & Jang, 2016, p.16).

Another perspective for ICT leadership in schools is the distributive view of leadership. In this view, the school principal delegates responsibilities to other staff who have skills in different aspects of ICT. In this way, the principal can create a learning community in the school wherein all staff are given an opportunity to contribute to decision making, thus empowering them by allocating ownership to the shared vision of integrating ICT into the school (Dubrin, Dalglish & Miller, 2006). The leader who can delegate responsibilities in this manner is according to Dubrin et al (2006) a transformational leader who has a vision for the organisation that is linked to the school community's values. This is a shared vision and assists in lifting people's aspirations, provides a purpose for the organisation and enables them to work together. Transformational leadership can also benefit school leaders by increasing the successful use of technology in schools (Mojgan, Kamariah, Wong, Bahaman, & Foo, 2009). According to Weng and Tang (2014, p.93), some of the behaviours of

transformational leaders that are applicable to ICT in education leadership include the following:

(1) identifying and articulating an organisational vision,

(2) fostering acceptance of group goals,

(3) having high performance expectations,

(4) providing appropriate models,

(5) providing intellectual stimulation, and

(6) developing a strong organisational culture.

The above literature supports the view that leaderships and management play a crucial role in the integration of ICT in schools. Thus, strong leadership and management at the various levels in schools is important.

2.3.3.4 ICT Financial resources

Financial resources are a cross-cutting concern in a school information system. They are required in the planning, development, deployment and operation stages (UNESCO, 2004a). In assessing the level of financial resources needed to develop and operate an information system consideration is usually given at the planning stage to the benefits that the system will bring to the organisation (Satzinger, Jackson & Burd, 2012). The same applies to a school information system(SIS), so in assessing the level of financial resources needed to develop a SIS, consideration needs to be given to whether the new system will make administration more efficient in the school, improve the performance of students in subjects, improve the efficiency of teaching and contribute to generally improving the education system. Some of these benefits take time to realise so it is often difficult to assess the impacts of the SIS and therefore how much to invest. In making choices about what technologies to procure, consideration is usually given to the design and functionality of the system. For

instance, will it be for the administration section only or for all sections of the school? Will it be for teaching a subject on computers or for teaching staff or both? In some school ICT projects, the funds sourced often underestimates the cost of developing and operating the system. A measure that is normally used for estimating the cost of developing and operating an information system is the total cost of ownership (TCO) of the system. It refers to all costs associated with developing, deploying, operating and maintaining the system (Satzinger, Jackson & Burd, 2012). The same applies to a SIS including costs associated with such programs as ongoing training for staff. By assessing the TCO, the school management can keep the system financially sustainable.

2.3.3.5 ICT System procurement

Traditionally the procurement phase of an information systems development process refers to the process of making high level decisions about the purpose of the ICT system, its requirements and functionality and the subsequent purchase of the system components (Sommerville, 2011). The literature on school ICT system procurement focusses more on how schools can be more flexible in procuring ICT products and services. Schools can procure the ICT systems in several ways: government-supplied or government funded, direct purchase by school funding, donations from aid agencies or private companies and individuals. Schools need expert advice in the procurement process especially on standard technologies and standard solutions for the system (UNESCO, 2004a; UNESCO, 2004b).

The management staff with the advice of the technical staff and other ICT experts usually make the procurement decisions in line with what has been agreed to in the ICT strategic plan. In making the high-level decisions, the main education objectives of the system need to be decided on (e.g., teaching and learning, school administration,

developing information systems literacy). Other objectives such as curriculum and learning objectives, the scale of the system in terms of whether it is for a specific targeted purpose or wider use in the school also need to be decided.

In terms of developing and implementing the system, a school can directly purchase the system components, develop and implement the system itself or it can outsource the work to a contractor. Outsourcing to a contractor has advantages because the school's core business is not ICT systems development. By outsourcing the work, it can free the school to focus on other ICT related components. However, the contractor needs to understand the school environment and requirements clearly and provide quality service according to the contract. In preparation for the ICT system, the school needs to ensure that the required infrastructure is in place. This is in terms of space requirements, furniture, electricity supply, telecommunication lines, and physical security.

When deciding to procure system components it is important to follow some general principles (UNESCO, 2004b) such as:

- considering whether the component will be valuable over the long term given the trends in technology change,
- adhering to mainstream standard technologies rather than new but rapidly changing technologies as the support base for these may be low,
- opting for technologies that are more suited to the functions required of the system, and
- opting for components that are affordable and easy to maintain

Each school is different, so a custom ICT system solution needs to be developed with the assistance of ICT experts. The solution will need to take into account the hardware components, software, network type and access to the Internet.

2.3.3.6 ICT system operation and technical support

When an information system is operational it will require technical staff to operate and provide technical support. Over time the system will naturally grow and some of its infrastructure components will become obsolete as ICT technologies evolve. If this anticipated growth is not built into the ICT system plan and design, then problems such as obsolete hardware and software will occur, and the system could become unsustainable (Satzinger, Jackson and Burd, 2012). This implies that anticipated growth and ICT technology changes must be built into the ICT system plan from the beginning. Some system components and service changes to anticipate and include in the plan are: changes to hardware and software components as technology evolves, increases in the level of technical support as the system expands, allowing for the modification of the system to include new components and, maintaining the quality of service to the users as the system expands (Burgess, 2003). In a school ICT system as in any information system changes occur at different levels. Some changes are operational in nature, smaller and occur more frequently. These changes are normally carried out by technical staff using such techniques as Total Quality Management (TQM) (Miller, 1996).

Other changes are more fundamental and require management to make strategic decisions in the planning stage. For instance, implementing a school ICT system will have a big impact on the way a school operates so management needs to get the staff on board so that all participate in it and accepts the new reality. There are principles that have been proven for making such successful big changes. A popular set of

principles by Kotter (1996) consists of 8 steps that lead management through the process of creating:

1. a sense of urgency for the new system,
2. rallying the staff around the new initiative,
3. creating a new vision for the organisation with the new system,
4. communicating it to the staff,
5. empowering the staff,
6. letting staff see small gains so they know the new system works,
7. consolidating the gains, and
8. institutionalising the system in the corporate culture of the organisation.

As well as general change processes, technical considerations are also essential. The following are some issues that technical staff need to consider when providing technical support (UNESCO, 2004a; Strudler & Hearrington, 2008; Moses, Bakar, Mahmud & Wong, 2012). Firstly, it is important to have a technical support policy and procedures for providing technical support. The policy provides guidance for carrying out support activities. Components of the technical support policy should include guidance on procurement of hardware and software platforms, system back-up, upgrades of hardware and software components and how to deal with donated and refurbished equipment. Another important component of the technical support policy is information security in terms of Internet security against unauthorized access, malicious software, confidentiality and privacy (Whitman & Matford, 2017). Technical policies assist in standardising operations so that there is compatibility of all system components and operation. Incompatibility of equipment and software operation can arise for example if schools either do not comply with policy or are

allowed to procure hardware and software from different vendors. In South Korea for instance, those implementing the national ICT for education program found that when regional offices of education were allowed to develop their own versions of a learning management system incompatibility issues arose. They concluded that mainstream or standard systems should be used otherwise it was "not easy to implement innovation in education using ICTs on a national scale because of coordination problems" (Kwon, & Jang, 2016, p.8).

In addition to the technical support policy, an acceptable use policy (AUP) for the school ICT system is also important. Its primary role is as a mechanism to deal with unacceptable use of ICT, but it can also serve to promote desirable and effective security behaviours (Pelgrum & Law, 2003; Cramer & Hayes, 2010).

Technical support activities include systems administration, maintenance, upgrades and user support (Burgess, 2003). As well, technical support includes providing quality service in terms of ensuring that the system is available, reliable, consistent and predictable in its operation (Sommerville, 2011).

Internet connectivity and school ICT infrastructure are important for the operation of a school ICT system. Internet connectivity provides access to Internet services and the world external to the school. ICT infrastructure provides the operational space, facilities and physical security for the ICT system.

School Internet connectivity. There are usually many options open to a school operating an ICT system. For instance, in Australian government run schools the government provides funding for internet access, but schools choose their own internet service providers. In the Solomon Islands, a UNDP funded rural telecommunication network called PFNet enabled many schools to connect to the Internet (Leeming, 2003). In Thailand, the government in partnership with

UNESCO's Schoolnet project enabled many schools to obtain internet access (Rattanakhamfu, 2016). In South Korea the central government provides internet access to all schools (Kwon & Jang, 2016). In Indonesia, small networks operated as co-operatives and assisted by government provide Internet access to schools (Putera1, Mochtar & Candra, 2015)

School ICT Infrastructure. Ensuring that school ICT infrastructure is adequate is an important aspect of providing technical support. Physical infrastructures such as buildings and electricity are important for the proper functioning of a school ICT system. Holistic planning is needed to cover technical support for other aspects as well, for instance supporting staff training, staff and student technical support (UNESCO, 2004b).

Operating school ICT systems in the Pacific region.

In the Pacific region, small island nations face many issues that together compound ICT integration into schools. With respect to ICT capacity building Va'a(2015) notes the following issues among island nations. In Fiji the government needs to put in place programs to improve the skill availability and competency levels of teachers and trainers as a matter of priority. In Kiribati the government has a lack of funding and difficulties in recruiting and retaining experienced technical staff. In Samoa, teachers need refresher ICT training because new technologies have introduced new ways of learning. As well, new "teaching approaches and methodologies in ICT go beyond computers and incorporating new communication technologies and multimedia for learning [and these] presents further challenges" (Va'a, 2015, p.40). In the Solomon Islands, the skill availability and competency levels of teacher trainers or facilitators needs to be increased.

2.3.3.7 Integration of ICT in the curriculum

Early use of computers in schools was mostly teacher centred and emphasis was on computer literacy, that is learning to use computers in which the focus was more on the technical knowledge of computers and competence in using software applications. But according to Pelgrum and Law (2003) if learning is to prepare learners for the information society, learners must be empowered to be more active and responsible for their own learning process. Some early studies (for instance, Jonassen, D.H., Peck, K.L. & Wilson, B.G., 1999; Wang, 2008) identified some features that could bring about this shift and they included a change in both teacher and student roles and in the way in which ICT is used.

Changes in teacher roles are as follows (Jonassen et al., 1999; Wang, 2008),:

- teachers should use teaching methods that stimulate active learning (group and individual activities),
- teachers in their actions should focus more on individual student needs and interests,
- teachers should provide more guidance to students in projects, and
- teachers should share responsibility with students for decisions in the learning process.

Changes in student roles (Jonassen et al., 1999; Wang, 2008):

- students should be more active and independent in planning their own learning paths,
- students should be more responsible for planning and monitoring their own learning progress, and

- students should be encouraged to work in teams.
- Change in use of ICT (Wang, 2008):make ICT tools and applications more user oriented,
- alter the learning environment to suit student learning individually or in small groups,
- make learning flexible in terms of time and location, and
- get multi-disciplinary teams to work together

Some early studies to measure the shift in pedagogic approaches as outlined above were conducted, (for instance Kozma et al., 2008; Mioduser, Nachmias, Tubin & Forkosh-Baruch, 2002). The results indicate that a shift towards student-directed pedagogy was being adopted in those institutions studied but that it was still at an early stage and that these types of shifts take root over the long term. As well, the studies also concluded that if change in the pedagogical approach is considered a high priority then educational planners must be willing to change the curricular goals meaning that decisions must be made at the broader level to make explicit changes to the curriculum to enable the shift to take place. Teaching without the use of ICT is complex in itself so the inclusion of ICT in pedagogy makes it more complex. Recognising this complexity, Koehler and Mishra (2005) developed the technological pedagogical content knowledge framework (TPACK) that can be used to facilitate the shift in pedagogical approach to include the use of ICT. The framework consists of the "complex interaction among three bodies of knowledge: content, pedagogy, and technology. The interaction of these bodies of knowledge, both theoretically and in practice, produces the types of flexible knowledge needed to successfully integrate

technology use into teaching" (Koehler & Mishra, 2009, p.60). Since this framework was developed several studies (Angeli & Valanides, 2005; Cox & Graham,2009; Graham, 2011; Niess, 2011) have applied TPACK in a practical way in order to understand how ICT integration into the classroom can be successful. According to those who advocate this approach "the framework stems from the notion that technology integration in a specific educational context benefits from a careful alignment of content, pedagogy and the potential of technology" (Voogt, Fisser, Pareja Roblin, Tondeur & van Braak, 2013, p.42). The TPACK framework is discussed in the foregoing as an example of a model that can be utilised to successfully integrate ICT into the curriculum

Nowadays as Internet connectivity and access to online resources and tools for learning and teaching are becoming more ubiquitous, there is already a shift to what is referred to as curriculum integration in many Asian nations that participated in UNESCO's Schoolnet project (UNESCO 2004a & 2004b). In these nations a main function of a school ICT system was to facilitate this integration. Curriculum integration is perceived as being about leveraging the power and malleability of ICTs, that is, their flexibility to be used in creative ways, to add value to teaching and learning processes. In these ways, ICT can be used in the classroom for such activities as interactive learning, simulations, online forums for exchanging ideas, searching for online resources for instance (Hayes, 2007; Baskin & Williams, 2006). Learning management systems such as Blackboard and Moodle are ICT enabled platforms which support online delivery of courses and allows online class interaction, access to course content and student support tools among many of their functions. Like earlier studies and the TPACK framework (Koehler & Mishra, 2005), curriculum integration is perceived as facilitating a shift away from teacher-centred teaching to a learner-

centred approach. This of course has implications for a school's teaching approaches. If the pedagogic style is supported by ICT, then ICT can be a catalyst for introducing new changes to the curriculum, otherwise it can hinder it. Curriculum integration requires teachers to map ICT enabled activities with curriculum goals for effective teaching and learning. In this aspect they would normally need guidelines and models for doing the mapping. Several studies (for instance, Almalki &Williams, 2012) recommend that sufficient training and preparation time is required to achieve effective use of ICT policy in the classroom.

Although ICT facilitates curriculum integration it should operate concurrently with changes to the existing curriculum. If it is retrofitted to function in a curriculum that is unchanged it will not be effective. Hayes, (2007) for instance observed in his study that ICT use had not fundamentally changed the ways in which teachers taught. They found that teachers were using ICT as a tool to enhance their existing practices. According to Hayes (2007, p.389) "they tended to integrate ICT in ways that supplemented existing learning designs".

It is notable that most of the research into using ICT as a catalyst to create a shift in pedagogical approach have been in nations where ICT integration into education is more advanced so that less emphasis is placed on technical aspects of ICT and more on pedagogy and changes in learning approaches (Koehler & Mishra , 2005). In other nations that have lagged behind in the ICT integration into education process, the more pressing issues concern technical factors (Al-Senaidi, Lin, & Poirot, 2009), teacher competencies (Samarawickrema & Stacey, 2007), adequate resources (Kumar & Daniel, 2016), financial support (Drent & Meelissen, 2008) and issues of technical security, privacy and safety. The foregoing applies to many Pacific Island nations. For instance Va'a (2015) and Chan Mow (2004) in their surveys of ICT in Pacific Island

nations found that the challenges in integrating ICT into education were more about such aspects as the high cost and accessibility of ICT infrastructure, hardware and software costs, reliable technical support and strengthening security and safety issues.

2.3.3.8 ICT capacity building

ICT capacity building for schools refers to all aspects of ICT related developments in the school including infrastructure development, teacher training and technical support (Unwin, 2005; Romeo, Lloyd., Downes, 2012). In schools that are not well resourced, the focus of capacity building is usually on improving ICT infrastructure and the level of technical support provided, for example in Samoa as reported by Chan Mow (2014). In well-resourced schools the focus tends to be on training teachers to be competent in using ICT tools and resources to assist them in their teaching activities. UNESCO (2018) and Ng, Miao & Lee (2009), in drawing from Schoolnet lessons learned in several Asia Pacific nations, identified four stages in ICT capacity training for teachers. In the first stage, the emphasis is usually on ICT literacy and basic skills, whereas in the second stage, emphasis is on how to use ICT tools and apply them in different disciplines. The third stage is focussed on understanding how and when to use ICT tools to achieve a purpose, and in the fourth stage, the learning situation is transformed through the use of ICT. Jung (2005) noted that in providing training, teachers need to be allowed time to learn to integrate ICT into their teaching programs and they need to be assisted by the provision of relevant equipment such as laptops. A study by Alazam, Bakar, Hamzah & Asmiran (2013) and Hamzah, Ismail and Embi (2009) suggests that pre-service and in-service training opportunities for teachers on the effective use of technology in the classroom should be encouraged because most teachers have a full teaching load and need time and

support. However not all staff willingly embrace the use of ICT in schools, there are usually some staff who resist for various reasons. Shohel and Kirkwood (2012) and Howard (2013) noted, for instance, that resistance to technology adoption can be attributed to risk perception and uncertainty, which can limit teachers' ability to make full evaluations of technology integration. Some studies claim that even with good ICT capacity training programs, teachers do not make good use of ICT for teaching. Hayes (2007) for instance noted that "professional development was identified by all schools as a key issue in the integration of ICT, but for the most part, this occurred in an ad hoc way" (p.392). In their study, Carlson and Gadio (2002, p. 122) note that:

> "While so-called 'champion teachers' ask for and seek out professional development opportunities in the use of technology, the vast majority of teachers do not. Teachers generally are reluctant to change their teaching styles and habits; are cautious of time-consuming activities that may take away from other high-priority obligations (economic, familial, or educational); have difficulty seeing the potential payoff beforehand of this kind of training; and may feel so threatened by technology that they want to distance themselves from it rather than embrace it. Put simply, many teachers require additional motivation and incentives to participate actively in professional development activities."

In order to make training more effective, UNESCO through their wide experience in Schoolnet projects across six nations in Asia, have suggested the following guidelines (Ng, Miao & Lee, 2009, p.72):

- Training teachers on ICT-related skills within the context of classroom objectives and activities ensures the development of skills in the integrated use of ICT in teaching.

- School-based training of teachers by their more experienced peers from other schools or senior instructors from the MoET (Ministry of Education and Training) ensures that teachers are trained in the context of their workplace.
- Needs-based just-in-time learning, and peer coaching ensure further development of teachers' ICT and pedagogical skills.

These suggestions are supported for example by Hughes (2004) and Alazam, Bakar, Hamzah and Asmiran (2013) who conclude that teacher ICT training is more effective when they learn and use ICT in the context of their work. Similarly, Otero, Peressini, Meymaris, Ford, Garvin, Harlow, Reidel, Waite & Mears (2005) claim that "teachers learn how to use ICTs more effectively when they see the technologies not as generic and decontextualized tools but as tools for teaching, that is, for motivating, managing, facilitating, enhancing, and evaluating learning" (p.72). The rising popularity of social media applications like Facebook, Google and Youtube in the mid-2000s has helped lessen the resistance because these applications have made it easier for teachers to be introduced to ICT use in an intuitive and perhaps less threatening way. This has thus encouraged more teachers to learn and use ICT for teaching. For instance, Kumar and Daniel (2016), in their study of Fijian teachers found that whereas their ICT use in the mid-1990s was low, when social media applications were available in 2005, their usage of ICT for teaching greatly increased. Even though their study focussed on teachers at a polytechnic institute the point they are making is that the Internet is now more widely accessible, and social media applications for instance, are making it easier for teachers to use technology for teaching.

The foregoing literature shows that while ICT capacity building is important for teachers, most require motivation, support and quality training programs. As well

developing teachers to be confident to use ICT for teaching takes time and this must be considered in ICT capacity building programs.

2.3.3.9 Partnerships in the integration of ICT into schools

Partnerships are working relationships between two or more groups to achieve a goal that is shared by all groups. In the context of schools, partnerships can be formed with government, civil society, the private sector and with other schools. Partnerships can take many forms some specific and others broader in scope. Partnerships can also lead to better use of resources. For instance, they can be used to assist in ICT system development, increase a school's resources and obtain relevant expertise and experience. In Samoa, Chan Mow (2014, p. 19) noted that projects that were implemented in isolation "stand little chance of success as there is no ground swell of support from other projects to maintain momentum in their implementation". Thus, he recommends an integrated approach to ICT development in which different ICT projects and stakeholder groups work together. This aspect is considered in the remainder of this section.

Partnerships with government

At the national level, governments can form partnerships with regional or international organisations to work together and share knowledge, experience and resources in integrating ICT into education. In the case of UNESCO's Schoolnet project, there were 8 nations that were partners with UNESCO developing the project in each nation (UNESCO2004b; UNESCO, 2007). These nations include Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand and Vietnam. One main achievement of this project was the compilation of the lessons learned in the integration process into a framework that the participating nations then used as a

guide to plan, fund and implement their own national programs for integrating ICT into education.

Within a nation, schools can work with government sectors to leverage resources. As well, it is important for schools to coordinate ICT activities with government so that they are aligned with the overall educational goals and objectives of government. In Australia for instance, the federal government formed the Education Network Australia (EdNA) in 1995 to provide a national education and training portal for quality resources, technology standards and online spaces for networking and collaboration. As noted by White & Parker (2016), "it was a collaboration of all of Australia's education and training sectors, operating under a joint Commonwealth/State funding agreement and including participation from the States, the Commonwealth and universities" (p.1). EDNA operated for fifteen years and having achieved its aims, it was closed in 2010. A major achievement of EdNA was that "as a collaboration and as an online service [it] had served the purposes of building a national online knowledge base and skill set in education, and this contributed towards the capacity of the states to move forward confidently" (White & Parker, 2016, p.12).

In the UK, the government established the British Educational Communications and Technology Agency (BECTA) in 1998 initially to build a national grid for learning. BECTA "worked closely with government, its agencies, with Local Education Authorities, schools, teachers and pupils to develop the use of technology to support learning in schools" (Dykes, 2016, p.7). The agency closed in 2011 however some of its achievements were as follows:

- its tools helped build capacity and community around the use of technology for learning,

- it contributed to the development of strategic leadership of ICT,
- it sought to develop procurement practices that would bring best value for public investment in technology for learning, and
- it acted as a point of aggregation of demand for companies working in education technology.

A further example of partnership is in Indonesia, where the Centre for Information and Communication Technology for Education (CICTE) developed a portal that provided educational resources for schools (Firman & Tola, 2008). In the Philippines partnership with the Commission of ICT (a government agency) led to the provision of advanced ICT training for teachers (Flor, 2008). In Thailand, partnership with the National Electronic and Computer Technology Centre (NECTEC), a science and technology development agency under the Ministry of Science and Technology assisted the government in rolling out its Schoolnet project (Rattanakhamfu, 2016).
In the Pacific region, many island nations have formed partnerships with regional and international organisations in projects to facilitate the integration of ICT in schools. The Oceania One Laptop per Child (OLPC) project is an example of such partnership. This project was a partnership between the South Pacific Community (SPC), the South Pacific Forum (SPF) and island governments that are members of these two organisations. The aim of the project was to provide to school students, low-cost laptops loaded with software especially developed for "collaborative, joyful and self-empowered learning" (Leeming, Thomson & Forster, 2009, p. 1). The project uses technology that does not require the use of the Internet, a central server allows laptops to be locally connected. The project began in 2008 and now has the following 15 participating nations: Cook Islands, Fiji, FSM, Kiribati, Nauru, New Caledonia, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu,

Vanuatu. The Vanuatu OLPC project is a partnership between SPC/ITU and the Vanuatu government. Although the implementation and operation of this project has been initially successful in many of these nations, there have also been challenges. Some of these include a lack of commitment by governments for long term funding of the project, providing training for teachers, reliable electricity and power supply and the need to provide content that is relevant for local community.

Another partnership between government and a regional organisation is the Samoa SchoolNet and Community Access project. This was a partnership between the Samoan government and the Asian Development Bank. This project was implemented in 2006 as a pilot and the aim was to determine the viability of running a schoolNet in Samoa and to identify issues related to its implementation and operation. (ADB, 2007)

In 2016 the Vanuatu government formed a partnership with SPC to enhanced the capability of its management information system - the Vanuatu Education Management Information System (VEMIS). This system is used by the Ministry of Education and Training to store information about schools, financial information from schools and examination results (Cullen & Hassal, 2016)

Partnerships with community and the private sector.

Many organisations in the community such as non-governmental organisations and private companies can provide significant assistance in the use of ICT in schools. Partnerships with such organisations can assist schools get access to expertise, useful information, technical support and funding for their ICT initiatives. For example, in the Philippines, the government initiated a program called Adopt-a-School in which private companies were encouraged to select schools they would like to support (Vergel de Dios, 2016). Although this program worked initially, some schools became wary of private companies that provided support while at the same time trying to sell company products to the schools. On the other hand, there are civil organisations and

private organisations that genuinely want to assist schools in their ICT projects, but they would prefer long term political and financial commitment from government (see for example, Butcher & Bodrogini, 2016).

Partnerships between teachers and schools

Partnerships between schools can assist staff in partner schools share information and learned lessons in different aspects integrating ICT into schools. In UNESCO's Schoolnet project there was some evidence of partnerships and networking among schools in Myanmar, Malaysia and the Philippines. However, in other nations that participated in the Schoolnet project there was not much evidence of collaboration (UNESCO, 2007). An example of a successful partnership between schools is in the European Schoolnet. In this partnership program, the governing authority established the "eTwinning initiative as part of its eLearning programme. In this initiative, teachers are invited to use an online portal in order to find potential partner schools and forge long-term school partnerships on pedagogical topics of their choice." (UNESCO, 2007, p. 42)

The foregoing literature highlights examples in which partnerships between schools and the stakeholder community can benefit schools. Partnerships can be formed between schools and government, between schools and community, between schools and the private sector and between schools themselves. Such partnerships are important because most schools do not have the necessary resources and expertise. Partnerships can assist schools get access to expertise, useful information, technical support and funding.

2.4 Sustainable ICT systems

This section reviews the literature on the sustainability of information systems and then discusses a systems theory approach to sustaining school ICT systems. This approach has been used in recommending a solution for a sustainable school information system which is detailed in Chapter 7.

The literature review in the foregoing sections has identified the many factors both within the school and in its external context that need to be considered in the process of integrating ICT into schools. It has revealed that those factors are linked and interdependent in many ways so that constraints on or changes to some factors can affect the others. For instance, the level of available financial resources determines the type and scale of the ICT systems that can be built, the level of technical support provided and access to ICT services that can be made available. Similarly, the level of access to telecommunication networks determines access to Internet services. The lack of ICT for education policies implies that there is no road map to be followed when implementing an ICT system. It follows that the sustainability a school ICT system as a whole is contingent upon the sustainable operation of its component or constituent parts as well as the sustainable interaction between other systems the school ICT system is part of. The diagram shown in Figure 2.1 below has been created by this researcher to illustrate the links between components in the school's ICT system environment as identified in the foregoing discussion.

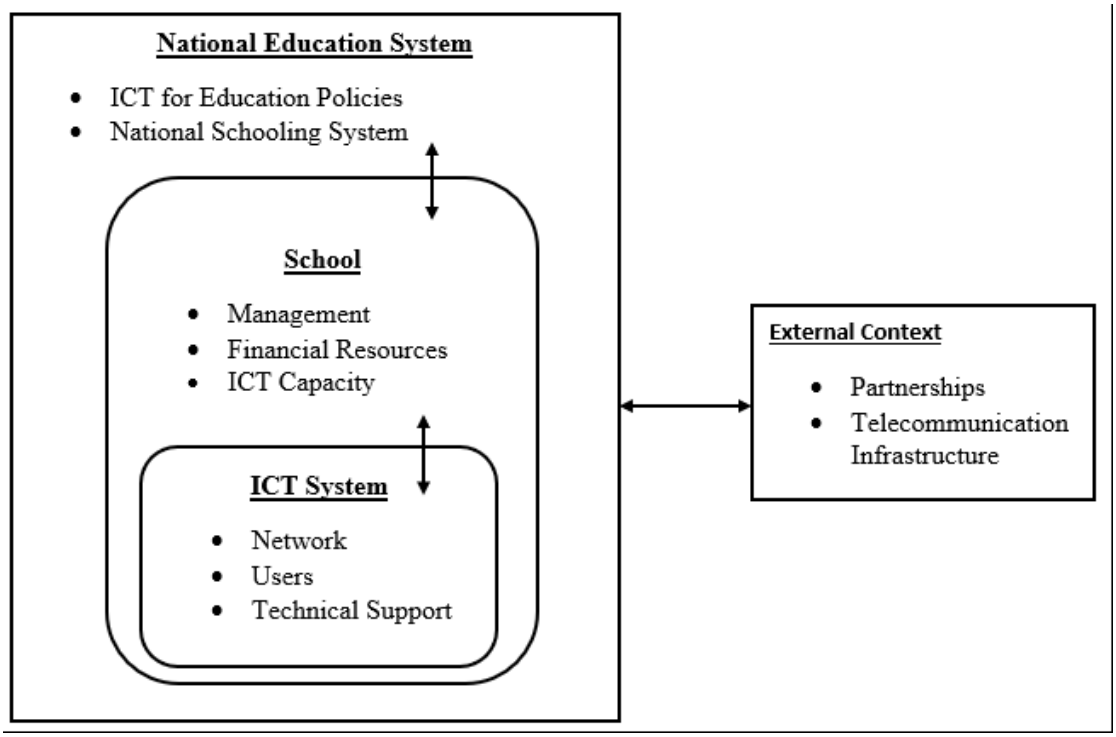

Figure 2. 1 Components in a school ICT system environment

As figure 2.1 illustrates, components within the national education system have an impact on the school and in turn, components in the school have an impact on the ICT system. Similarly, components in the school external context also have an impact on the ICT system. So, the sustainability issue is, how does one sustain the various components that impact the school ICT system and the interactions between these components?

2.4.1 The Schoolnet sustainability model

One model for sustaining school ICT systems was proposed by UNESCO in its Schoolnet project (UNESCO, 2004a). This model identifies five dimensions of sustainability that it considers important for developing and operating a sustainable school information system. They include the following:

- *Economic sustainability*: the affordability of the solution and ability of a school to meet continuing operating, support and replacement costs
- *Social sustainability*: the extent of community involvement and acceptance of ICT facilities by end-users

- *Political sustainability*: leadership and policy support and the success of change processes
- *Technological sustainability*: long-term effectiveness of the technology infrastructure, including the extent to which it provides the needed services
- *Educational sustainability*: an appropriate match between technology and educational goals, such that educational changes and benefits enabled by ICTs become institutionalised. (UNESCO, 2004a, pp. 71 -72)

In this model, a school is required to consider those five dimensions of sustainability in the planning phase of the school ICT system and not as add-ons after the system has been implemented. For instance, there should be a realistic assessment of funding sources to build and operate the system in the long term. Where possible a school should build partnerships with stakeholders in the community to leverage support. At the design phase, a school should choose technologies that are stable and easy maintain. A school should plan and implement the system around educational objectives rather than technical ones and align ICT resources with the curriculum. Finally, school management should gain the support of the staff from the beginning so that there is a sense of ownership of the system.

2.4.2 Systems theory and sustainability

An alternative to UNESCO's model for sustaining a school ICT system can be developed based on systems theory. Systems theory is the study of systems in nature, society, and in many scientific domains. It is also a framework for investigating systems from a holistic perspective (Capra, 1997). According to this theory, a system is a collection of interrelated and interdependent components that are linked together to form a whole (Tien & Berg, 2003). It has a boundary around it to distinguish between its external and internal environment. A system has structure, purpose and operates over the course of time. Changes to one component of the system affects

other components and the whole. The system as a whole can be more than the sum of its parts and this is referred to as its emergent property. Systems theory is multi-disciplinary; it has been applied to studies of natural and ecological systems (Hannan &Freeman, 1977), chemical and biological systems (Maturana & Varela, 1975), society and social systems (Clark, 1993), information technology-based systems (Beer,1972) and systems thinking (Checkland & Scholes, 1990).

Living Systems. A living system is an example of a system, but it is different from other systems in that it can adapt, preserve itself and re-enforce its existence in the environment in which it survives. Maturama (1975), calls this fundamental feature autopoiesis or autonomy. According to Maturama (1975) and others, a living system exhibits at least the following traits:

- *Organisation*. It is structurally composed of one or more components that are arranged in a hierarchical manner. For instance, cells combine to form organs, organs in turn combine to form sub-systems and sub-systems form the whole.
- *Open system*. It can exchange energy, matter and information with the environment
- *Homoeostasis*. This is its ability of the system to regulate its internal environment in order to maintain a state of equilibrium over the course of time.
- *Metabolism*. It uses energy to maintain its internal organisation.
- *Growth*. It increases in size in all its components, rather than just simply accumulate components.
- *Adaptation*. It can interact with its environment and adapt itself to survive.

Living systems are sustainable because they can autonomously carry out the processes described above and over time, they have adapted by selecting those properties that enable them to survive in their habitat. Living systems are a good model for developing and operating sustainable school ICT systems because there are parallels

between a living system and a school ICT system as will be explained in the next section.

2.4.3 Living systems theory and school ICT system sustainability

The property exhibited by a living system as a whole is called its e*mergent property* (Maturama, 1975). According to Maturama, this property emerges as a result of the way in which the system has evolved over the course of time so that its internal sub-systems and processes link and interact in a way that makes the whole system sustainable. There are similarities between traits of a living system and a school ICT system as identified in the literature in Section 2.3.3. This makes the theory of living systems a suitable theory for modelling sustainable school ICT systems. These similarities are shown below in Table 2.2.

Table 2. 2 The similarities between a living system and the school ICT system.

Living system trait	Equivalent school ICT system trait
Organisation	System consists of sub-system components that are in turn made of smaller components. In turn, it is part of larger systems.
Open system	System exchanges information, energy, and other resources with its external environment
Homeostasis	Operation of system can be tuned to operate at an optimal level depending on available resources and needs
Metabolism	System needs energy and other resources to operate
Growth	Over time the system can grow and expand
Adaptation	System adapts to changing technologies and policy changes. It works in partnerships with stakeholders to meet requirements

The obvious difference between a living system and a school ICT system is that a living system is autonomous whereas a school ICT system is an artificial system that needs to be operated by humans and built-in technology hardware and software components. However, modelling a school ICT system as a living system implies that the system should be built and operated like a living system for it to be sustainable over the long term in the same way that a living system is sustainable.

2.5 Standards and models for developing and operating information systems

This section reviews the literature on standards and models for developing information systems. The review is used to inform the discussion of results in Chapter 6 and recommendations in Chapter 7.

2.5.1 Characteristics of an information system

A critical characteristic of information systems is that they are complex because they include many components that interact in a logical way to provide the functionality required of it. Information systems are examples of socio-technical systems which are systems that include humans as well as technical components. It is very difficult to understand a socio-technical system as a whole because of this complexity. Rather it can be viewed as consisting of layers (Sommerville, 2011) which make up the socio-technical stack as shown in Figure 2.2.

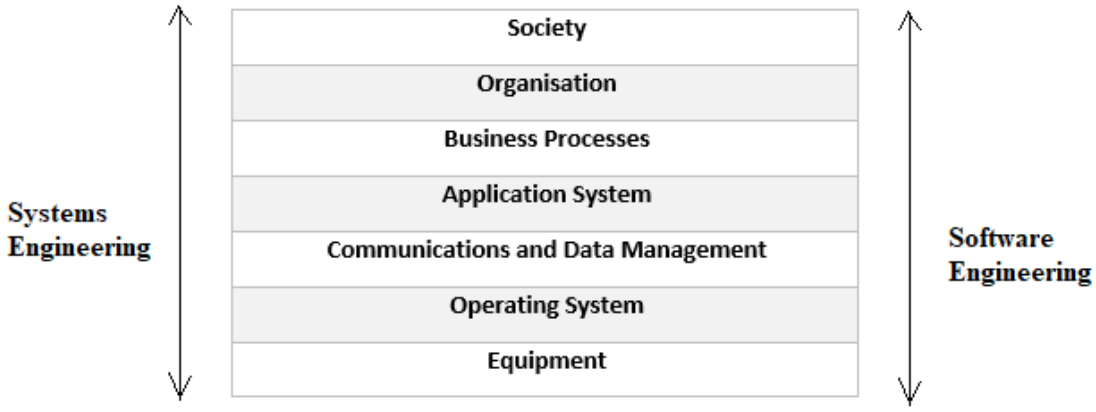

Figure 2. 2 The layers of an information system.
[Adapted from Sommerville (2011, p. 265)]

It can be seen from the figure that the Society layer represents the organisation's external environment, the organisation and business processes layers represent the organisation and the processes it uses to interact with the technical part of the system and the remaining lower layers represent the technical part of the system. Viewing a socio-technical system in this way assists in understanding the complexity of such systems. Each layer groups components that operate at that layer and separates them from components in adjacent layers. This grouping and separation of functions and responsibilities also assists in operating and supporting the system. So, for instance if a fault occurred in the system that was developed and deployed according to standard models then it can be identified by tracing to the layer where it occurred. The other system components that are also affected by the fault can also be identified. If business processes are changed due to policy changes at the organisation level, these can be translated and incorporated into the application layer ensuring that the system functionality reflects correctly the changes in policy.

A further characteristic of information systems is that they can also be considered as having different perspectives depending on the agent viewing the system (Coronel & Morris, 2017, pp. 54-60). These perspectives include:

1) user perspective which is the view according to the particular group of users using the system, so for instance, a teacher's view of the system would be different from a student's view of the same system;
2) the conceptual perspective which can be considered as the designers view and sees the big picture of the system with all components related in a logical manner and having an overall architecture;
3) the internal perspective which is the view of the system according to the electronic engine that drives and controls the functions in the system according to the logic built into it; and
4) the physical perspective which consists of the physical network, hardware and software components and the physical connections between them.
Viewing an information system according to these perspectives assists planners, designers and system implementers build the system according to requirements and assists categories of users in understanding the system.

Another important characteristic of an information system is that its technical components evolve at a fast pace over time due to rapid advances in information and communication technologies. This rapid pace was predicted by Gordon Moore back in 1965 in what is referred to as Moore's law which states that the price of computer processors is halved every 2 years (Moore, 1965). This law has been valid up to now (Endres & Rombach, 2003) and has been the driving force in advances in the information and communication technologies industry.

2.5.2 Information systems development standards

This section discusses standards for developing information systems. From a technical perspective, the integration of ICT into schools involves setting up an information system for the school as an application domain. An application domain is a particular

organisation category for which a system is to be built. From this perspective, it is important to make sure that the system that is set up operates as expected and can be sustained over the long term. This implies that it would need to be set up according some sort of standard. Information systems need to be developed according to standards for many reasons. The following are some of the main standards that are relevant to this research based on the work of Sommerville (2011), and Satzinger, Jackson and Burd (2012) and Coronel and Morris (2019):

- Information systems are complex usually consisting of many technical components as well as human components. All components and the way they work together as a whole need to be considered when constructing the system. (Sommerville, 2011, Satzinger, Jackson & Burd, 2012)

- An information system is built to meet specified requirements of an organisation and so those requirements need to be carefully elucidated and built into the system. (Coronel & Morris, 2019)

- Unlike living systems, information systems are artificial and so must be constructed, operated and maintained for the duration of their lifetime. Strategic plans for carrying out these activities and their resource implications need to be considered. (Sommerville, 2011)

- An information system must be constructed according to a specified design in order to meet the organisation's requirements. The design blueprint allows designers to make modifications to the system such as scaling up or scaling down the system to meet future requirements. (Sommerville, 2011; Coronel & Morris (2019; Satzinger, Jackson & Burd, 2012)

- Having information systems development standards makes it easier to build systems that have compatible components and enable such systems to interact more easily. (Sommerville, 2011)

- There are costs involved in building, operating and maintaining an information system, therefore costs and benefits must be calculated so the organisation knows if the system is delivering value for money. Coronel & Morris, 2019)

Information systems development standards began to be developed in the 1970s when many of the above listed characteristics were realised. The Systems Development Life Cycle (SDLC) standard emerged as the main approach used in the early 1980s and is still used widely today. Other recognised standard models include the Agile development model (Satzinger, Jackson & Burd, 2012) and Rapid Application development model (Martin, 1991; Barry & Lang, 2001).

2.5.3 The Systems Development Life Cycle (SDLC)

This section details the phases of the Systems Development Life Cycle (SDLC) standard. It was selected over the other standards because it is suited for application domains where the organisation is stable in its operation, its organisational structure as well as its functions are well understood. In this researcher's view the SDLC is well suited for building an information system for the school organisation because the school as an application domain meets the criteria for using the SDLC. The approaches described below are from Satzinger, Jackson and Burd (2012), Shelly and Rosenblatt (2010) and Sommerville (2011).

There are two basic approaches to using the SDLC depending on the nature of the application domain. In the predictive approach, development proceeds from one phase to the next without backtracking to the previous phase to re-work or refine it.

The adaptive approach allows developers to re-work a previous phase in order to make refinements. The predictive approach is alternatively known as the Waterfall model (Satzinger, Jackson & Burd, 2012; Shelly & Rosenblatt, 2010; Sommerville, 2011) in which six succeeding phases are flowing down one after another as in a flowing river as illustrated in Figure 2.3.

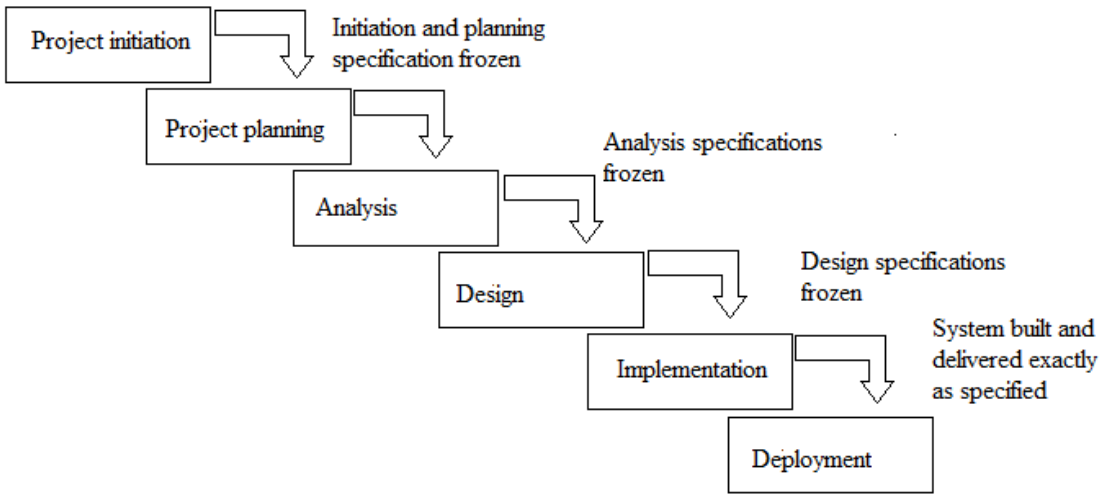

Figure 2. 3 Waterfall model of the Systems Development Life Cycle (SDLC)
[Adapted from Satzinger, Jacakson and Burd (2012, p. 229)]

According to Satzinger, Jackson and Burd (2012), the phases in the Waterfall model of the SDLC are as follows:

Project initiation phase. In this phase, the problem(s) to be resolved by the proposed information system are identified. These are specified in a System Vision document which states the problems, the proposed system's benefits and its capabilities. The scope and impact of the system are also assessed in this phase. This is in terms of development time, systems development costs and anticipated benefits. Also carried out in this phase are the system's development risks and feasibility. This is in terms of technical, organisational, operational and resources risks and feasibility.

Project planning phase: In this phase, the environment in which development work will be carried out is assessed, the project development activities are identified and

detailed, the activities and tasks are scheduled and allocated to staff, work progress is evaluated, monitored and corrections made. Management of activities in this phase is carried out in the form of a managed project with a timeframe for completion.

Analysis phase: In this phase the requirements of the whole system are elucidated. This entails gathering detailed information through various techniques such as interviews, policy and procedure documents and clearly defining and prioritising the requirements. This is in terms of specifying system requirements, functional as well as non-functional requirements.

Design phase. In this phase, designs for the various components of the system are developed. This is in terms of the overall architecture of the system, designs for input and output interfaces, design for security and system controls, design for the physical network configurations and designs for connecting to the external environment.

Implementation phase. In this phase system components are developed or acquired. This entails developing or acquiring needed software components, integrating all the components and testing them to ensure they work individually, in modules, and as a whole.

Deployment phase. In this phase, the system is made available to the users, data is transferred from the existing system to the new one and communication with other systems in the environment are established. As well, the users are trained in using the news system.

Using standard models such as the SDLC for developing an information system ensures that the resulting system can be operated sustainably. It satisfies the requirements for which it was developed. Its design lays out the system's structure, captures the design decisions that were made during development and forms the blueprint for future references and changes. The implementation and deployment

phases ensure that the system is constructed according to the design using chosen technologies, that it is rolled out according to schedule and that staff are trained to use it properly.

2.6 Conclusions and summary

This research concerns the sustainable use of information and communication technologies in schools in the republic of Vanuatu. This literature review guides the research and underpins the design of the study by identifying key issues that need to be investigated.

The foregoing literature review identified the research associated with the integration of ICT into schools mainly focussing on nations in the Asia-Pacific region. This is to determine the extent to which research has been done in this area in order to provide the guidelines that would form the basis of this investigation.

This review has established that the Vanuatu context in terms of its physical geography, socio-economic status, national education system and telecommunication infrastructure are important in this research investigation. The national education system and telecommunication infrastructure were reviewed in this chapter. The other aspects were reviewed in Chapter 1 and together they constitute the context in which the integration of ICT into schools in Vanuatu is taking place.

This review has revealed that the pace and scale of ICT integration into schools varies among nations. More affluent nations have the required financial and technical resources to plan, implement, roll out and operate school ICT programs nationwide. They are thus more advanced in the integration process. Other nations such as some in the Asian region have ICT programs but are constraint by financial and technical resources. Island nations of the Pacific region lag behind other nations in the Asia-Pacific in the integration of ICT into schools. Not only do they lack the necessary

financial and technical resources and ICT expertise, but they are also constraint by the nature of the physical geography of islands and isolation from the main centres of advanced telecommunication infrastructures.

Despite the differences in pace and scale of integration of ICT into schools among nations, this review has identified several factors that are experienced by all in the integration process. These include the following:

- *Rationale for the use of ICT in schools*. The use of ICT in schools is seen by many as important for transitioning society to the information age. For instance, appropriate ICT knowledge and skills prepare the young for an ICT-rich workplace; ICT programs can expand access to education; ICT in schools can assist in addressing deficits in an education system; and ICT programs can be a vehicle for economic development.

- *The importance of the school education environment*. The review has revealed that national ICT policies for education are important. They provide a road map for planning and implementation of school ICT programs, determine how resources are allocated and what approach to use in integrating ICT into schools.

- *The importance of strong leadership and management in schools*. The literature supports the view that strong leadership and management at various levels are crucial for the successful implementation and operation of a school ICT system. Leaders and managers at the top level should have minimum level of ICT competence, be involved in strategic planning and get the staff onboard to support the school ICT system project. The identification and participation of ‘champions’ – those staff with particular ICT interests, knowledge and

skills – can be engaged to improve the operation, support and use of the school ICT system.

- *Availability of financial resources*. Financial resources are crucial for successful integration of ICT into schools. The literature indicates that more affluent nations are more advanced in their programs for integrating ICT into schools because they have the required financial resources. At the school level, the review confirms that financial resources are required for the successful implementation, operation and sustainability of a school ICT system.

- *System procurement*. The literature on school ICT system procurement focusses more on how schools can be more flexible in procuring ICT hardware and software components as well as services. Procurement decisions must be in line with the school ICT system strategic plan and the focus should be on the main education objectives of the system. For instance, a school can outsource the procurement work to a contractor. In this way, it can free the school to focus on other ICT related components.

- *Technical operation and support*. This review has revealed that it is important to have a technical support policy to guide and standardise the operation of the ICT system. This policy should include guidance on technologies to be used, system back-up, security, privacy and confidentiality issues. It also highlighted the importance of having an acceptable use policy to guide users of the system. Technical activities include systems administration, maintenance, providing quality support service and providing user support. The review highlights two aspects of technical support which relate to supporting internet connectivity and making sure that school ICT infrastructure is adequate. The review noted

that compared to other nations in the Asia-Pacific region Pacific island nations lag behind in technical support aspects because of issues particular to that region.

- *ICT integration into the curriculum*. This review has shown that teaching and learning approaches must change if learners are to transition to the information society. ICT can be the catalyst for this shift in teaching and learning approach. In the new ICT mediated approach, teachers should change their teaching strategies, students should be empowered by making them more active in the learning process and ICT must be used the right way for the shift to occur. The review highlighted the TPACK framework which has been developed to be used to facilitate this shift. TPACK has been used successfully in some schools. But the review also indicated that more affluent nations with advanced school ICT programs are ahead in making this shift. Other nations, particularly Pacific Island nations lag behind in this transition because of the particular challenges they face.

- *ICT capacity building*. This review has revealed that in low resourced schools, the focus of capacity building tended to be on technical aspects such as basic computer literacy and the application of ICT tools. In better resourced schools the focus tended to be on advanced use of ICT such as using ICT to achieve a learning objective and enabling the learning situation to be changed by ICT. The review shows that not all teachers embrace ICT. Some teachers resist because they are reluctant to change. But the review indicated that if teachers are trained to use ICT in the context of their work activities then they are more likely to accept the use of ICT. There is evidence to indicate that with the

popularity of current social media platforms, learning to use ICT will become easier for teachers.

- *Partnerships with stakeholders*. This review has documented some examples in which partnerships between schools and the stakeholder community can benefit schools. Partnerships can be formed between schools and government, between schools and community, between schools and the private sector and between schools themselves. Such partnerships are important because most schools do not have the necessary resources and expertise. Partnerships can assist schools get access to expertise, useful information, technical support and funding,

This literature review has revealed that many components of the school ICT system are linked and interdependent. Some components are at ICT system level, some are at school level, some are at national education level and others are connected to the school's external environment. Thus, the sustainability of the whole ICT system is dependent on the sustainability of many of its components.

The review has identified two models for building a sustainable school ICT system. The first one is a model developed by UNESCO. There are five dimensions to this model namely: economic sustainability, social sustainability, political sustainability, technical sustainability and educational sustainability. For a school ICT system to be sustainable it must ensure all of these dimensions are also sustainable. This model makes the assumption that components of a school ICT system are linked and interconnected. The second model can be developed from systems theory, in particular Living Systems theory. This model draws parallels between characteristics of a living system and those of a school ICT system. Characteristics of a living system that have parallels with a school ICT system in that they both: have hierarchical

organisation, are open systems, have homeostatic tendencies, use energy to operate, grow over time and adapt to their environment. As in the first model, this model also assumes that components of the system are linked and interdependent. Together, these two models will be used in Chapter 7 to frame a solution for the sustainable use of ICT in Vanuatu schools.

This review has included an overview of standard models for developing information systems. This was considered to be important as it informs the discussion of results in Chapter 6 and the framing of the conclusions of the research in Chapter 7. The section provided an overview of characteristics of an information system and then discusses the software development life cycle.

In summary, the synthesis of the literature in this chapter provides a direction for investigating the issues explored in the sustainable use of ICT in Vanuatu schools. It provides direction by determining how the issues investigated can be resolved and used to develop guidelines for building and operating a sustainable school ICT system in Vanuatu. The next chapter will discuss the research methodology and design.

Chapter 3

RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter provided a synthesis of the literature concerning the issues that may affect the sustainable use of ICT in Vanuatu schools. This chapter details the research methodology adopted in this research. It begins by discussing the philosophical framework in which the research has been situated. It does this by examining the assumptions underlying the positivist and interpretivist paradigms and then provides justification for positioning the research within the interpretivist paradigm. The chapter then discusses a number of different types of research methods commonly used in qualitative research with a view to justify the case study research method chosen for this research. The chapter goes on to describe the research design developed for the study and the design decisions and considerations that guided the design. The data samples and data collection methods used are then discussed and the chapter concludes with a brief discussion on the importance of ethical considerations in the data collection process.

3.2 Paradigms and their underlying assumptions

In this section the two main paradigms for research and their underlying assumptions are presented as a background to the stance and assumptions adopted by the researcher in this study.

3.2.1 Paradigms

According to Patton (1990), a paradigm is "a set of propositions that explain how the world is perceived; it contains a world view, a way of breaking down the complexity of the real world, telling researchers and social scientists in general what is important, what is legitimate, what is reasonable" (p. 37). This set of propositions is unlike a set of axioms that must hold true at all times. Instead as Guba and Lincoln (1996) point out, paradigms are basic belief systems which cannot be proven or disproven, but they represent the most fundamental positions that researchers are willing to take.

The two dominant paradigms currently used in research are the positivist paradigm and the interpretivist paradigm. The positivist paradigm has been used predominantly in the natural sciences while the interpretivist paradigm has been mainly used in the social sciences to enable researchers to study social and cultural phenomena (Myers, 2009). An understanding of the assumptions underlying each paradigm is important in deciding where to position the research.

3.2.2 Ontological assumptions

Ontology (Guba & Lincoln, 1996; Gruber, 1995) is that branch of philosophy called metaphysics and is concerned with issues of being, existence or reality. Ontological assumptions are those made about the nature of the world that is being modelled.

The ontological assumptions of the positivist paradigm maintain that there is only one reality out there and that it is detached from the observer. It has no meaning in and of itself. It is governed by generic laws and it can be observed and be known. Thus, all people experience this reality in the same manner (Denzin & Lincoln, 2011; Lee, 1992).

The ontological assumptions of the interpretivist paradigm on the other hand consider reality to be subjective - it depends on the person experiencing it. As Krauss (2005)

points out, interpretivists "do not assume that there is a single unitary reality apart from our perceptions. Since each of us experiences our own point of view, each of us experiences a different reality" (p.760). Thus, for interpretivists, reality is socially constructed and can change over time depending on the knowledge that individuals have gained (Bryman, 2001).

3.2.3 Epistemological assumptions

Epistemology according to Guba and Lincoln (1996) and Becker (1996) is that branch of philosophy that deals with the origin of human knowledge, the nature and limits of this knowledge. It is concerned about the relationship between the person who is seeking this knowledge and what is known. Epistemological assumptions are those made about how researchers obtain valid knowledge of the world that they seek to model (Weber, 1997).

The epistemological assumption of the positivist paradigm maintains that because of the nature of one objective reality, the researcher must remain detached from the objects of investigation for the research results to be unbiased (Guba &Lincoln, 1996). It maintains that even in social science enquiry, reality must remain objective, which implies that it must be time and context-free in order for the enquiry to be valid and reliable. Under these conditions, generalisations of the results are possible.

On the epistemological assumption of the interpretivist paradigm, Lythcott and Duschl (1990) assert that "people impose order on the world perceived in an effort to construct meaning; meaning lies in cognition not in elements external to us; information impinging on our cognitive systems is screened, translated, altered, perhaps rejected by the knowledge that already exists in that system; the resulting knowledge is idiosyncratic and is purposefully constructed" (Lythcott & Duschl, 1990, p.760). Orlikowski and Baroudi (1991) concur pointing out that "reality, as well as

our knowledge thereof, are social products and hence incapable of being understood independent of the social actors (including the researchers) that construct and make sense of reality" (p. 13). Thus, according to Guba and Lincoln (1996), "it is impossible to separate the enquirer from the enquired into, since the researcher and research participants are integral parts of the research process" (p.163).

3.2.4 Methodological assumption

According to Sarantakos (1998; 2013), a meaningful definition for methodology in the research context should relate its nature to a more abstract context, that is, "a methodology offers the research principles which are related closely to a distinct paradigm translated clearly and accurately, down to guidelines on acceptable research practices. The methodologies that result from this definition are the quantitative methodology and the qualitative methodology" (Sarantakos, 1998, p. 33). Specifically, according to Guba and Lincoln (2005), while the aim of the positivist methodology is to verify hypotheses, the aim of the constructivist/interpretivist approach is said to be hermeneutic meaning that it is an iterative process. It cycles through the data collection, analysis and interpretation phases until a new revised interpretation of the observation emerges.

Based on the foregoing discussion on paradigm assumptions and taking into consideration the nature of the phenomenon being investigated in this research, that is, the integration of ICT into Vanuatu schools, it follows that the interpretivist paradigm would be the most appropriate to adopt in this research investigation. This is the approach that has been chosen in this research and the following section provides the justification for grounding the research in the interpretive paradigm.

3.3 Research paradigm choice

As detailed in chapter 1, this research investigated the use of ICT in secondary schools in a particular context, namely in the Republic of Vanuatu. The questions that this research sought to answer relate to the current practices of implementing and using ICT in schools, to the preparedness of schools to accommodate ICT, and to how the physical, social and cultural contexts influence the way ICT is being used. There are concerns about sustaining ICT in schools in this context and as stated in Chapter 1, the aim of the research is to determine factors that influenced the sustainable use of ICT in those schools over the long term.

The context of this research are as follows:

- secondary schools that took the initiative to implement ICT for administration and for teaching and learning,
- the staff of the schools who are either users and/or operators of the ICT systems implemented,
- the Vanuatu schooling system that is under the authority of the Ministry of Education and Training (MoET),
- the school stakeholder community that are providing ICT assistance to some schools, and
- the cultural and geographical context.

Thus, for this research, the social 'reality' as described above suggests the following ontological elements: ICT systems, understanding ICT systems, implementing ICT systems, using ICT systems, school system readiness, cultural influence, stakeholder influence, school staff attitudes, physical context influence, leadership and

responsibilities. Capturing evidence of this reality addresses the research questions posed in Chapter 1. To do this, the researcher needed to interact with the people who know or have experience in the activities in which the above ontological categories are involved. Interaction with the people involves obtaining their perspectives on the various issues, and from this to gain an understanding and insight about what may be happening in the process of implementing and using ICT systems in Vanuatu schools. In addition, as is detailed in the next section, the researcher brings into the interaction what he already knew about the context in which the research was being undertaken.

Yin (2013) and Silverman (2013) suggest that in choosing a research approach, it is necessary to be guided by the nature of what is being researched. The ontological and epistemological assumptions that guided this research were associated with the interpretive research paradigm. This, as explained above, is because the nature of the research concerns trying to explore and understand what is happening in an emerging contemporary phenomenon – the integration of ICT in Vanuatu schools. Thus "what would count as knowledge or evidence" (Mason, 2002, p. 16) of this phenomenon would be the knowledge gained from the perspectives of the persons interrogated and the background knowledge of the researcher.

Interpretive qualitative methodology was adopted in this research and the goal in this methodology was to learn from the data collected. But as Richards (2005) points out, researchers do not enter the field with empty minds. So, it was important to build into the design what the researcher already knows "and how this knowledge can be used and tested" (p. 25).

In this investigation, the researcher is from a Vanuatu Indigenous background and has experience of Vanuatu traditional culture. He completed his education in the Vanuatu schooling system. As well, he has taught at secondary school level and at tertiary

education level in Vanuatu. He was a member of the Vanuatu Teaching Service Commission (VTSC) for several years. This background knowledge and experience has been used in the design of the research, in planning and implementing data collection, in analysing the data and in discussing the results. In the data collection and analysis phases, the researcher was careful to separate the collected data from the ideas he has brought through his background of Vanuatu culture and education system. In Chapters 5 and 6, ways in which the researcher has used this background knowledge and experience in data analysis and discussion respectively are explained.

3.4 Choice of Research Method

3.4.1 Introduction

This section discusses several research methods that were considered as possible options for examining the research questions in this study. A research method according to Myers (2009), is a strategy for moving from the philosophical assumptions to the research design and data collection phases. Choosing the right research method is important because it influences the choice of data collection methods. In addition to this, each research method requires that the researcher uses a different set of skills and practices (Myers, 2009).

3.4.2 Types of Research methods

Several qualitative research methods were considered for this research, among them case study methodology, ethnography, action research and grounded theory.
The case study methodology (Yin, 2013; Stake, 1995; Simons, 2009) was selected over the other research methods listed above because the focus of this research is an in-depth investigation of the integration of ICT into Vanuatu schools. The emerging trends on the integration of ICT into schools is a contemporary phenomenon that is

not clearly understood. Little is known about the long-term sustainable use of ICT in this context, and so the focus is on developing an in-depth analysis of a set of multiples sites – the schools.

Ethnographic research was not adopted because its focus is on describing and interpreting social phenomenon and it requires field work for extended periods of time. Field work was not necessary in this investigation. Grounded theory was not chosen because it focuses on developing a theory from collected data. This research utilises existing theory. As well, grounded research requires long and intensive interviews and a rigorous method of coding (Creswell, 1998), which is not relevant to the aim of this research as it is exploratory in nature. Action research was not adopted for this research as the researcher does not live in close proximity to the sites of investigation and would not have any influence on the way in which ICT is being used in schools.

3.5 Case Study Methodology

This section details the case study research methodology and the rationale for its use in this research.

3.5.1 The Nature and Purpose of Case Study

A case study can be described as an in-depth investigation of an organisation in a field setting. According to Yin (2013), a case study is an empirical enquiry and it is useful for investigating a phenomenon that is contemporary or emerging rather than one that is historical. The phenomenon is examined within its real-life context and is especially important when it is not clear to the researcher what the boundaries are between phenomenon and its context. Yin adds that since the boundaries between the phenomenon and context cannot be clearly distinguished “a whole set of other technical characteristics, including data collection and data analysis strategies must be part of the case study research strategy. It is not merely a data collection tactic or

design feature alone but a comprehensive research strategy" (Yin, 1994, p.13). He adds that a "major strength of the case study data collection is the opportunity to use many different sources of evidence" and he points out that direct observation and systematic interviewing are among the main sources of evidence (Yin, 1994, p.91). Case study research methodology is not necessarily associated with the interpretivist paradigm. It can be positivist or interpretive depending on the case being studied, the paradigm and the underlying assumptions that have been chosen (Yin, 2013). A positivist case study is similar in its techniques for measuring variables, testing hypothesis and making inferences to the natural science research model (Lee, 1989; Yin, 2013; Thomas, 2013, 2015). An interpretive case study on the other hand is exploratory in nature and seeks to understand phenomena through the participants' interpretation of their context (Klein & Myers, 1999). With respect to research design, an interpretive case study design is typically flexible (Anderson & Runeson, 2007) because it must cope with the dynamic reality of the case being studied so there are usually a number of iterations over the design phases as the focus of each one becomes clearer. However, they point out that there is a limit to the flexibility; the case study should have specific objectives set out from the beginning (Anderson & Runeson, 2007). Yin (2013) distinguishes between holistic and embedded case studies. In a holistic case study, the case is studied as a whole, whereas in an embedded case study multiple unit of analysis are studied within a case.

3.5.2 Use of case study in this research

As alluded to above, case study research methodology is a comprehensive research strategy, not a phase of some other research method. As such it includes all the phases required of a research method from the framing of the research questions, to the research design, data collection, analysis, and reporting on the outcome (Yin, 2013).

For this research, the questions were framed in such a way as to enable effective data collection and analysis using the case study research method rather than other methods such as survey or ethnographic methods. The first research question, RQ1, is a 'what' question – an exploratory 'what' - and seeks to explore what is currently being done in the practice of integrating ICT into schools. The next three research questions, RQ2, RQ3, and RQ4 are 'how' questions and seek explanations about how schools are adapting to accommodate the introduction of ICT, how the context influences ICT uptake and how answers to these can in turn inform the search for improving and sustaining ICT use in schools over the long term. According to Yin (2013), the case study method is appropriate for answering such 'what' and 'how' questions. Although no proposition was made for this research, the overall aim, the focus of the research questions and the fact that the questions are logically related, narrow down the scope and direction of the field of investigation. The case in this investigation is about the sustainable use of ICT in Vanuatu secondary schools. Even though many schools are part of the study, the focus is on sustainability of ICT in schools in Vanuatu as a whole. Using Yin's case classification approach this study is considered a holistic single case design (Yin, 2013). Each school is considered a site rather than a case. Data is gathered from multiple sites in order to build the bigger picture of what is happening as a whole in Vanuatu with respect to the integration of ICT into schools.

The framing of the questions, their focus and the selection of the case type in turn guided the choice of data collection methods, the development of data collection instruments, the data collection process and analysis. These subsequent steps and design considerations on them are detailed in the next section.

3.6 Research Design

3.6.1 Introduction

The research design used in this investigation is deemed by the researcher to be both a plan of action for carrying out the field work as well as a strategy for ensuring that the data collected does address the research questions (Yin, 2013). According to Nachmias & Nachmias (1992), it is a plan that "guides the investigator in the process of collecting, analysing, and interpreting observations… the *logical model of proof* that allows the researcher to draw inferences concerning causal relations among variables under investigation." (Nachmias and Nachmias, 1992, pp.77-78). Its "main purpose is to help avoid the situation in which the evidence does not address the initial research questions. In this sense, a research design deals with a "l*ogical* problem and not a *logistical* problem" (Yin, 1994, p.20). Maxwell (2005) discusses a similar approach, referring to his research design model as a model *of* as well as *for* research.

3.6.2 Research design and implementation plan

The case study method provides the broad framework for developing the research design. As well, the framing and focus of the research questions and the identification of the study type as a holistic single case provide a further dimension of the framework in which to develop the research design. The research design consists of phases and the rationales for using them together with a strategy for implementing the design.

Research design components:

When designing the research questions, the choice of data collection methods, data sources and data collection samples were key considerations. The research questions are a key part of the design as the data collection methods and data sources need to be developed to answer the research questions. Thus, the data collection methods

selected, as detailed below, were those that were appropriate for collecting relevant data to answer the research questions. Similarly, the data sources (data collection instruments) were designed to collect the range of data needed and were appropriate for using case study analysis methods.

Implementation strategy:

The implementation strategy for this research consisted of two phases: the pilot study followed by the actual data collection phase. According to Yin (1994), "the pilot case is used more formatively in assisting an investigator to develop relevant lines of questions – possibly even providing some conceptual clarification for the research design as well" (p. 74). Accordingly, the purpose of the pilot phase in this study was to explore what data could be collected in the field, what data collection methods would be appropriate, the right sample mix and size and the appropriate logistics for data collection in the field. The findings from the pilot study were then used to refine the design and implementation strategy of the data collection phase.

The second phase (data collection phase) used the results of the pilot study, to ensure that the tools were valid and reliable. As such, the pilot study provided the opportunity to test the interviews, focus group discussions and observations, collection methods in order to carry out data collection in the participating school sites in phase 2. The data collection methods are further detailed in the next section. Figure 3.1 below illustrates the research design and implementation strategy. As the flow chart shows, the initial data collection methods were developed taking into account the research questions. This was the input for the pilot study. The data generated served to revise and fine-tune the data collection instruments for the data collection phase. The revision of the data collection instruments was also informed by the research questions.

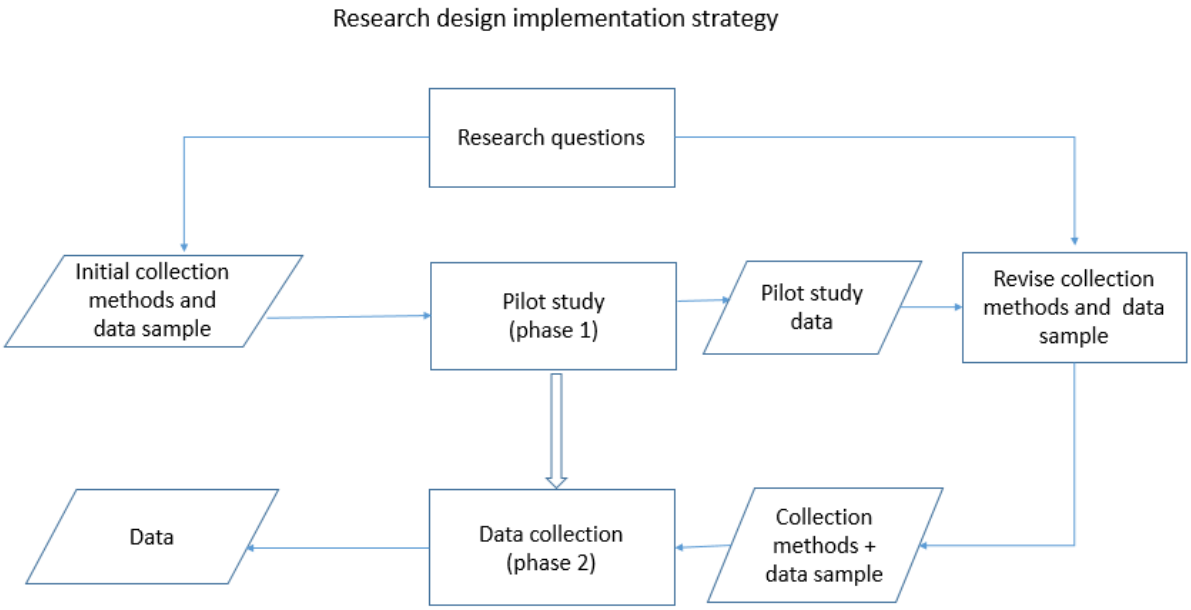

Figure 3. 1 Flowchart showing the research design implementation strategy

3.7 Data collection methods and data samples

This section details the data collection methods and data samples in both the pilot study and data collection phases. The rationales for their selection are included in the following sections.

3.7.1 Determining data collection methods

Pilot study collection methods. It was decided, in conjunction with the researcher's supervisors to use the interview method on a small sample through the pilot study. Semi-structured in-depth interviews with staff in two schools and the Ministry of Education and Training (MoET) were considered appropriate for exploring the field to obtain the required information for the data collection phase. The findings of the pilot study phase were discussed with the supervisors before the phase 2 data collection phase began.

Phase 2 collection methods. The pilot study identified a number of different data collection methods that could be used to yield more reliable data in a triangulation

approach (Yin, 2013). The pilot study revealed that careful consideration ought to be given to the context in which data was to be collected, especially in relation to obtaining data from participants who themselves come from a particular cultural background. In addition, the pilot study revealed that in Vanuatu schools, both English and French are used in most of the schools so the choice of language to be used in data collection was considered. Ethical issues of privacy and individual rights were also considered in the selection of data collection methods.

On the basis of the above considerations, it was decided to use the following three methods: qualitative interview, focus group, and observation. As well, it was decided that the Bislama language, the lingua franca of Vanuatu should be used as it is used by both Francophone and Anglophone staff of the schools.

Use of qualitative interviews

Three types of interview are typically used for data collection in qualitative research: structured interviews, semi-structured interviews and open-ended interviews (Mason, 2002; Myers & Avison, 2002; Myers & Newman, 2007). Semi-structured qualitative interviews were considered effective in this research for a number of reasons. Firstly, talking in a casual conversation style is a preferred way of communicating in Vanuatu. So in-depth semi-structured interviews in the Bislama language with participants were considered a natural way of getting them to share their knowledge, experiences and perceptions on issues related to ICT in schools. Secondly, some school staff members prefer to share their views on a one-on-one basis rather than in front of others. This is because, in Vanuatu culture, it is disrespectful to disagree openly with a person of authority or person who is in a senior position. Thirdly as the researcher comes from a Vanuatu background and is familiar with the schooling system, in-depth semi-

structured interviews would enable him to pick up on more subtle and deeper issues that would otherwise pass unnoticed.

Use of focus groups

The use of focus groups is another method of data collection (Krueger & Casey, 2015). A focus group in this research is a group of selected school staff with some experience in using a school information system (SIS) and whose views can provide useful information about the SIS. Anecdotal evidence and findings from the pilot study indicated that schools were progressing at different rates in introducing ICT into schools. This suggested that for some schools, focus group discussions may be more effective in identifying issues than would interviewing individual staff. In those schools, as staff relate and share their experiences in a brainstorming manner, they would collectively highlight underlying issues. Such discussions would be more effectively done among staff who are at the same level, as for instance, among teachers or administration staff because they would be more comfortable sharing among the group rather than in the presence of their superiors.

ICT infrastructure observation

School ICT infrastructure includes such components as computer laboratories, access to electricity and telephone networks, physical computer network, Internet access, computer hardware and software. ICT infrastructure is considered important in this research. Thus, observation of a school's ICT infrastructure would yield data about the type and quality of technology that is used, the scale of the ICT setup, and the resources used to operate it in terms of human, technical and financial resources. Since the observations were to be made on those same schools visited for interviews and focus group discussions, it was hoped that the data would corroborate those obtained from interviews and focus group discussions in a triangulation approach (Yin, 2013).

3.7.2 Determining Data Collection Samples

Selecting the school sample

In determining the school sample to be included in the research, a number of issues were considered. Firstly, the school sample should be representative of the geographic region of the country. This was considered important because the data collected should provide answers to the research question which seeks to determine the ways in which the context, which includes the physical context, has influence on the sustainable use of ICT. Secondly, schools selected should be from among Anglophone, Francophone, private as well as church owned schools. This was considered important because the data collected would be more representative of the schools and would give a more accurate assessment of the current practices of introducing ICT into schools. Thirdly, it was considered important that the sample should be a mix of urban and rural schools again to determine the ways in which context has an influence on the use of ICT, especially ICT access issues. A fourth consideration was that the sample should be a mix of some of the larger and better funded schools and the smaller poorer schools.

The school sample

On the basis of the above considerations the following schools listed in Table 3.1 were selected to be included in the study.

Table 3. 1 The school sample.

Sch. Code	Province	Location	Cat.	Owner-ship	# Staff	# Students
S1	TAFEA	Rural	F	Public	8	136
S2	SANMA	Urban	F	Public	30	400
S3	SHEFA	Urban	F	Church	(25)	360
S4	MALAMPA	Urban	F	Public	10	153

S5	SHEFA	Urban	F	Public	57	539
S6	TAFEA	Rural	A	Public	8	262
S7	SHEFA	Urban	F	Public	50	678
S8	SHEFA	Urban	A	Public	48	580
S9	SANMA	Rural	A	Public	31	381
S10	SHEFA	Rural	A	Church	24	294
S11	MALAMPA	Rural	F	Public	26	(309)
S12	TAFEA	Rural	A	Public	20	263
S13	PENAMA	Rural	A	Church	22	305
S14	SHEFA	Urban	B	Public	10	200

Category Key: A – Anglophone, F – Francophone, B – Bilingual. Numbers shown in brackets are estimates.

The staff interview sample

As with the selection of the school sample, several issues were considered in determining the school staff interview sample. Firstly, it was decided that school interview participants were to be selected from staff in different roles in a school. This would enable different perspectives on the use of ICT in school to be presented. It was decided that participants for the interview in each school should include the principal or his deputy, at least two representatives from the teaching staff, at least one representative of the ICT technical team and one from the administration section – a total of 5 staff members for interview in each school. At the research design stage, the number of staff available for interviews and focus group discussions was not confirmed. However, it was decided based on the pilot study findings and anecdotal evidence that in at least 8 schools, those that were known to be using computers for administration and for teaching the computer studies subject, interviews should be

conducted. Thus, the total number of staff members proposed to be interviewed would be around 40.

The focus group sample

Having determined that interviews would be carried out in at least 8 schools, that left 6 schools available for focus group discussions. Thus, in those 6 schools it was proposed to carry out one focus group discussion in each school. The focus group discussion in each school would target teaching and administrative staff but should not exclude management staff joining. In those schools where focus groups were to be conducted, it was determined that interviews with senior management could be conducted, but that it would depend on their availability.

The ICT infrastructure observation sample

Once the institution and staff sample were determined, determining the observation sample then became straightforward. Since interviews and focus group discussions would be conducted in the school premises, it would be convenient to carry out the observations during the same visit. In this way it would be possible to carry out ICT infrastructure in all the schools to be visited if it could be fitted into the visit schedule. It was thus decided to carry out observations in all 14 of the schools to be visited.

3.8 Ethical Consideration

Ethical considerations are about the responsibility of the researcher for the consequences of their research and its results. The code of ethics followed in this research is the Australian Code for Responsible Conduct of Research (ACRCR, 2018), developed by the National Health and Medical Research Council. The protection of individuals involved in the interviews and focus groups was agreed to as part of the ethical clearance procedure. Also agreed to, was the researcher's responsibility in any publications, including this dissertation, to protect the anonymity of the participants in

the interviews and focus group discussions. In arranging the interviews and focus group discussions, permission was sought both from the Ministry of Education and Training in Vanuatu, which was the authority responsible for the schools studied, as well as the principal of each of the schools. Ethical Clearance for this study was approved by the CQU Human Research Ethical Clearance Committee.

Obtaining the consent of the interview and focus group participants was also important. This was done in the form of a consent form which was signed by each participant prior to the interviews and focus group discussions. An information sheet was also sent out with the consent form to inform the participants about the purpose of the study, to clarify issues about confidentiality and personal consent as well as to inform them of their right to not participate if they so choose. As well, prior to recording each interview and focus group discussion, the participants were asked for their consent to record.

3.9 Summary

This chapter described the ontological and epistemological assumptions of the positivist and interpretivist paradigms and justified the choice of the interpretivist paradigm as more appropriate for gaining and understanding factors that affect the sustainable use of ICT in Vanuatu schools. The case study research method was selected for this study over three other methods as this is an in-depth study of a contemporary phenomenon and its approach was more appropriate for answering the research questions posed in Chapter 1. The positioning of the research in the interpretivist paradigm and the selection of the case study method provided the framework within which to develop the research design. The research design consisted of components and a strategy for implementing the research. This strategy consisted of a pilot study to explore the field and to revise and refine data collection

methods and instruments and a second phase which used the findings of the pilot to carry out data collection. This chapter concludes with a sample of the schools and staff to be used in the study and an explanation on how ethical practice was designed into the study.

Chapter 4

INSTRUMENTS DESIGN, DATA COLLECTION AND ANALYSIS

4.1 Introduction

The research design, data collection methods and data samples were discussed in Chapter 3. This chapter focuses on the design and development of the data collection instruments, the data collection process and data analysis. First the design and development of the data collection instruments are discussed. This is followed by a discussion of the data collection process and finally an explanation of the method used to analyse the data is discussed.

4.2 Design and Development of Instruments

4.2.1 Introduction

The rationale for designing the data collection instruments in this investigation was to ensure there was a framework for implementing data collection in the field (Mason, 2002; Richards, 2005). In this way, there would be consistency in the data collection process. As well, the data collection instruments were designed to focus data collection on those aspects that would yield data that represented evidence for the epistemological claims, as considered in Chapter 3, that are held by the researcher in this investigation (Mason, 2002; Cresswell, 1998).

As detailed in Chapter 3, the data collection strategy in this study consisted of two phases: the pilot study phase followed by the actual data collection phase. The purpose of the pilot study was to explore the field of study to determine what data should be collected, what methods would be most suitable for collecting the data, the locations of the data collection sites and the most effective way to carry out data collection. The outcomes of the pilot study guided the design and development of the data collection instruments and the subsequent schedule for data collection. The main topics for the interviews and focus group discussions were identified from the outcomes of the pilot study. Questions were then developed around these topics to create the instruments for management staff, teachers, technical staff and focus groups. The development of the observation instrument and data collection protocol and schedule were also guided by the outcomes of the pilot study. These are described in greater detail in the following sections.

4.2.2 Pilot study

As detailed in Chapter 3, the reason for carrying out the pilot study was to establish the focus of the research. For instance, the following were not at all clear before data collection was carried out:

- which schools had a School Information System (SIS),
- the scale of these SISs in terms of network size,
- access to technical resources and expertise,
- the administration and use of these systems, and
- the role of the Ministry of Education in the integration of ICT into schools.

Thus, the purpose of the pilot study was to determine the extent to which some of the above issues were occurring in schools so that data collection could be appropriately

targeted. The pilot study entailed carrying out preliminary interviews in two selected schools and staff at the Ministry of Education and Training (MoET).

Pilot study interviews

Two schools which had an operating SIS, as well as the Ministry of Education, were selected for the pilot study interviews. The Ministry of Education was included as it is the national education authority and it would be able to provide relevant information on secondary schools and the national education system.

School Interviews

Two interviews were conducted with the principals of the selected schools. The purpose of the interviews with the principals was to elicit information about the activities concerned with the uptake of ICT in the schools, in particular with activities concerning the setting up, use and maintenance of the school Information System (SIS) in place. The interview questions focussed on the following issues:

- SIS project initiation – what were the initial decisions and plans to start the SIS project?
- SIS feasibility study and user requirements analysis – what procedures or methods were used to determine user and system requirements?
- SIS design – what methods were used to design the physical and logical components of the system?
- SIS development – what approaches were used to develop, build or acquire components of the system?
- SIS deployment – how was the system rolled out in terms of system installation, testing and training of staff?

- SIS Administration and maintenance – what arrangements were put in place for maintaining the system and providing technical support to the users?
- SIS use – how was the system used by the administration, teaching staff, and students?

Although the questions were focussed on technical aspects of a typical SIS, they were asked in non-technical language as interviewees were not technical persons. The interviews were conducted at the school premises. Arrangements for the interviews were organised by the researcher in coordination with MoET. The interview questions are presented in Appendix A1. Permission for the interviews was requested through MoET and the interview topics were sent to the interviewees prior to the interviews.

Ministry of Education Interview

This interview was conducted with a senior staff member of the Ministry of Education and Training and it was completed after the school interviews. The purpose of the interview was to obtain background information on secondary schools in Vanuatu, and the Ministry's involvement with ICT in schools. As well, the interview sought to elicit information on how the national school system operates, and to seek advice on appropriate ways of accessing the schools during data collection. The interview questions focussed on the following:

- Ministry of Education school ICT policy
- Funding and technical support for ICT in schools
- Examples of schools that use ICT
- Issues with ICT in schools
- Obtaining access to schools in outer islands

The interview was undertaken at the Ministry of Education. Arrangement for the interview was also organised by the researcher and topics of the interview were sent to the interviewee before the interview.

Pilot study interview responses

Responses from the interviews are presented below. They are a summary of the main issues raised by the interviewees.

Summary of school interview responses

In response to questions on the development of the SIS, that is, on planning, feasibility study, design and implementation of the SIS, the interviewees revealed that:

- The computer services agents that were given the contracts to set up the SIS in both schools oversaw the implementing of the projects.
- An informal process was used to gather user and system requirements.
- There was little evidence of systems design apart from the design of the physical network layout.
- There was little evidence of in-house software development. Instead, commercial off-the-shelf software packages such as the Microsoft Office suite were used.
- The scarcity of funds to build and sustain the operation of the SIS was a significant issue in both schools as it hindered progress in the development, maintenance and use of the SIS.

Responses to the questions on SIS administration and technical support revealed that:

- Ongoing technical support was weak mainly because there were not enough technical staff members in the schools, but also because the lack of funding restricted technical support activities.

- Donor agencies, particularly the AUSAID and the Japanese Overseas Cooperation Volunteer (JOCV) organisations, donated equipment to the schools and provided technical expertise in the form of volunteer staff to operate, upgrade and maintain the SIS as well as provide user support.

Responses to the questions on system use revealed that:

- The SIS was mainly used for administration as well as for teaching the Computer Studies curriculum at senior school level. However, teachers were also beginning to use it for lesson preparation.

- The level of computer literacy in both schools was low and the schools did not provide training because they neither had the expertise nor the necessary funding to do so.

Summary of Ministry of Education interview responses

The following summary of responses from the Ministry of Education and Training (MoET) interview reveals some of the main issues in relation to the uptake of ICT in schools:

- There was no national ICT policy for schools although MoET was working on getting one developed.

- The national MoET budget did not include funding for ICT in schools.

- Sometimes MoET coordinated and/or facilitated the work of some donor agencies in providing funding, computer equipment or ICT expertise to schools.

- MoET was not directly involved in the integration of ICT into schools.

- Telecom Vanuatu Limited (TVL), the national telecommunication service provider provided a free dial-up internet service for schools. Access was limited to school hours.

- Transporting computer equipment between islands was expensive.

- The scale of SIS in the schools varied. The bigger schools were in Vila and Luganville, the two main urban centres in the nation.

SIS issues revealed by the pilot study

An interpretive and reflective reading of interview responses revealed that issues concerning the setting up, operation and use of a SIS were much broader than the technical aspects that were the focus of the interviews. Five broad issues were identified in the pilot study and they include:

- **The technical aspects of the SIS**. This was the main target of the school interviews and included the planning, funding and management stages of the SIS project as well as the technical aspects of developing, implementing, deploying and maintaining the SIS.
- **Leadership issues**. The SIS set up in both schools appeared to have been technology driven which implied that the management was not in full control of the SIS set up cycle. Interview responses from the Ministry of Education and Training confirmed that it did not take a leadership role in the uptake of

ICT into schools; it did not have a national ICT policy for schools, a budget for ICT in schools and it was not directly involved with SIS activities in the schools.

- **ICT expertise and computer literacy issues**. Interview responses from the schools indicated that the level of technical support in both schools was low because ICT expertise was scarce and also because schools did not have sufficient funding to recruit technical staff. As well, the schools did not operate computer literacy programs for the staff which implied that computer literacy among the staff was probably not at the level the schools expected.

- **Purpose of the SIS**. As the SIS set up in both schools was technology driven, this also implied that the schools had not clearly thought through the role of the SIS in the schools and how it would dovetail in with other components of the school's organisational structure and activities. As well, since the Ministry of Education ad Training did not have an ICT policy for schools, it did not provide guidance on the broader framework within which schools should set up and operate a SIS.

- **Current issues affecting the SIS**. Current issues in this research concerned those issues that challenged the schools in setting up and operating a SISs; most were context related issues and were partly outside of the control of the schools. Responses revealed that these included issues of SIS reliability as in the reliability of technical support; affordability as in the ongoing funding of the SIS; and accessibility as for instance in the transportation of SIS components between the islands.

Pilot Study Outcomes

Results of the pilot study informed and guided the strategy for the data collection phase in the following ways:

1. With respect to the data collection methods the study confirmed that:

- Interviews would be conducted in schools that had a working SIS and had staff members who could be available to be interviewed.

- Bislama, the lingua franca of Vanuatu, would be the appropriate language to be used to conduct interviews and focus group discussions as this was the language spoken by staff in both Anglophone and Francophone schools.

- Focus group discussions would be conducted in schools where it was determined that focus groups would be more effective in capturing the required data.

- Observation of ICT facilities was to be carried out in all the schools to be investigated.

2. The pilot study revealed that SIS issues were not confined to those that were technical in nature. Accordingly, the content of the interview and focus group data collection instruments were to be broadened to include the five broad topics that the study had identified.

3. With respect to the data collection schedule, it was decided to carry out the interviews, focus group discussions and observations during the period of the visit to each school; it was more efficient, less time consuming and less expensive done this way.

4.2.3 Development of School Interview Instrument

Introduction

School interviews were conducted in 8 schools and the criteria for the selection of these were detailed in Chapter 3. For each school, it was decided to interview representatives from different categories of staff so that data from different perspectives regarding the SIS could be collected. Thus, it was decided that interviews would be considered for: a representative from management, two or more teachers, a representative of the school technical staff, and where possible, a representative from the school administration. In all it was planned to interview at least 40 staff members in the schools selected, however the availability and willingness of staff was a factor in the final number of interviews conducted. At each school visited, all scheduled interviews were carried out during the period of the visit.

Development of Interview Questions

The design and development of interview questions for all categories were initially done in consultation with the supervisors. The main topics to be covered in the interviews were those revealed in the pilot study. The interview questions were developed around these topics and framed so as to elicit data that will assist in answering the research questions (Mason, 2002). As well, the design and development of interview questions was informed by the following literature:

- Qualitative research methods (Yin, 1994; Yin, 2013; Mason, 2002; Mason, 2018; Cresswell, 2017; Richards, 2005; Silverman, 2004; Blaxter, Hughes & Tight, 2006).
- Standard methodologies for developing, implementing and maintaining information systems (Valacich, George & Hoffer, 2011; Satzinger, Jackson &

Burd, 2015; Gido & Clements, 2015; Sommerville, 2016; Robertson & Robertson, 2013).

- The experiences of schools in other parts of the world in integrating ICT into schools (Meleisea, 2007; Sanchez &Salinas, 2008; UNESCO Institute of Statistics, 2014; ICT capacity building at USP project, 2006; Lai & Pratt, 2004).
- The researcher's background knowledge and experience of the Vanuatu cultural setting and of the Vanuatu schooling system context also informed the design and development of the interview questions.

Interview Content

The interviews for all staff categories were developed around the same topics, but the questions for each category were about the participants' experiences and perceptions of the SIS as shown in Figure 4.1.

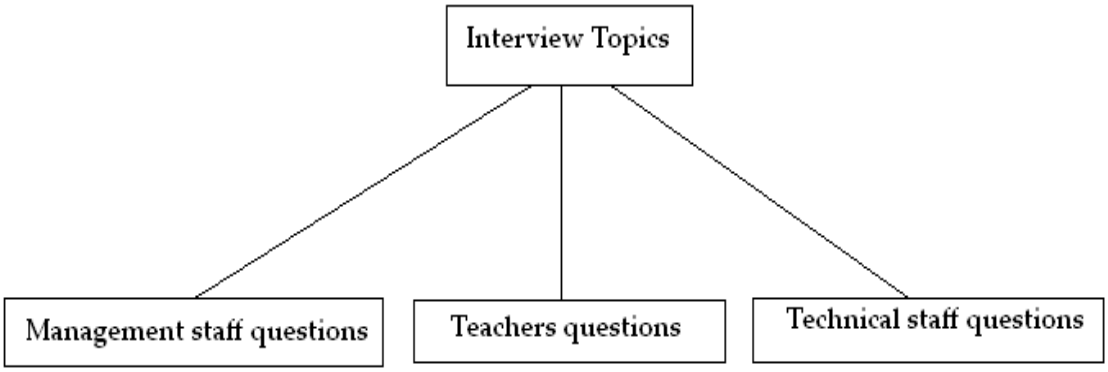

Figure 4. 1 Questions for the three categories of staff

The topics for the interview questions concerned the following five aspects which were identified in the pilot study:

- Purpose of the SIS
    - How different categories of users view the purpose of the system
- SIS Structure

    - SIS set up cycle including funding, planning, development, deployment and system support
- Staff expertise and information for SIS development
    - Technical expertise
    - Staff literacy level and training
    - School stakeholder community involvement in the SIS
- Leadership role in the SIS
    - Leadership roles played by staff in the SIS
- Climatic factors that affect SIS sustainability
    - Interviewee's perspectives on issues affecting the sustainability of the SIS into the future.

School interview questions all staff categories are presented in Appendix B.

4.2.4 Development of Focus group discussions instrument

Introduction

As explained in Chapter 3, focus group discussions were conducted in schools where either the SIS was formally set up but later broke down, or where the SIS consisted of just stand-alone computers that were used in an ad hoc manner and were poorly maintained. In these schools it was felt that focus group discussions were considered more effective than interviews as staff did not have a lot to share about their personal experiences in using the SIS. On the other hand, round-the-table discussions would enable the staff to share their experiences about what had happened to the SIS, how they were coping with what ICT resources the school had and what they would like to see happen in order to rebuild and sustain the SIS. Six schools were identified for focus group discussions.

Design and content of focus group discussion questions

The topics around which questions were designed for the focus group discussions were the same as those used in the interviews, but the questions asked were directed at the group rather than individual staff members.

4.2.5 Administration of Interviews and Focus groups

Results from the pilot study revealed that it would be more efficient to carry out all the data collection required for each school in one visit. This was because the 14 schools to be investigated were on five islands spread across the six provinces of the country so that it would be expensive and impractical to make multiple visits to each school. Thus, each visit to a school that had interview sessions began with an interview of the principal followed by teachers and or technical staff and then the observation was carried out. The same procedure was used in schools where focus group sessions were conducted.

Protocols for arranging and conducting interviews and focus group sessions.
The interview and focus group sessions were carried out at the school premises. The time duration of the interviews and focus groups sessions was set so that it was adequate to cover all the topics in the interview and focus group questions. An hour was scheduled for each session, but actual sessions varied in length between 45 minutes and 75 minutes depending on the topics being discussed and the availability of staff.

The following protocol was used for arranging visits to the schools:

1. Following authorisation from the Ministry of Education and Training, the researcher contacted the school directly or via the Ministry of Education and Training and scheduled a suitable date prior to the visit.
2. Once the date was confirmed, the researcher confirmed with the principal of the school those staff members who would participate in the interviews or focus group sessions.

3. The researcher then sent out the information sheets and consent forms to the school. In this respect, the researcher was most indebted to the Ministry of Education for providing logistical support, especially in relation to forwarding the questions and consent forms to schools in the rural areas.

The following protocol was used for conducting the interviews and focus group sessions:

1. Before the session, the researcher checked that the consent forms were signed by the participant(s).
2. Permission was sought to record the session.
3. The researcher thanked the participants and explained the purpose of interview/focus group session.
4. The interview or focus group session was then carried out and recorded.
5. The sessions was concluded by thanking the participants once again.

Recording and translation.

Most of the interviews and focus group sessions were tape recorded using an audio recorder and they were conducted in Bislama, the lingua franca of Vanuatu. The recordings and the notes taken had to be transcribed and then translated into English. The researcher is fluent in Bislama and so carried out the translation.

4.2.6 School SIS Infrastructure Observations

The observations were considered as an essential component of the research design. The scale and status of the SIS in a school in terms of the number of computers available, the layout of the physical network, the allocation of computers among staff

and students, the availability of resources for the SIS and the state in which the network is maintained were considered important in this research for several reasons:

- The number of computers provide a measure of the scale of the SIS, the level of technical support required as well as the level of access of the SIS to staff and students.
- The physical SIS infrastructure in terms of network architecture, internet connectivity and computer laboratory layout also provide an indication of access to the SIS and technical support requirements.
- These in turn provide an indication of the relative level of funding required to operate and maintain the SIS.

Thus, in addition to the school interviews and focus group sessions, it was decided to carry out an observation of the SIS infrastructure in each school. As well as observing and taking note of several selected SIS features, the researcher also asked questions and noted explanations given by the staff member accompanying the researcher. As such the role of the researcher was not just that of a passive observer but of an observer-participant (Mason, 2002).

Observed features of a SIS

SIS infrastructure features that were selected to be observed were those that could provide information for addressing the research questions. The following features were selected to be observed and recorded for each school in the sample:

- Number of student laboratories
- Total number of computers
- Number of computers allocated to teaching and administration staff
- Number of technical support staff
- Whether or not the SIS was networked
- Whether or not the SIS had Internet access

- The status of the electricity power supply

Observation Process

Observation of the SIS was carried out by the researcher in all the 14 schools selected in the study. For each school, the observation was scheduled to take place after the interviews or focus group session whichever the case. Arrangements for SIS observation in each school were done by the researcher in consultation with the principal of the school prior to it being carried out and the principal assigned a staff member to accompany the researcher through the school premises. In most schools, the accompanying person was a member of the technical staff.

4.3 Analysis of the Data

4.3.1 Introduction

A thematic approach (Mason, 2002; Richards, 2005) was used to organise and analyse the interview and focus group data since in this research the research questions concerned the identification of factors that influence the sustainable use of ICT in schools. In this approach, the researcher reviews the raw data, sorts them into categories and then interprets and reflects on the meaning of the data segments under the categories. The purpose of this interpretive and reflexive reading of the data is to help the researcher move the analysis from a broad reading of the data towards discovering patterns and developing themes. An explanation of interpretive and reflective reading is given in the following section.

4.3.2 Analysis procedure for Interview and Focus group data

In this research, the following two step procedure was followed in performing the thematic analysis.

1. **Perform topic coding**: The raw data was organised under the topics used in the interviews and focus group discussions. The purpose of this step was to group all data related to a topic in one place so that analytical coding could be done on it. The result of this process was a list of topic categories containing related data.

2. **Perform analytical coding**: Once gathered under the topics, an interpretive and reflexive reading of the data was done. The purpose of analytical coding was to discover patterns and explanations in the data. This was an iterative process and took place over a longer period after the initial step in the process. The result of this process was a list of final themes. Figure 4.2 shows a flowchart diagram illustrating the thematic analysis process.

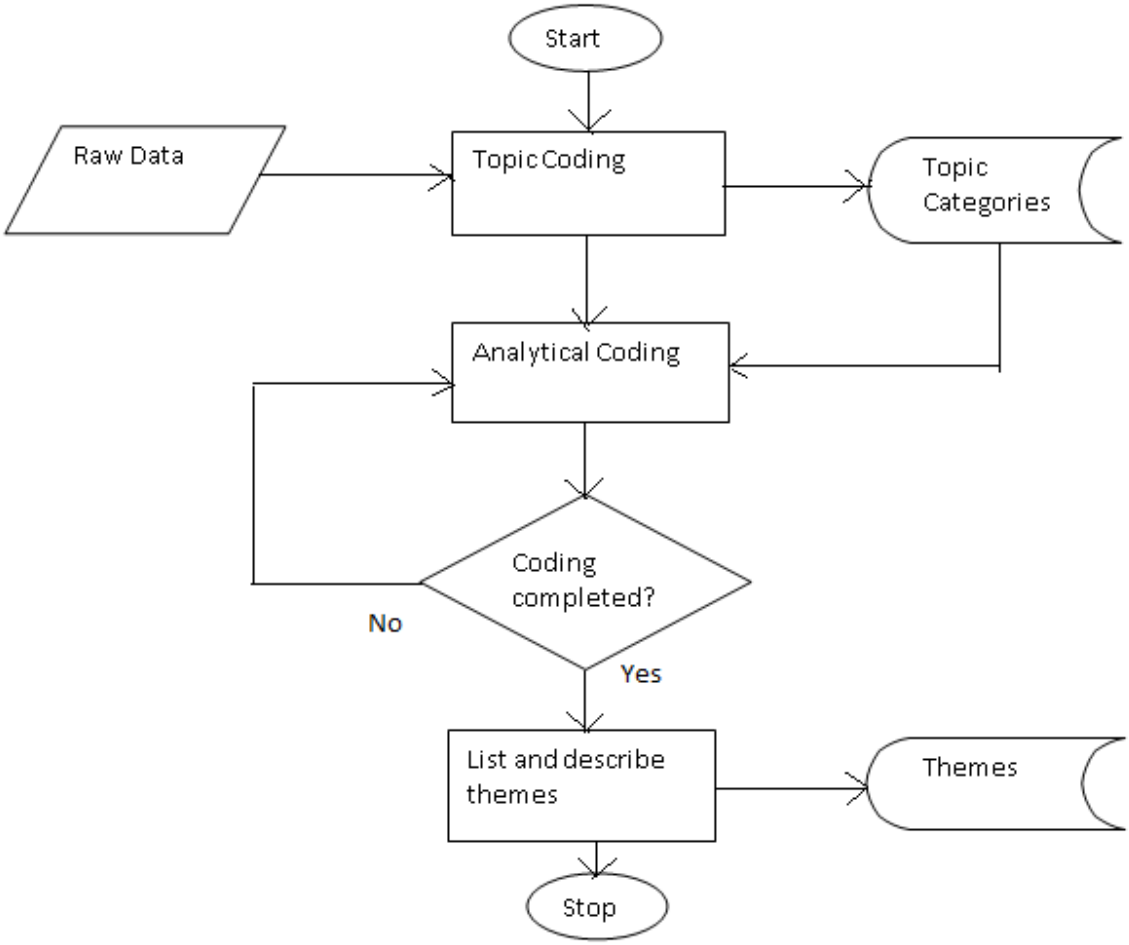

Figure 4. 2 Flow chart illustrating the thematic analysis process used

The thematic analysis approach described above was used for both the interview and focus group data. The two-step thematic analysis procedure is further explained below

Step 1: Topic coding

Topic coding (Richards, 2005) is about allocating meaningful text segments, phrases or words from the raw data to topics. The first step in analysing the data in this research was topic coding and the purpose was to gather meaningful responses to questions on a topic from different interview or focus group sessions in one place. This then allowed the researcher to reflect on what the data segments said about the topic, how the topic might be related to other topics and the meanings of those relationships. The process involved reading through the interview and focus group

session transcripts and asking which text segments, words or phrases belonged to a previously identified topic. The topics used for the coding were the ones previously identified in the pilot study (Section 4.2.3) namely:

1. Purpose of the SIS
2. SIS Structure
3. Staff expertise and information for SIS development
4. Leadership role in the SIS
5. Climatic factors that affect SIS sustainability

It should be noted that in developing the interview and focus group instruments, the questions were ordered consecutively but they were also grouped under the above topics. Thus, in topic coding, it was logical to group responses to questions on a topic under the same topics. Table 4.1 illustrates topic coding for the responses from interview data.

Table 4. 1 Topic coding for interview data

Interview	**Topic 1 Questions**	**Topic 2 Questions**	**Topic 3 Questions**	**Topic 4 Questions**	**Topic 5 Questions**
Interview 1 … … … Interview n	Interview 1 responses to topic 1 questions. … … … Interview (n) responses to topic 1 questions.	Interview 1 responses to topic 2 questions. … … … Interview (n) responses to topic 2 questions	Interview 1 responses to topic 3 questions. … … … Interview (n) responses to topic 3 questions	Interview 1 responses to topic 4 questions. … … … Interview (n) responses to topic 4 questions	Interview 1 responses to topic 5 questions. … … … Interview (n) responses to topic 5 questions

In Table 4.1, each row gathers meaningful responses to questions on each topic from each interview session. Each column gathers meaningful responses to questions on each topic from interviews across all the schools where interviews were carried out.

Topic coding was done for all categories of staff interviewed, namely management staff, teachers and technical staff; so, for instance, in table 4.1, the first interview (first row), would contain interview responses from management staff, teachers and technical staff on each topic (column). A similar topic coding procedure was done for the focus group data and this is illustrated in Table 4.2 below.

Table 4. 2 Topic coding for focus group data

Focus Group session	**Topic 1 Questions**	**Topic 2 Questions**	**Topic 3 Questions**	**Topic 4 Questions**	**Topic 5 Questions**
FG 1	FG 1 Topic 1 responses: 1. Management responses 2. Teacher responses 3. Tech staff responses	FG 1 Topic 2 responses: 1. Management responses 2. Teacher responses 3. Tech staff responses	FG 1 Topic 3 responses: 1. Management responses 2. Teacher responses 3. Tech staff responses	**etc**	**etc**
FG n	FG (n) Topic 1 responses: 1. Management responses 2. Teacher responses 3. Tech staff responses	FG (n) Topic 2 responses: 1. Management responses 2. Teacher responses 3. Tech staff responses	FG (n) Topic 3 responses: 1. Management responses 2. Teacher responses 3. Tech staff responses	**etc**	**etc**

In Table 4.2, as in Table 4.1, each row gathers meaningful responses to questions on each topic but this time from each focus group session. Similarly, each column gathers meaningful responses to questions on each topic from focus group sessions across all the schools where focus group sessions were conducted. However, in this case, the category of staff making the response was identified.

Step 2: Analytical coding

Analytical coding requires an interpretive and reflexive reading of the data. According to Mason (2002, p. 149):

> "An interpretive reading will involve you in constructing or documenting a version of what you think the data mean or represent, or what you think you can infer from them. A reflexive reading will locate you as part of the data you have generated and will seek to explore your role and perspective in the process of generation and interpretation of data."

In coding the data organised under the topics, an interpretive reading of a code segment was taken to mean telling the researcher something about what the interviewee meant or implied, or something about the rules or culture under which the interviewee was operating or influenced by, or something that indicated a cause and effect situation. Furthermore, as the researcher has a Vanuatu cultural background, he sees himself as inevitably part of the data generation and interpretation process. Thus, for him, a reflexive reading of interview and focus group data segments meant constructing the meaning of what was said taking into account some of the researcher's cultural experience and knowledge in order to interpret what was said, meant, implied or even what was not said.

The following procedure was used in analytical coding. Considering the data grouped under each topic:

1. First the code segments under the topics were read to discover important issues. These were fine-grained concepts or text segments that stood out from the data either because they appeared more frequently, were striking or surprising to the researcher or were emphasised by respondents. A list of these issues was gradually generated.

2. Next, all the issues were examined to see how they were related if at all. Two or more issues were considered to be related if they were seen as part of a bigger whole. Related issues were then combined by abstracting to coarser grained categories which are referred to in this research as sub-themes.

3. The sub-themes were then revisited, re-read, viewed from different perspectives and those that were found to be related were combined into themes. Sub-themes were temporary entities and eventually were made themes or subsumed into other themes.

The analytical coding procedure used to discover themes as described above was iterative and took place over a longer period of time after topical coding was done. This was because grouping of the data into sub-themes and themes allowed the researcher to view emerging patterns in different ways. In the process some issues, sub-themes and themes were discarded or subsumed into other groups and new ones were created. This iterative process continued until the researcher was satisfied that the themes were related in logical ways, formed stable and meaningful patterns and could be used to provide explanations to answer the research questions. Figure 4.3 illustrates the stages in the analytical coding process.

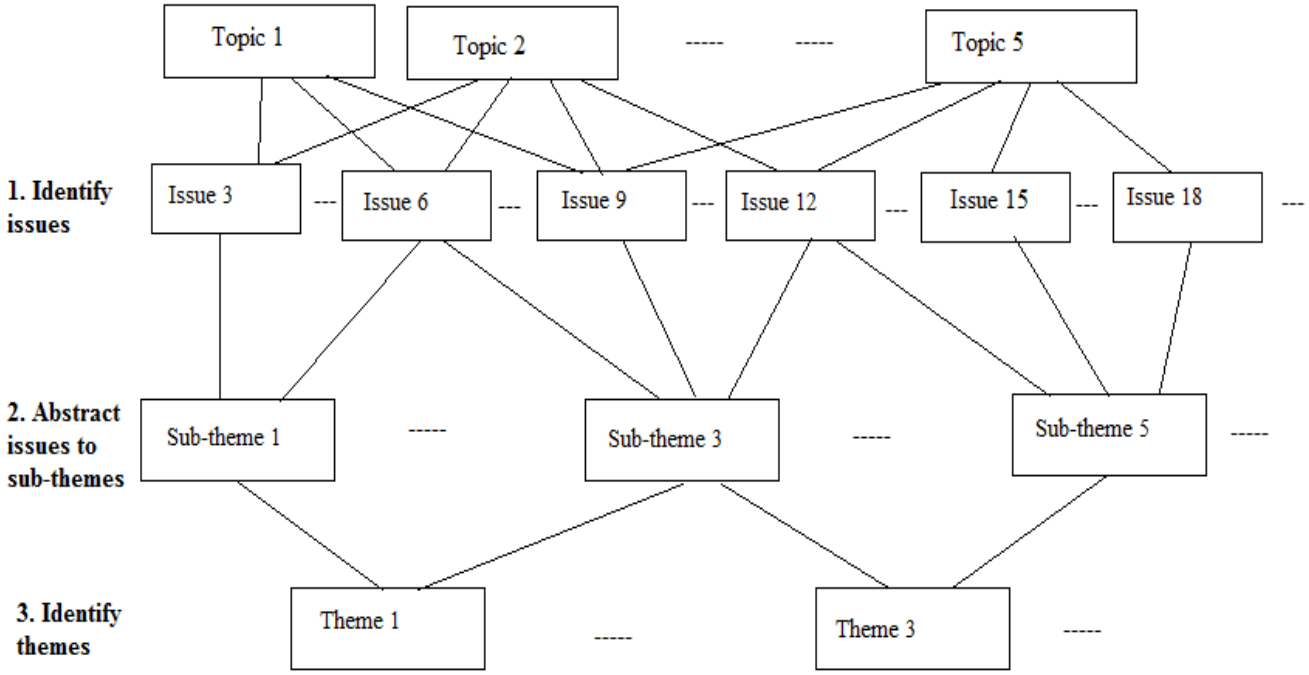

Figure 4. 3 Diagram illustrating the analytical coding procedure.

In Figure 4.3, the direction of progression in analytical coding is from top to bottom. Although it is not indicated, progressing from step 1 to step 2 was an iterative process as was progressing from step 2 to step 3 as alluded to above.

4.3.3 Analysis of SIS infrastructure observation data

The SIS observation data were recorded in the form of field notes. These were later condensed into tabular form and loaded on Microsoft Excel for analysis. Simple analysis was done such as sorting and presentation in different graphical formats to highlight important information. Of particular interest in the analysis was the physical state of a SIS in terms of size and the technology used, the level of technical support for the system and for staff, access to ICT services such as Internet, telephone and electricity services and SIS use both for teaching and learning. The results of the analysis were compared with those of the Interviews and focus groups to see if they corroborate.

4.3.4 Identified Themes

The outcome of the analysis for the interview data as well as the focus group data using the procedure described in Section 4.3.2 and the outcome of the observation analysis was the identification of ten themes. These were discussed with the principal supervisor and with feedback, the themes were further refined. That the themes identified in the interviews and focus group analysis were the same did not come as a surprise since the context, data sources and instruments were of the same types in both interviews and focus groups data collection. The themes are listed with brief descriptions in Table 4.3 below.

Table 4. 3 School themes

Theme	Description of theme
Systems Processes	Standard models and techniques used for setting up and operating an information system
Systems Support	Technical support that is needed at all stages of the SIS lifecycle.
Systems Fitness for purpose	A measure of the extent to which a functioning SIS meets its requirements.
Pattern Language	An organised collection of templates for translating core school tasks to technical language together with rules for using them and the context in which they apply.
Affordability	The extent to which a school can afford a SIS in terms of its costs and the school's ability to pay.
Accessibility and ICT	Physical constraints in the use of ICT and the small size of the islands, island isolation, remoteness and vulnerability. ICT accessibility refers to a school's ability to access the resources and services it needs in order to use a SIS effectively.
ICT Capacity	A school's readiness or its potential to set up and operate a SIS.
Cultural Influence	Vanuatu cultural patterns of behaviour that shape influence on SIS activities in schools.
Organisational Leadership	The leadership and management roles assigned to staff in the context of the SIS environment.
Partnerships	The relationships that schools form with stakeholder

groups for the purpose of engaging in SIS activities.

4.4 Summary

The data collection process was undertaken in two phases; a pilot study followed by the actual data collection. The pilot study identified those issues that the data collection instruments should focus on. As well, it confirmed that interviews, focus group discussions and observations were to be data collection methods to be used as they were more effective than other methods. The pilot study also confirmed the strategy to be used for data collection.

The design of the data collection instruments was guided by outcomes of the pilot study, informed by the literature and by the researcher's personal experience of Vanuatu culture and the Vanuatu school system. The supervisors were consulted during the design of the data collection instruments. Three categories of participants were used for the data collection, namely: management and administration, teachers and technical staff. Also, three interview instruments were developed. One instrument was developed for the focus group discussions and one for the observations. The questions for the interviews and focus groups were organised around the same topics but the questions for each category of staff focussed on their perspectives and experiences with the SIS.

The data collection strategy used was to carry out the interviews, focus group sessions and observations together on each school visit rather do them on separate visits as the schools were on separate islands and there were transport difficulties. A standard protocol was used to arrange for the school visits, for conducting the interviews and focus groups and for the observations. The interviews and focus group discussions

were transcribed and translated to English by the researcher as they were conducted in Bislama the lingua franca of Vanuatu.

A thematic approach was used to organise the data for analysis. What was considered data was a combination of an interpretive as well as reflexive reading of the data. The interview and focus group data were first organised under the topics around which questions were developed. Important issues were then identified, and these issues were then collapsed into a small set of emerging themes. The result of this analysis was a set of ten themes. The observations data corroborated the results of the interview and focus groups analysis. In Chapter 5 the results of the analysis of the data collected are presented.

Chapter 5

RESULTS

5.1 Introduction

The previous chapter described the development of the data collection instruments, the data collection process as well as the techniques used for analysing the data collected. This chapter presents the results from the data analysis. First an explanation is given of the methods used to present the results from each of the data sources. The results are then presented, followed by a summary.

5.2 Identified Themes

As detailed in Chapter 4, analysis of the data in both the interviews and focus group sessions yielded ten themes. The themes concern those aspects relating to the School Information System (SIS) itself, aspects relating to the school and its readiness to operate a SIS and those that relate to the environment in which the school and its SIS operate. The themes identified are shown in Table 5.1 below.

Table 5. 1 Identified themes

Theme	Theme definition
Systems Processes	Standard models and techniques used for developing, implementing and operating an information system
Systems Support	Technical support that is needed at all stages of the SIS lifecycle.
Systems Fitness for purpose	A measure of the extent to which a functioning SIS meets its requirements.
Pattern Language	An organised collection of templates for translating core school tasks to technical language together with rules for using them and the context in which they apply.

Affordability	The extent to which a school can afford a SIS in terms of its costs and the school's ability to pay.
Physical constraints & ICT Accessibility	Physical constraints in the use of ICT and the small size of the islands, island isolation, remoteness and vulnerability. ICT accessibility refers to a school's ability to access the resources and services it needs in order to use a SIS effectively.
ICT Capacity	A school's readiness or its potential to set up and operate a SIS.
Cultural Influence	Vanuatu cultural patterns of behaviour that have an impact on SIS activities in schools
Organisational Leadership	School leadership and management roles and responsibilities in the integration of ICT into schools.
Partnerships	The relationships that schools form with stakeholder groups for the purpose of engaging in SIS activities.

5.3 Method of presentation of the Results

This section describes the methods used to present the results. As detailed below, the results of the analysis are presented in the context of the ten themes listed in Table 5.1.

5.3.1 Presentation of School Interview, Focus Group and infrastructure results.

Under each theme, a table summarising main comments by each category of staff is presented. The summary of comments was made from interview and focus group transcripts during the analytical coding process described in section 4.3.2. The summary of comments is then followed by explanations that elaborate and contextualise the comments and emphasise where appropriate those issues that embody the theme. The SIS infrastructure observation data are also presented in a series of tables after the interview and focus group results.

5.4 Interview Results

Information Systems Processes

The **Information Systems Processes** theme concerns standard models and techniques used for planning, developing, deploying and operating an information system; they are used in all phases of the information system lifecycle. Table 5.2 provides a summary of the participant's responses that relate to the *Information Systems Processes* theme.

Table 5. 2 Summary of responses about *Information Systems Processes*

Group	Summary Comments
Management & Administration	The school did not build the whole system in one go. It started with the administration section and then the school labs. The system was initially started in one section of the school and then as the school expanded, and money was available, the SIS was expanded. The SIS started as a few standalone computers. Then AUSAID provided more computers and a local computer agent set up the network. There was no ICT policy guidance from Ministry of Education
Teachers	There were no formal consultation processes with the teaching staff about the setting up of the School Information System. No formal policies or procedures exist for using the system.
Technical Staff	There were no formal plans used in planning the system, developing it, deploying it or operating. The vendor just followed standard procedure in setting up the network.

The summary of responses presented in Table 5.2 highlight several issues concerning the way SIS development took place in most schools. These include:

- *Stage by stage ad hoc development of SIS*
- *Limited long-term planning*
- *No guidance from Ministry of Education and Training (MoET)*
- *Stakeholder participation in SIS*

- *Low ICT literacy levels among staff*

Stage by stage ad hoc development of SIS. Except for one school, S5, there was no evidence that a systems development model was followed to set up the school information system (SIS). That is, there was no master plan to develop, implement and operate the whole system.

Rather in most schools, it appeared that the system evolved in stages in a bottom up manner. First, a small number of computers were bought and installed as standalones for the administration section; later they were networked. This was followed by the procurement of more computers for the student laboratories because the school had started offering the Computer Studies subject for the senior classes. Then several more computers were procured and installed for the teaching staff. Finally, computers were installed in the school library. This was the pattern of ICT integration into the schools. At some point in the set-up period connection to the Internet was established.

Limited long-term planning. The results reveal that the management in most schools did not have a long-term plan for their SIS. Rather each stage in the development was carried out as the need arose. Interview responses from management in many schools revealed that lack of funding, technical expertise and technical resources determine, to an extent, this trend in SIS set up.

No guidance from Ministry of Education and Training (MoET). Responses from staff in most of the schools confirmed that there was no guidance from the Ministry of Education about the use of ICT in schools. Indeed, as revealed from interviews with staff from the MoET in the pilot phase of the investigation, no national ICT for Education policy had been developed at that time.

Stakeholder participation in SIS activities. In most of the schools visited, management acknowledged that aid donors, particularly the Australian government through

AUSAID, the French government through its various aid projects, and PEACECORP had aided in the set-up of ICT in schools. It was evident from responses to this issue that assistance was provided in an ad hoc manner and not part of a planned SIS development policy.

Low ICT literacy levels among staff. Following the interviews with some of the school Principals the impression was gained that they only have a general understanding of how a SIS works or should work. This was evident in the way they attempted to answer questions relating to the various phases of a SIS, such as planning and development. Even though they were aware that computers become obsolete after a certain period, they had not made explicit any strategies for dealing with changes in the system and the associated risks and costs; it appeared that they were not factoring into their considerations a SIS change management strategy.

System Support

The **System Support** theme concerns technical support that was needed at all stages of the information systems lifecycle, that is, technical support at the planning, development, deployment and operation stages of the SIS. Table 5.3 provides a summary of the responses that relate to the *System Support* theme.

Table 5. 3 Summary of responses about *System Support*

Group	Summary Comments
Management & Administration	It was difficult to recruit permanent technical staff. Some teaching staff members were involved in low level technical support. Maintenance work was expensive because of transport costs, hardware/software spare parts and servicing costs. The school had informal arrangements with a vendor and computer servicing agents to provide technical support. The school did not have a separate SIS budget.
Teachers	Frequent breakdown of computers. It often took a long time to repair broken down equipment. Computers and printers were unavailable when needed which was frustrating.

Technical Staff	There were not enough computers for teaching staff to use. School staff members were happy with the support that school technical experts and colleagues provide. There were no formal systems operation policies and procedures. The roles of the technical support staff and their tasks were not clearly identified. School did not have an IT Section. Servicing equipment usually took a long time because they had to be shipped to another island to be repaired. Upgrading of hardware and software was not done on a regular basis due to lack of funding School did not have a proper data backup system. School did not have a system for securing the SIS from viruses and other security risks.

The responses in Table 5.3 highlight some of the main issues associated with system support in most of the schools visited. Six main issues were identified:

- *Lack of technical expertise*
- *System components servicing problems*
- *Resource access problems*
- *No clear policies and procedures*
- *Safety and security issues*
- *User support*

Lack of technical expertise. Lack of technical expertise appears to be part of the reason why formal systems processes were followed in only one school (S5) and not in the others; since management in most schools did not have access to the advice of an ICT expert, they did not know how to go about setting up the SIS. It was apparent from interviewing management staff in most schools that they did not have the support of an ICT technical expert to plan, develop, deploy and operate the SIS. Responses from staff in most schools linked poor technical support to a lack of availability of expertise and to the high cost of recruiting experts. One school Principal complained that he had advertised for a part-time technical staff without

getting any applicants. The point this Principal was making was that it was difficult to recruit ICT technical staff to work in a rural school.

System components servicing problems. Most teachers and technical staff members interviewed raised the issue of servicing system hardware by computer service agents. This tended to concern the following matters:

- poor quality and reliability of services provided – all schools except S5, S7, S8
- high servicing and transportation costs – all schools on Malekula, Tanna and Ambae islands
- long turn-around time for servicing components – all schools on Malekula, Tanna and Ambae islands

Resource Access problems. Issues were raised by interviewees particularly, those in rural schools, that access to resources, especially access to reliable telephone connections for internet use, access to needed hardware and software, access to reliable electricity supply and access to expertise information was problematic.

No clear policies and procedures. Technical staff in some of the schools pointed out that the schools did not have clear policies and procedures for technical support. This was mainly in relation to the procurement, servicing and upgrading of system hardware and software. On further questioning some teachers revealed that there were also no policies for system safety and security especially in relation to internet access and to data storage and safe keeping.

Safety and Security issues. Interviewees from those schools connected to the *Lagoon School* free Internet service provided by TVL, said they depended on TVL to provide content filtering. Three of the schools (S5, S7, and S14) had firewalls installed in their networks. The rest did not. Concerning the backing up of data, responses from interviews in some of the schools revealed that there were no policies for backing up school proprietary data. In one school, the bursar admitted backing up accounting data

onto a USB drive because there were no other backup devices. However, he added, he was keeping a manual copy of the data 'just in case'.

User Support. Teaching staff from those schools that had technical staff said they were happy with whatever technical support was provided. Some even commended the support of their colleagues who helped out whenever they encountered a technical problem. The level of technical support received from technical staff at the schools was mostly tier 1, the basic level, and in only a few cases tier 2. But most tier 2 and virtually all of tier 3 support was provided by the system vendors or system support agents.

System Fitness for Purpose

The **System Fitness for Purpose** theme is concerned with the extent to which the functioning SIS meets its requirements. The responses in Table 5.4 summarise the general trends of activities in setting up a SIS.

Table 5. 4 Summary of responses about *System Fitness for Purpose*

Group	Summary Comments
Management & Administration	When asked about whether a formal user requirements analysis was done, many interviewees said no such analysis was carried out before the system was set up. As well, they said that no formal hardware or software requirements analysis was done. The vendors were asked to set up the system, so they set it up the way they normally did other such systems. The building of the SIS was an ongoing project.
Teachers	Many teachers were not consulted about their system needs before system was set up. The school had some old computers that could not be loaded with new software – they were too slow. The software installed on the SIS by the vendor was not specialised for education but was adequate for use. The software helped in the preparation of lessons, report cards, and assessments and in storing resources for future use. Computers helped made work easier and saved time.
Technical Staff	Volunteer experts set up the system. Some donated computer equipment was not compatible with the rest of the computers. The main application software packages on the computers were

	installed by the vendors. Frequent computer break-downs and long servicing times especially in remote schools, thus system was not running at full capacity.

The responses in Table 5.4 highlight some of the main issues associated with system fitness for purpose experienced by schools. Three main issues were identified:

- *Formal systems analysis process was not followed*
- *Policies and procedures for hardware and software*
- *Technology driven SIS set up and operation*

Formal systems analysis process not followed. Summary of responses in Table 5.4 confirms that in most schools, a formal systems development model was not followed in setting up the SIS. The management of most schools admitted that no requirements analysis was done on behalf of the various categories of staff in the school, that in most cases the technical experts that were invited to set up the system were left to make many decisions about system development and deployment. Comments from the teachers reveal that many staff members were not consulted for their opinions or their user needs and this further confirms that a formal process was not followed in setting the SIS in most schools.

Policies and procedures for hardware and software. With respect to computer hardware and software, although many were happy with the use of the system for their work, teachers in some of the schools highlighted that computers were too out of date to run new software applications. The issue of hardware incompatibility in some schools was also highlighted by technical staff and they attributed this to the fact that some donated equipment, which schools willingly accepted, turned out not to be compatible with the rest of the computers.

Technology driven SIS set up and operation. Comments from the technical staff reveal that system setup in most schools was largely technology driven. Except for schools

S5 and S14, the vendor organisation setting up the SIS concentrated on just the physical network and the installation of commercial-off-the-shelf (COTS) software for general productivity use. In most cases the software package was the current Microsoft Office Suite and for many teachers interviewed, this was sufficient to meet their work needs. Beyond this, it was deemed the school's responsibility to develop applications to meet its business needs. It was evident from interview responses that little of this in-house application development activity was being done by the schools.

Leadership

The **Leadership** theme is concerned with SIS leadership and management. As the literature indicates, there are leadership and management responsibilities to be carried out in all phases of the SIS lifecycle. Table 5.5 provides a summary of responses made by interviewed staff members that highlights leadership and management issues of a SIS.

Table 5. 5 Summary of responses about the *Leadership* theme

Group	Summary Comments
Management & Administration	Management recognised the importance of ICT in the school and was going about setting up the SIS in stages as funding became available. The management had plans but there was no money. Without funding it was difficult to acquire computers and get technical support. Management in most schools responded that there was no leadership for ICT from the Ministry of Education: no information about national ICT for education policy, no guidance and no funding provided. In some schools, one or two teachers had been trained in ICT and they were given the roles of providing technical support for the SIS
Teachers	The Principal was proactive in getting the SIS set up and the staff members support him in this. The Principal was seen as inactive in getting the SIS set up – [few schools]. Some staff members were sometimes reluctant to step forward and take a leading role. Some attributed this to the Vanuatu cultural attitude of restraint.

Technical Staff	The management did not have a long-term plan for the SIS and the school did not have an IT section. Staff were assigned the technical roles by the Principal. Management and staff thought casually about the SIS – there were no written policies or procedures. The schools did not have permanent technical support staff but some of teachers had some IT background and offered to provide technical support. Expatriate volunteers worked with teachers and taught them how to run the network.

The summary of comments in Table 5.5 reveals several leadership and management issues in the development and operation of a SIS in schools. These issues include the following:

- *Leadership constraints*
- *Proactive versus reactive leadership*
- *SIS management issues*
- *SIS leadership and cultural influence*

Leadership constraints. Management in most schools recognised that ICT was just emerging in Vanuatu and that it was important to have ICT in schools. However, SIS set up was said to depend on funding. Management in most of the schools said that a major constraint affecting their decisions about SIS development was lack of funding. Another constraint was that management staff did not have access to expertise advice to make SIS development and operation decisions.

Proactive versus reactive leadership. With respect to leadership, most school teachers interviewed indicated that the Principal was proactive in getting ICT set up in the school and the Principal had the support of the staff. However, in a few schools the Principal was viewed as not proactive, did not know how to initiate and carry forward a project and mainly concentrated doing the routine tasks.

SIS management issues. With respect to the assignment of leadership and management responsibilities within in a SIS, 4 of the 14 schools had permanent technical staff members. Of the other schools, some had the technical support roles assigned by management to staff that had been given prior IT training. In other schools, one or two teachers who had an IT background, for instance the Computer Studies teacher, offered to provide some technical support for the SIS.

Four well known management responsibilities are planning, organising, leading and controlling, and yet from the interview responses there was little evidence that a systems approach was used in carrying these out. Instead responsibilities were assigned or delegated as the need arose. ICT tasks were carried out in a casual manner again in response to needs, and the scheduling of tasks did not seem to be a high priority. The interview responses from some schools indicated that tasks were usually considered completed when they were done and not according to firmly set deadlines.

SIS Leadership and cultural influence. An observation made by one of the participants was that Vanuatu teachers were reluctant to step forward and take a leadership role. He attributed this to a culture-based attitude of restraint.

SIS Affordability

The **SIS Affordability** theme is concerned with the extent to which a school can afford a SIS in terms of its set up and operation costs and the school's ability to pay over the long term. Table 5.6 summarises the responses made by interviewees related to the theme of *ICT Affordability*.

Table 5. 6 Summary of responses about *SIS Affordability*

Group	Summary Comments
Management & Administration	Responses from management in most schools revealed that: The main difficulty in setting up and operating a SIS was lack of funding. It was difficult to raise funds in the local communities

	because people were poor. Aid Donor agencies played a significant role in providing funding, donating computer equipment, providing technical expertise for some school SIS. Due to lack of funding, schools could not afford to attract and recruit permanent ICT technical staff. Telephone bills for internet access were high – this was especially so for rural schools. High fuel costs in rural schools meant less access to electricity and also meant less access to computers.
Teachers	Responses from teachers: Computers were still too expensive. Not all staff could afford a computer. It was expensive to pay to attend computer courses offered by CNS - a local computer agent that provided computer literacy training.
Technical Staff	Computer maintenance was expensive. This applied to normal maintenance, upgrading hardware and software and expanding the SIS. Transporting computers between islands added to maintenance costs.

The responses in Table 5.6 reveal that funding was central to the development and operation of a SIS and the scarcity of it hindered development work and the smooth operation of a SIS. The following issues were raised by participants:

- *Funding is key to development and operation of a SIS.*
- *Donor agencies provided funding, expertise and equipment*
- *Lack of technical experts due in part to lack of funding*
- *High ICT access and service costs*
- *Computer hardware and software are expensive*
- *High computer prices and literacy training fees for staff*

Funding is key to development and operation of a SIS. Management staff responses in most schools reveal that the biggest concern with regard to affordability was how to secure funding for the SIS. There was general agreement among the majority of staff interviewed that with respect to affordability:

- most schools were poor; that they are public service institutions and not profit generating organisations,

- the main sources of income were school fees, and in a few schools, small income generating activities,
- the Ministry of Education and Training did not have a budget for ICT in schools at the national level, and
- the communities close to the schools were generally poor and so could not be relied on as a base for fund raising activities.

SIS support from Donor agencies. In respect to the foregoing, the researcher found that this was where school stakeholders, particularly donor agencies, had stepped in to assist by donating computers, providing technical expertise, software and training.

Lack of ICT technical experts due in part to lack of funding. Lack of funding was one reason given by most schools for why they could not recruit full time ICT technical staff. A number school management staff commented that even if experts were available, the full-time salaries they offered were not competitive enough to attract ICT technical experts. As alluded to above, the donor agencies filled in this gap by providing technical staff on a volunteer scheme basis.

High ICT access and service costs. For most schools but particularly the remote schools, the costs of setting up and operating a SIS were higher. This was mainly because they were further away from the centres of most ICT resources (Port Vila and Luganville) which meant that transportation costs as well as telephone and internet access costs were higher.

SIS hardware and software are expensive. Responses from management staff in most schools revealed that the schools only bought some of the computer hardware and software from school funds. The rest was provided by donor agencies and/or private individuals. This was the case because computers and their components were expensive.

High computer prices and literacy training fees for staff. Comments from staff in most schools revealed that they could not afford a personal computer for their own use. Some staff members in rural schools commented that fees for computer literacy training courses provided by external training institutions were high and they were usually held in Vila and Luganville and so travel fares added to the training costs.

Information and Communication Technologies (ICT) Capacity

The **ICT Capacity** theme concerns a school's readiness to set up and operate a SIS in terms of its ICT infrastructure, its ability to source funding and technical resources, the availability of expertise to provide system support, the computer literacy level among the staff and the culture of ICT use in the school. Table 5.7 provides a summary of the responses about *ICT Capacity* in schools from staff interviewed.

Table 5. 7 Summary of responses about *ICT Capacity*

Group	Summary Comments
Management & Administration	There was no reliable source of funding for setting up and operating a SIS. Even with funding, sometimes it was difficult to recruit technical staff because they were scarce particularly in rural schools. In most schools the computer lab was a converted classroom. Urban schools had more reliable access to technical resources including computer hardware and software, telephone services, the Internet and reliable electricity supply; remote schools had difficulty getting access to them. No regular computer literacy training programmes offered by the schools. The level of computer literacy was low among staff in schools.
Teachers	In rural schools, it was difficult for staff to get access to ICT training programs. Many teachers were ICT self-taught.
Technical Staff	Only a few schools had full-time ICT technical staff Some schools did not have technical staff, and a few had part time technical staff. Volunteers from PEACECORP and JICA trained the technical staff on how to look after the system.

The responses in Table 5.7 reveal that access to funding and resources were not reliable in most schools but was especially unreliable in remote schools. These had a constraining influence on a school's capacity to set up and operate a SIS. Responses from interviewees raised the following issues regarding ICT Capacity:

- *Unreliable source of funding*
- *Opting for least expensive solutions*
- *No computer literacy training programs*
- *Donor agency support*

Unreliable source of funding. Most comments concerned the nature of unreliable sources of funding for the SIS. This issue also came up under other themes and reveals how central it is in setting up and operating a SIS. There was broad agreement among interviewees that lack of funding prevented schools from:

- hiring full-time technical staff,
- offering computer literacy programmes for staff,
- purchasing hardware equipment and software, and
- building or upgrading school ICT infrastructure.

Opting for least expensive solutions. With respect to ICT infrastructure, except for school S5, management staff in other schools said their computer laboratories were converted classrooms because this was the most cost-effective of setting up a lab for the SIS.

No computer literacy training programs. With respect to computer literacy training for staff, the responses in Table 5.7 reveal that there were no regular training programmes for staff. However, in some schools (S2, S3, S5, S8, S13) courses were offered a couple of times when a new software package was introduced. In this respect, schools relied on local training institutions, such as Computer Network

Services (CNS) and the University of the South Pacific (USP) to provide ICT training. The management of most schools said that the computer literacy level among their staff was not as high as they would like.

Donor agency support. In four of the schools (S5, S7, S8 and S14), partnerships with donor agencies had enabled technical experts in those organisations to train their counterparts in the schools. This training enabled the transfer of technical skills to local staff.

Pattern Language

The **Pattern Language** theme concerns school policies and procedures that need to be automated using the SIS, the codification of these and the translation from school-based language to technical language. Following this logical procedure ensures that when implemented, the SIS will function according to its requirements. Summary of the responses in Table 5.8 highlights some of the main concerns raised in the interviews that relate to the *Pattern Language* theme.

Table 5. 8 Summary of responses about *Pattern Language*

Group	Summary Comments
Management & Administration	Most schools had policies and procedures for carrying out their work but not all were documented. School policies and procedures were based on national education policies laid out by the Ministry of Education. Instructions were usually given in verbal form to the system implementers that installed the network. System implementers were considered the experts, so it was usually left to them to set up the SIS and whenever they needed help on how some things were done in the school, they asked management for guidance. No national ICT policy from Ministry of Education to guide schools and stakeholders in setting school ICT. No national policies on standard hardware, software and computer use in schools.
Teachers	Teachers knew their teaching tasks, but they were usually not explicitly documented. The internet was used for accessing teaching resources. Many teachers were beginning to explore ways of accessing,

	storing and using downloaded resources. For example: creating a hierarchy of folders as a first step in building a repository of teaching and resources. Teachers were mainly using software that was installed by the system implementers for lesson preparation, student report cards and examinations. Staff members sometimes had to learn again what they used to do in the old system in the new system, because instructions were not documented.
Technical Staff	The technical solutions were worked out by the technical staff. There was little guidance to go by because rules for doing them were not documented. Technical staff had difficulty fixing the system because the previous staff did not leave any documents. The school did not have a policy for backing up important data – [many schools]. The school did not have a written policy for internet safety and security. It just required the teachers to supervise all computer lab sessions – most schools.

The responses in Table 5.8 reveal the following issues relating to the translation of tasks from the language of the school application domain to the technology domain:

- *Lack of documentation of policies and procedures*
- *Implemented business functions were not documented*
- *Implemented technical changes were not documented*
- *No policy guidance from Ministry of Education and Training*

Lack of documentation of policies and procedures. As can be seen, Table 5.8 reveals that with respect to the operation of a SIS, most schools had basic policies and procedures in place. However not much of this was formally documented and communicated among the staff. As a result, many teachers and technical staff felt they had no guide on how to operate or use the SIS. This situation also allowed the implementers of the SIS the discretion to make some decisions on their own about how the system should run and therefore how the technical solutions should be shaped. Responses from interviewees in schools S2, S5, S7, S8 and S13 reveal that while they were using the Internet and software installed on the SIS for their teaching tasks, they were not aware of standard methods for doing these tasks. So, some were experimenting and discovering new methods as they continued using it.

The issue of technical back up of data is highlighted again under this theme and it is apparent from some responses (S1, S8) that one reason why this is the case is because there were no documented school policies and procedures for back up of data.

Implemented business functions were not documented. Technical staff commented that whenever system implementers needed advice or guidance it was usually given to them verbally. The result was a SIS in which some school business functions were performed as required but the functions were only available in the working system. As picked up by some teachers, when the new version of the software was installed, the technical solution changed and with it the business functions as they were coded in that version and it took time to work out how to do it in the new version.

Implemented technical changes were not documented. Technical staff in schools S2, S3, S7, and S13 highlighted the fact that because no documentation of tasks was available, they had to work out the technical solution to some problems themselves. As well, previous technical staff did not document changes or modifications made to the system, so it was difficult to fix errors when they occurred (S7, S13). This was particularly to do with the installation or replacement of components in hardware equipment or network equipment.

No policy guidance from Ministry of Education. In those schools where management staff was interviewed, there was agreement that a national policy for ICT in education would provide guidance to schools on how to set up and operate a SIS. Of importance they suggested would be some guidelines for recommended hardware and software to be used in schools.

Physical constraints and ICT Accessibility

The **Physical constraints and ICT Accessibility** theme concerns those physical constraints which restrict a school's ability to access the resources and services it needs to use ICT effectively in the school. In chapter 1, four main physical constraints were identified:

1. Small size of islands – the fact of the small size of the islands
2. Isolation – the separation and segregation of islands by the ocean
3. Remoteness – the relatively large distances separating the islands
4. Vulnerability – the susceptibility of the islands to adverse tropical weather conditions and natural disasters

Table 5.9 provides a summary of responses made by interviewees on the *Physical Constraints and ICT Accessibility* theme.

Table 5. 9 Summary of responses on *Physical Constraints and ICT Accessibility*.

Group	Summary Comments
Management & Administration	Schools in rural areas had difficulty with transport and telecommunication. Telephone lines were usually unreliable for internet access. Shipping services between the islands were not regular and did not provide a reliable service. Electricity availability was restricted particularly in rural schools. Difficult to attract technical staff to rural schools. Urban schools had better access to transport and telecommunications
Teachers	Not enough computers for teaching staff. Teachers had to queue up or book to use a computer. Many teachers did not have access to school computers after hours because they lived outside the school area. Staff sometimes could not use computers when they needed to because the electricity was off. Internet not available to all staff because computers were not networked.
Technical Staff	Difficult for the school to get computer spare parts. It usually took a long time to get computers repaired by service agents and cost more for rural schools.

As the responses in Table 5.9 reveal, rural schools were more affected by physical constraints than those in the urban areas. Issues identified from the interviews include:

- *Transport and telecommunication costs*

- *Access to computers and other SIS components,*
- *Access to electricity,*

Transport costs and telecommunication costs. In rural schools S1, S4, S13 and S13, staff indicated that the transport service was less frequent, trips were irregular, they were relatively more expensive, and took much longer to arrive at the destination. Similarly, in those schools, as pointed out by most staff, telephone service and hence access to the internet was less reliable, relatively more expensive and of a poor quality.

Access to computers and other SIS components. Teachers in many schools, but particularly those in the rural areas, commented that there were usually not enough computers allocated for staff. In addition, some staff pointed out that they could not access the school computer after hours because they live outside of the school premises.

Access to electricity. An important issue highlighted by teachers was that of access to electricity. In urban areas, most schools were connected to the town power grid and so electricity was not an issue but in rural schools, electricity had to be rationed because fuel was both scarce and expensive. Many teachers expressed their frustration with this because they were unable to do much work using the network when they needed to because the electricity power generator was switched off.

Cultural Influence

The **Cultural Influence** theme concerns those aspects of Vanuatu traditional culture that are considered have an influence on SIS activities carried out in schools. Hofstede's cultural dimensions theory (Hofstede, 1984) provides evidence that cultural values held by members of a society influence their attitudes and behaviours at work. An interest in this research was whether the cultural attitudes and behaviours

of Vanuatu staff in schools influenced the development and operation of a SIS in any way. Table 5.10 provides a summary of responses by interviewed staff which highlight the above cultural aspects.

Table 5. 10 Summary of responses about *Cultural Influence*

Group	Summary Comments
Management & Administration	No sense of hurry or urgency in doing work either in school or in community. Community lifestyle permeated all communities from which school staff and students came.
Teachers	Slow pace of getting things done, e.g., equipment repair. Sometimes frustrating for staff especially when they needed to use the equipment (scanner, printer) urgently. Management was said to be reactive to current ICT project needs rather than being proactive and making a long-term plan.
Technical Staff	Some teachers were not creative with the software. They were using just one or two packages to do the same sort of tasks. Some staff members found it difficult to apply what they had learned in one software setting to another similar setting.

The responses in Table 5.10 highlight the following patterns of activities that, in the researcher's view, reveal how cultural values held by school staff have a shaping influence on their SIS activities:

- *Slow pace of work*
- *Ad hoc rather than systematic approach to work*
- *Focus on current concerns*
- *Conformity rather than creativity*
- *Context oriented thinking*

Slow pace of work Teachers interviewed in schools S1, S2, S5, S4, S8, S9, S13 highlighted the poor quality and slow pace at which computer support services were provided. The delays in servicing were attributed to technical issues by a computer service agent. However, observation of this issue by the researcher and based on his

experience growing up in the islands, the slow pace of doing work is part of culture. This attitude is briefly discussed in Chapter 1.

Ad hoc rather than systematic approach to work. Responses from many school staff revealed that there was a casual and ad hoc approach to carrying out technical support tasks in the schools. In most of the schools visited, it was observed by the researcher that there were no formal processes put in place for systematically coordinating and carrying out tasks according to a schedule. Problems were dealt with as they arose each in their own unique way rather than dealt with in a consistent manner following a well-defined process.

Focus on current concerns. Interview responses from schools (S2, S5, S8, S9, S10, S13) revealed that management was more focussed on current concerns rather than making long term plans about SIS development. Focussing on current concerns rather than making long terms plans is an issue that was re-iterated in the interview with the Director of Secondary Education in the Ministry of Education. His comment on this was that management in some schools preferred to focus on current concerns and routine tasks rather than plan and carry out a project such as a SIS.

Conformity rather than creativity. The SIS is supposed to be a tool to be used by staff to improve the effectiveness of their duties. And yet the researcher has observed both in the laboratory observations and through interview responses that this view was not realised to the extent that it should by many staff. Interview responses indicated that many of the teachers were not actively exploring new ways to utilise the SIS to improve their teaching. Rather, they were just doing more or less the same thing with one or two software packages.

Context oriented thinking. Staff interviewed in schools S2, S7, S8, S9 and S13 commented that some teachers found it difficult to translate the skills they had learned

from one software environment to another similar environment even though the user interface is supposed to be intuitive. The changes in the appearance of software components and their physical reorganisation made it more difficult to learn about the new software.

Partnerships

The **Partnerships** theme is concerned with the relationships that individual schools form with stakeholder groups in the community for the purpose of engaging in school ICT activities. Stakeholder groups are those organisations that have an interest in ICT in schools. These include governmental organisations, foreign aid agencies, non-governmental organisations, other institutions, the private sector, local communities and individuals. Stakeholder involvement in school ICT activities can be at all the phases of the SIS lifecycle.

Table 5.11 provides a summary of responses made on partnerships between stakeholder organisations and schools from staff interviewed.

Table 5. 11 Summary of responses about *Partnerships*

Group	Summary Comments
Management & Administration	Most partnerships were with Aid donor agencies notably AUSAID, PEACECORP, French, Japanese and New Zealand governments and church groups. Some partnerships were bilateral in nature. Some schools dealt directly with stakeholder while others were organised through the Ministry of Education. Most stakeholder activities had been about providing funding, donating computers to schools and/or providing technical support.
Teachers	Volunteers from PEACECORP worked with some teachers to set up the network. They also provided training for some staff as their counterparts. AUSAID provided technical staff to train INTV staff to operate the school network.
Technical Staff	Technical Staff in four schools were given training by stakeholder staff. No system in place in the school to formalise the recruitment of staff from stakeholder organisations to maintain continuity.

As revealed in Table 5.11, the most active stakeholders in the schools were aid donor agencies notably: AUSAID coordinated by the Australian embassy, the PEACECORP Foundation, the French government through its embassy, JICA and JOCV through the Japanese embassy and the New Zealand government. From interviewee responses, it appears that the partnerships with vendors and external technical support agencies were only of a business-customer type.

Some of the activities that aid donor agencies have concentrated on include:

- Providing funding for equipment for the SIS,
- Providing technical expertise for SIS development, deployment and operation,
- Providing local capacity building by training local counter parts,
- Providing Equipment, and
- Building software solutions.

The exception is TVL which in addition to providing commercial telecommunication equipment and services also provides a free Internet service to schools.

One church's involvement was said to be in making available its social and organisational network which could be and had been tapped in the past to provide ICT support – in the case reported expertise provided technical support in general and a solution for the SIS data backup system.

With the exception of the church owned schools, responses from the interviewees reveal that the public schools and other privately-owned schools did not have much involvement with the local or village communities, which was revealing. Some of the interviewees pointed out that their schools were located in such remote areas that it does not have a supporting local community in the neighbourhood. This situation applied to the following schools: S1, S6, S9, S10, S11 and S12 as the focus group discussions results confirm.

5.5 School Focus Groups Results

This section presents results from the analysis of the focus group data. The focus group discussions were carried out in 6 of the 14 schools investigated and the participants included management staff, teaching staff as well as technical staff. As explained in the previous chapter, the analysis of focus group data identified ten themes. The presentation of the results is thus organised under the ten themes. In presenting the results, the comments made by staff were grouped by staff category. A table summarising main comments by each category of staff is presented. This is followed by explanations that elaborate and contextualise the comments and emphasise where appropriate those issues that embody the theme. As the definition of the themes were given in the interview results, they will not be repeated here. The focus group discussions are now presented.

Systems Processes

Table 5.12 provides a summary of comments made by focus group participants for the **Systems Processes** theme.

Table 5. 12 Summary of responses on the *Systems Processes* theme

Group	Summary Comments
Management & Administration	System was set up as part of the school development project funded by AUSAID (S9). System was funded by AUSAID contracted to a local company (S10). System was set up as part of the PASEP project funded by AUSAID (S14). There was a general plan to set up a SIS but there are no resources (S6, S11, and S12).
Teachers & Technical staff	Teachers were not involved in setting up the SIS (S9, S10, and S14). Management was thinking about a SIS, but the school did not have the necessary resources.

As comments in Table 5.12 reveal, the SIS in schools S9, S10 and S14 was set formally set up as part of an aid funded project. Staff in school S9 commented that SIS planning did not include funding and technical support arrangements for the after-the-project (operation) phase and that is the primary reason for its collapse. Staff in school S10 said that the SIS had funding arrangements, but the SIS collapsed due to technical problems. Schools S6, S11 and S12 were at the early stages of setting up a SIS at the time of the focus group interviews. These schools had several computers, but they were not networked.

Systems Support

Table 5.13 provides a summary of staff responses for the *Systems Support* theme. The responses reveal a lack of planning for the operation phase of a SIS and the consequences of this lack of planning.

Table 5. 13 Summary of responses on the *Systems Support* theme

Group	Summary Comments
Management & Administration	No contingency planning was put in place and after about 6 years, and all system equipment became obsolete and was never replaced. Eventually the system was dismantled (S9). System support by contractor was terminated when it was realised that 'salt spray' was corroding computer equipment (S10). Technical support was a major problem in schools. It was difficult to attract technical staff to work on the island (S6, S11, and S12).
Teachers & Technical staff	No system support (S9), minimum system support (S10), full-time technical staff (S14) No computer dealer or repair agent based on this island. About ½ the computers were not working at time of discussion. (S11, S12). The computers were not well maintained. (S6, S11, S12). School accountant was reluctant to store accounts on computer because school did not have good backup system (S12).

A number of issues are revealed in Table 5.13:

- *No contingency planning*
- *Technical support in remote and rural schools.*
- *Adverse tropical weather effects*

No contingency planning. An important issue highlighted here is that the project funded SIS did not plan well for the after-the-project phase in terms of making arrangements for funding and technical support. This was especially the case with the SIS in schools S9 and S14, both of which were AUSAID funded projects.

Technical support in remote and rural schools. The focus group responses indicated that although SIS technical support was lacking in most schools, it was worse for remote and rural schools because:

- there were no local computer servicing agencies, and
- it was difficult to attract technical staff to remote and rural schools.

As a result, computers were not maintained properly and there were no services such as for assistance in data safety and security.

Adverse tropical weather effects. One school, S10, reported on the effect of 'salt spray' on computer equipment and how the computer support contract was terminated because of this problem. Although the issues of vulnerability to national disasters such as cyclones was not raised, the researcher knows from previous experience that such disasters occurred in Vanuatu on a regular basis and did affect services such as access to telecommunication, electricity and damage to school buildings.

Systems Fitness

Table 5.14 provides a summary of responses for the *Systems Fitness* theme. Comments reveal that the focus was more on getting the SIS up and running and less about its operation over the long term.

Table 5. 14 Summary of responses on the *Systems Fitness* theme

Group	Summary Comments
Management & Administration	The SIS collapsed after operating for several years in schools (S9, S10). The schools just had several computers and they were not networked. Most computers were donated to the school. Schools did not have guidelines or rules for using the computers (S6, S11, and S12).
Teachers & Technical staff	Most computers were out of date (S14). Computers were used in ad hoc manner (S6, S11, and S12).

As responses in Table 5.14 reveal, two funded SIS projects (S9, S10) collapsed because there was no post project planning. In the other schools, computers were just procured or donated, and the focus was on getting computers installed. No plan was put in place for what role the of the SIS should be in the school, how this would be done and whether the SIS was working as it should.

Leadership

Table 5.15 provides a summary of responses for the *Leadership* theme. The responses reveal that in some schools, management was proactive and in others it was not so. Also revealed was the participation of donor agencies in SIS activities.

Table 5. 15 Summary of responses on the *Leadership* theme

Group	Summary Comments
Management & Administration	Inability to progress ICT plans because of lack of funding (S6, S9 S10, S11, S12) Management saw the importance of ICT and was in the process of negotiating with AUSAID for funding (S12) Negotiation for 15 computers from AUSAID was under way. New Lab building had just been built (S11) Management did not see ICT as top priority. No space for a SIS (S6)
Teachers & Technical staff	Principal was not proactive and had not acted so far (S9) Principal took the view that it was the responsibility of individual teachers to buy their own computers because then it became their responsibility to look after it (S10)

	Staff supported management in its efforts to set up a SIS (S11, S12)

The responses in Table 5.15 raise the following issues:

- *Lack of funding for SIS*
- *Leadership and management issues*
- *Staff responsibility for technology use.*

Lack of funding for SIS. Lack of funding was cited as a barrier preventing management in several schools from going ahead with their SIS plans

Leadership and management issues. Management in most schools was seen as proactive and were negotiating with Aid donors for funding. In a few schools, management was seen as not being so active.

Staff responsibility for technology use. In one school, management took the view that the school does not need a SIS. Instead, individual staff who need computers for their work should purchase the computers themselves.

SIS Affordability

Table 5.16 provides a summary of responses from focus group discussions for the *Affordability* theme. The responses highlight lack of funding as a main factor hindering SIS set up, operation and use and the role of Aid donor agencies in stepping in to support SIS activities.

Table 5. 16 Summary of responses on the *SIS Affordability* theme

Group	Summary Comments
Management & Administration	Current ICT problem stemmed from lack of funding (S6, S9 S10, S11, S12, S14). The school could not raise the necessary funds to build and operate a SIS. Schools depended on Aid Donors (S6, S9 S10, S11, S12). Purchasing and transporting equipment to the school was expensive.

	Computer maintenance was expensive on the island.
Teachers & Technical staff	Many staff members could not afford to buy own computer. For staff in rural schools, purchasing a computer was an arduous task.

The responses revealed the following issues from Table 5.16:

- *Lack of funding for operating and upgrading the SIS*
- *SIS transport related costs for the remote schools (S6, S11, S12)*
- *It is expensive and difficult to purchase a computer for staff in remote schools*
- *Aid donors assisted with SIS set up and operation.*

Lack of funding for operating and upgrading the SIS

The lack of funding for operating and upgrading the SIS is more acute in rural and remote schools because it is harder for these schools to secure funding sources. In addition, the remote locations of the schools add other costs such as access to ICT services, transportation and electricity costs.

SIS transport related costs for the remote schools (S6, S11, S12)

These schools are located further away from the town centres of Luganville and Port Vila. Thus, transportation costs for SIS equipment as well as electricity fuel is high.

It is expensive and difficult to purchase a computer for staff in remote schools.

At the time of this investigation, mobile devices were not yet widely available. There were not many computer equipment vendors thus there was not much choice when purchasing computers. Transportation costs add to the cost of purchasing a computer.

Aid donors assisted with SIS set up and operation.

Responses from school staff regarding SIS aid indicate that all schools will accept whatever aid they were offered. However not every school received aid. Aid was in the form of donated equipment, volunteer assistance or funds. This aid however was

offered in an ad hoc manner to individual schools rather than as part of a larger national project.

ICT Capacity

Table 5.17 provides a summary of responses for the *ICT Capacity* theme. The responses highlighted difficulties in organising and accessing computer literacy training in the schools, the lack of leadership in ICT capacity building and the poor ICT infrastructures of most of the schools.

Table 5. 17 Summary of responses on the *ICT Capacity* theme

Group	Summary Comments
Management & Administration	School had computer lab space (S9, S10) School had lab but computers were getting out of date (S14) No computer literacy training for staff (S9, S10) School needed to set up a lab building or convert a classroom to a lab (S6) Some training for staff was provided when the PASEP project was being set up (S14) Little culture of use of computers (S6, S9 S10, S11, S12)
Teachers & Technical staff	Management was not proactive in SIS development (S9, S10) Most of the staff did not have computer skills because school no longer had a network (S9, S10) Difficult to get computer literacy training unless one went to Vila – where courses were conducted (S6, S9 S10, S11, S12).

Comments raised in Table 5.17 reveal the following issues:

- *ICT infrastructure in all six schools needed to be upgraded.*
- *No formal computer literacy training programmes and access to such from remote schools was considered expensive.*
- *Lack of computers or inefficient SIS was cited as reason for low computer literacy level among staff and low culture of use of computers.*

ICT infrastructure in all six schools needed to be upgraded. Responses from the participants revealed that the SIS in all six schools needed upgrading. The SIS in school S14 for example was a fully funded AUSAID project. However, there was no funding for sustaining the SIS after the project was completed. Staff pointed out that it has been 4 years since the SIS was established and computer equipment and software was becoming obsolete. The other schools also received some aid but on a one-off basis and again after the SIS was set up there was no further funding to sustain the SIS.

No formal computer literacy training programmes and access to such from remote schools was considered expensive. Responses from participants regarding ICT training for staff revealed that no regular training programs were organised. The reasons given was that there was a lack of funding and also a lack of experts to provide the required training. Staff were aware that ICT training programs were run by training institutions such as CNS and USP, but to enrol in such programs meant travelling to Port Vila and paying the fees which for them was expensive.

Lack of computers or inefficient SIS was cited as reason for low computer literacy level among staff and low culture of use of computers.

Responses from participants on the computer literacy level of staff revealed that many were not comfortable using basic computer tools for teaching. Some attribute this to a lack of ICT training but others pointed out that another reason was because there were not enough computers allocated to staff so that they can train on their own. Staff have to share the use of computers. In some rural schools where electricity use was restricted to school hours, this meant that there was not enough time to use the shared computers.

Pattern Language

Table 5.18 provides a summary of responses for the *Pattern Language* theme. The responses reveal that relevant policies and procedures, and business rules that the SIS was supposed to automate, were not considered in the SIS set up.

Table 5. 18 Summary of responses on the *Pattern Language* theme.

Group	Summary Comments
Management & Administration	School business functions were known but not fully documented (S6, S9, S10, S11, S12, S14).
Teachers & Technical staff	Teachers knew their teaching, and curriculum development tasks but not all was explicitly documented (S6, S9 S10, S11, S12). Use of computers was restricted to MS-Word and Excel (S6, S9 S10, S11, S12).

Table 5.18 reveals the issues that the schools faced with respect to the Pattern Language theme:

- *Lack of documentation of school policies and procedures,*
- *Teachers curriculum development tasks not documented, and*
- *Limited use of software tools.*

Lack of documentation of school policies and procedures. Focus group discussions in all six schools S6, S9, S10, S11, S12 and S14 revealed that schools did have policies and procedures but that these were not fully documented.

Teachers curriculum development tasks not documented. In schools S6, S9 S10, S11 and S12, the staff said they knew their teaching and curriculum development duties but none of them were documented or incorporated into the function of the SIS.

Limited use of software tools. Discussions in schools S6, S9 S10, S11and S12 indicated that staff were mostly using the Microsoft Office tools particularly Microsoft Word and Microsoft Excel. It reveals that there were no specific teaching and learning software tool installed in the SISs.

Physical constraints and ICT Accessibility

Table 5.19 provides a summary of responses for the *Physical constraints and ICT Accessibility* theme.

Table 5. 19 Summary of responses on *Physical constraints and ICT Accessibility*

Group	Summary Comments
Management & Administration	School located in remote area, so transport and telecommunication services were poor (S9). Telephone and Internet access was poor (S6, S11, S12). Electricity was restricted (S6, S9, S10, S11, S12). Difficult to organise the purchase of computer equipment from the island (S6). No public transport to the school. Use of taxis was expensive (S6, S9, S11, S12).
Teachers & Technical staff	Teachers needed but could not access the software to do inventory of chemistry equipment and supplies as well as cataloguing system for the library (S9). Only a couple of computers were allocated for staff to share so access was restricted (S6, S9, S10, S11, S12).

The responses raised in Table 5.19 highlight the following issues:

- *Transport problems*
- *Poor quality of telephone and Internet access*
- *Access to electricity power*
- *Lack of public land transport.*
- *Few computers to share.*

Responses from schools highlighted the fact that for rural and remote schools, access to ICT resources and services were more restricted.

Transport problems. In schools S6, S9, S11 and S12, staff commented that both air and sea transport to in remote islands was expensive and services were irregular and sometimes unreliable.

Poor quality of telephone and Internet access. Staff in schools (6, S11, S12 commented that telephone and internet costs in the islands were high compared to urban areas. Also, the Internet was slow to access online resources.

Access to electricity power. In 5 of the 6 schools, electricity was restricted to certain hours of the day because the cost of petrol was high in the islands.

Lack of public land transport. Schools S6, S9, S11, S12 did not have access to public land transport to the schools, thus this made organising the acquisition and servicing of computer equipment from these schools arduous and expensive.

Few computers to share. Teachers in schools S6, S9, S10, S11, S12 highlighted that they had to share the use of a few computers because the school could not afford more. Additionally, computer servicing costs were high.

Cultural Influence theme

Table 5.20 provides a summary of responses for the *Cultural Influence* theme. Responses reveal the slower pace of doing work and the focus on current concerns rather than long term planning.

Table 5. 20 Summary of responses on the *Cultural Influence* theme

Group	Summary Comments
Management & Administration	The pace of work in school reflected the slow pace of work in the islands (S6, S9 S10, S11, S12).
Teachers & Technical staff	Pace of doing ICT work was much slower and ad hoc than in Vila and Luganville (S6, S9 S10, S11, S12). The management reacted to current SIS demands or needs rather than had a long-term plan (S9, S10).

Responses raised in Table 5.20 reveal the following issues:

- *Slow work pace*
- *Ad hoc approach to work*
- *Leadership issues*

Slow work pace. Most staff agreed that the pace of operating the SIS, providing technical support and using the SIS in the schools was slow. Some of this is due to external factors such as unreliable transporting of ICT equipment, restricted electricity and long turn-around times for ICT equipment servicing. However, management staff in some schools attribute this behaviour to the leisurely pace of life in the islands.

Ad hoc approach to work. The researcher's observation of the computer laboratories along with comments from the laboratory guides indicate that the tasks of operating and maintaining the SIS and providing user support was done on a casual basis rather than following a systematic approach.

Leadership issues. Staff in S9 and S10 commented that the management of their schools focussed more on current concerns about the SIS rather than develop a long-term SIS plan.

Partnerships

Table 5.21 provides a summary of staff responses for the *Partnerships* theme.

Table 5. 21 Summary of responses on the *Partnerships* theme

Group	Summary Comments
Management & Administration	There was a church social network that the school could tap into but was not making use of it (S10). Partnership with AUSAID for the PASEP project ended about 2 years ago (S14). School was already negotiating with AUSAID to secure funding for a SIS (S11, S12).
Teachers & Technical staff	School should create partnership with local companies with which it carried out business dealings, like those who supply fuel, furniture, food supplies to the school (S9).

The responses from Table 5.21 reveal the following issues regarding the partnership theme:

- *Direct negotiating with Aid Donors*

- *Discontinued projects*
- *Partnership opportunities*

Direct negotiating with Aid Donors. Comments from schools S11 and S12 reveal that many schools were directly engaging with donor agencies to assist with setting up or upgrading their SIS.

Discontinued projects. In school S14, an aid-funded SIS project that that had been operating for several years was terminated. Staff said the SIS aid was tied to another funded program for teachers and when that project concluded, SIS aid also stopped.

Partnership opportunities. While discussing partnership issues some staff suggested that schools should be more proactive in seeking out partnerships with local groups rather than just depend on Aid Donor agencies. Staff in S9 pointed out that some church networks could assist with SIS projects if approached. Staff in S10 said they had created partnerships with those local companies with whom the school has business dealings to leverage the cost of transport for SIS equipment and services.

5.6 School SIS infrastructure observation results

This section presents the results for the SIS infrastructure observations. The results are presented mainly in tabular form. Table 5.22 shows the results of the SIS infrastructure observations.

Table 5. 22 SIS infrastructure observation data

School	Labs	Lab computers	Teacher computers	Admin computers	Network?	Internet Access	Tech staff	Electricity	Students	Teachers
S1	1	8	5	3	Partly	No	1 (C)	Res	136	8
S2	1	15	6	Use student lab	Yes	Yes	3 (T)	Yes	400	30
S3	1	20	6	5	Yes	Yes	1 (T)	Yes	360	-25
S4	1	12	5	4	Partly	Yes	1(C)	Res	153	10

S5	3	48	30+	15+	Yes	Yes	2 (F)	Yes	539	57
S6	0	0	2	3	No	No	0	Res	262	8
S7	2	30	15+	8	Yes	Yes	1 (F)	Yes	678	50
S8	2	30	8	7	Yes	Yes	1 (V) 1 (T)	Yes	580	48
S9	0	0	5	4	No	Yes	0	Res	381	31
S10	1	5	5	4	No	No	1(C)	Res	294	24
S11	1	8	5	3	No	No	1 (C)	Res	-309	26
S12	0	0	4	3	No	No	0	Res	263	20
S13	1	15	5	5	Yes	Yes	1(T)	Res	305	22
S14	1	15	10	5	Yes	Yes	1 (F)	Yes	200	10

Key:

- F - Fulltime employed technical staff
- T - Teacher who had received technical training and had been assigned the role of taking charge of the SIS. This was a role which he assumed in addition to teaching duties.
- C- Teacher who because of his ICT technical background had taken the initiative to take a leadership role in the school SIS with the approval of the school management.
- V- An expatriate volunteer on a short term contract to assist with the activities of the school SIS.
- Res – Restricted electricity power
- Data in last 2 columns sourced from the Ministry of Education.

The data collected and summarised in Table 5.22 provide some basic statistics regarding computers, SIS infrastructure and users. To put the data in context Table 5.23 lists the urban and rural schools.

Table 5. 23 Urban vs rural schools

Category	School	Total
Urban schools	S2, S3, S5, S7, S8, S14	6
Rural schools	S1, S4, S6, S9, S10, S11, S12, S13	8

Other SIS infrastructure observations

As pointed out in Chapter 4, in this part of the data collection, the researcher was an observer-participant. He made observations and also asked the laboratory guide questions and took notes. Below are summary notes taken during the observations of all the school laboratories.

System Support. The notes that the researcher took from the guided tours of the computer laboratories concerning system support indicate that:

Most schools had one or two technical staff. It was difficult to recruit full-time technical staff due to the scarcity of people with such skills and the low salary offered by schools. As well, technical staff preferred to work in Vila and Luganville. Volunteer staff provided by some Aid Donor agencies assisted school with technical operation and also providing technical training for the local staff.

Electricity power supply. Electricity power supply is an issue in rural schools. That is, the power was switched on only at certain periods of the day. The reason given for this restriction was that the transportation of electricity fuel, mostly petrol, to the school was infrequent and irregular, and fuel costs more in rural areas. Renewable energy sources were still very expensive and not widely available at the time the data collection was done.

Internet Access. Internet access is an issue in rural schools. The 5 schools without Internet access were rural schools. The reason given for this was that telecommunication coverage in rural areas was poor, the band width slower and access was relatively more expensive.

Computer networks. Seven of the 8 rural schools investigated in this study have a SIS that was either partly networked or not networked. Reasons given for this were that

access to network components, technical expertise and technical support was poorer in the rural schools.

Computers for staff. In terms of teacher access to computers, the general pattern was that there were more teachers than computers in the schools.

Student access to computers. In urban schools the number of computers increased with student numbers but in rural schools there was no such correlation. The staff attribute this to the problems of access to computer resources, technical support and expertise in rural schools.

Partnerships. Conversations with staff during the observations revealed that donor agencies were involved in SIS activities. For instance, AUSAID funded the SIS projects in S5, S9, S10 and S14. The French government through its education aid program provided funding for the SIS in S2, S3, S5 and S7. PEACECORP assisted with the SIS in S8 and S10 and the Japanese government through its volunteer program, JOCV, assisted with the SIS in S8.

5.7 Summary

The results presented in this chapter are derived from the data analysed in Chapter 4. Three data collection methods were used to collect the data, namely: school interviews, school focus group discussions and school infrastructure observations. The interviews and focus group discussion results were both organised around the 10 themes identified in Chapter 4 and overall, they highlight many common ICT issues experienced by schools. Some issues were highlighted under just one or two themes while others were highlighted under numerous themes.

The schools Infrastructure observation results provide a relative measure of the status of SIS in the schools in terms of how well equipped the computer labs were, the scale

of the networks and the level of technical support that existed. The findings from the results presented in this chapter will be discussed in the next chapter, Chapter 6.

Chapter 6

DISCUSSION OF RESULTS

6.1 Introduction

This chapter discusses the results presented in Chapter 5. The discussion of the results is undertaken in the context of the research questions proposed in Chapter 1, the Vanuatu context also covered in Chapter 1 and informed by and literature examined in Chapter 2. The chapter concludes with a summary of the main findings of the research.

6.2 Discussion of results

This section presents the approach for bringing together the results presented in Chapter 5. This approach is then used for framing the discussion of the results in terms of the research questions. In Chapter 1, the first three research questions were respectively about current practices in setting up a School Information System (SIS), ways in which schools were adapting to accommodate a SIS and the influence of the external context in which the school operates a SIS. The results respond to the research questions that were presented in Chapter1 and reveals that the themes and the findings they embody can be categorised as either belonging to the SIS, school or external context category. Thus, three broad categories can be identified in a model to frame the results discussion namely:

- School Information System (SIS). This category integrates those findings that concern SIS technical activities.

- Application Domain (AP). This category integrates those findings that concern a school's roles and responsibilities in setting up, operating and using a SIS

- External Context (EC). This category integrates those findings that are related to external factors that influence the development and operation of a SIS in some way.

Using the above definitions for the categories, the themes and findings they embody have then been allocated to the categories as presented in Figure 6.1

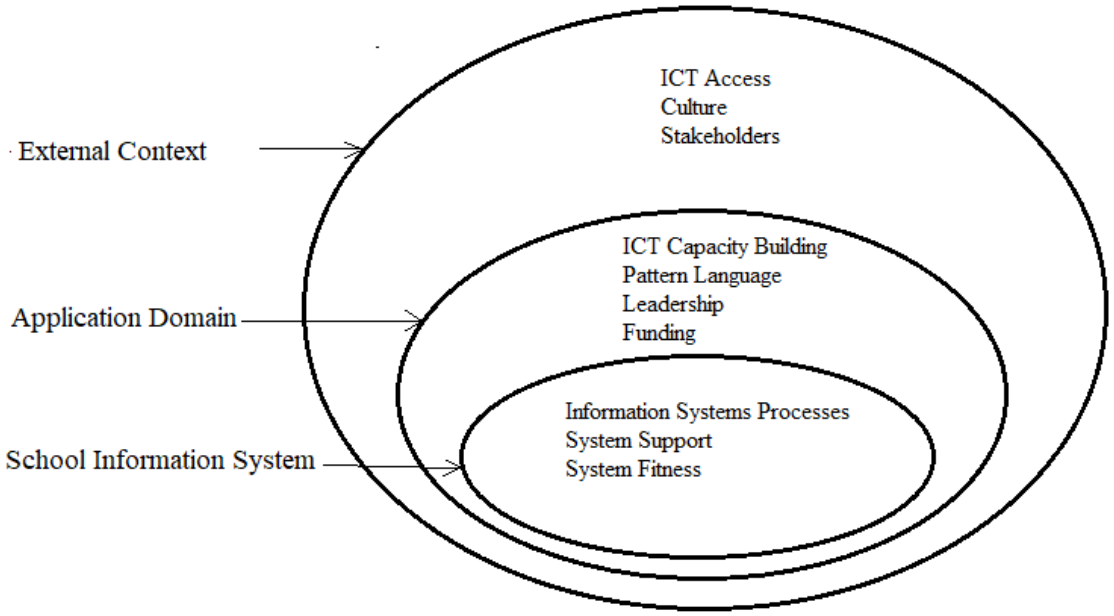

Figure 6. 1 Three broad categories encapsulating the themes.

The concentric circles illustrate the relative positions of the categories in the structure in the following way: The School Information System is located within the Application Domain and the Application Domain is in turn located within the External Context . If we consider the two inner categories as systems which they are, then in going from the outer to the inner category, we have two nested systems in an external context. Alternatively considering the middle category, the application

domain, we can say that we have a system that has a subsystem and at the same time it is both a ‘whole’ and a ‘part’ of a bigger system.

Although the themes and findings they embody have been classified as belonging to categories, the results in Chapter 5 suggest that some findings in one category were also found in other categories. For example, the lack of relevant policies and procedures is both a SIS finding as well as an Application Domain finding. Lack or scarcity of access to resources is both SIS finding as well as an External Context finding. In this sense, they are referred to as cross-cutting findings. This suggests that the systems theory perspective of an organisation would be a logical model for framing the discussion of the results. As discussed in Chapter 2, an open system has ‘emergent properties’ that are more than the sum of the system’s components and it can interact with the system that is external to it as well as with the subsystems nested within it.

In the following sections, the results will be discussed in the context of the first three research questions and brought together according to the open systems model described above. The discussion considers together the findings for the interviews, focus groups and laboratory observations.

6.3 Consideration of Research Question 1

Research Question 1 *What are the current practices for integrating the use of ICT into secondary schools in Vanuatu?*

This research question focuses on the experiences of schools in setting up a SIS, that is, the technical issues involved in setting up a SIS. As Figure 7.1 indicates the focus is on the findings in the SIS category.

6.3.1 School Information System (SIS)

Introduction

Standards for developing information systems were considered in Chapter 2 and it was pointed out that for any organisation in a particular application domain, the standards should be applied and customised to suit its requirements and circumstances (Satzinger, Jackson & Burd, 2012; Sommerville, 2011). The results presented in Chapter 5 describe three themes that concern the technical activities in a SIS namely, systems processes, systems fitness for purpose and system support. This section discusses the findings on these SIS technical activities taking into consideration these standards models for developing an information system.

SIS technical activities considered in this research are those that are concerned with:

- the use of systems processes in the phases of the systems development life cycle: namely planning, analysis, design, implementation, deployment and operation. (see Chapter 2, Section 2.5.3),
- the involvements of technical staff in providing technical support in the above phases, and
- the measures used by systems developers to ensure that the resulting system functions as intended.

The results in this research identified some main issues concerning SIS technical activities and they are embodied in the themes: Information Systems Processes, System Support and System Fitness. The findings concerning these SIS technical activities are discussed below and the discussion is organised under the sub-topics with theme names.

Information Systems Processes

It is well documented in the literature (Satzinger et al, 2012; Shelly & Rosenblatt, 2010, Sommerville, 2011) that systems processes are required for SIS development, as well as ongoing technical support and adapting to changes and advances in

information and communication technologies. Several standard information systems development and operation models were described in Chapter 2 and these are the models against which current practices of building and operating a SIS in the schools studied have been compared. With respect to the use of information systems processes, the results presented in Chapter 5 indicate that in most schools these standards were not used in building and operating a SIS and four main reasons were identified as to why they were not followed.

Firstly, the results indicated that management staff in most schools were not familiar with information systems development standards and models. This was evident from the vague language used by respondents to explain SIS activities being carried out in the schools. This unfamiliarity was expected as most management staff were either not familiar with the use of a SIS or did not have an information systems background. However, as revealed from the results in Chapter 5, only a small number of the schools had full time technical staff that would have provided SIS advice. Thus, there was unfamiliarity as well as lack of access to SIS advice.

Secondly, the research found that the Ministry of Education and Training did not have a 'National ICT Policy for Education' and consequently did not provide advice and guidance on standards for developing information systems for education at the national level. The results showed that this lack of policy at the national level made it more difficult for schools to implement a SIS as they did not have a common framework to work from. Each school was left to make its own decisions.

Thirdly, and this is a consequence of the above two points, the findings indicate that there was no long-term strategic plan and design for setting up the SIS in most of the schools. Instead the results indicate that SIS development happened in stages in a bottom-up manner, that is, the SIS began in one section of the school and then

gradually expanded to other sections as the need arose and as funding and other ICT resources became available. The following SIS development pattern emerged in most schools. SIS development usually began at the administration section, then as the school offered computer studies subjects the SIS was extended to the student laboratories. With further funding, the SIS was then extended to the staff section and then into the library. So, the findings indicate that the SIS development process in most schools was emergent rather than one that followed a master plan according to standard information systems development models. However, in three of the schools, the SIS was set up as part of a larger externally funded aid project for the schools. In these schools, standard SIS development processes were used to plan, develop and launch the SIS. However, at the conclusion of the projects, there were no long-term operation plans so over a period of a decade, the SIS deteriorated as components broke down or became obsolete.

Fourthly, lack of adequate funding support was a further reason for why systems processes were not followed. In several schools, the staff had a clear understanding of their requirements for a SIS and had basic plans, but the lack of funding support restricted them from obtaining the required technical resources and technical expertise.

System Fitness for purpose

It was indicated in Chapter 2 that validation and verification checks ensure that the right system is being built and it is being built the right way. This in turn ensures that the resulting system will be fit for its intended purpose (Sommerville, 2011). These checks are normally made at all phases of the systems development life cycle, that is, in systems planning, analysis, design, implementation and operation. Thus, validation and verification checks are cross-cutting activities. The results in Chapter 5 indicate that this aspect of systems checking was not done properly in most schools. For

instance, the previous section noted that in many schools there was no formal strategic plan for the SIS. This implies that the main goals of the SIS as it developed over time were not properly aligned to those of the strategic goals of the school.

The results show that for most schools no formal systems analysis activity was carried out before setting up the SIS. Instead, informal discussions were held, usually at the beginning with the technical experts invited to set up the system, and it was left to them to develop and deploy the system. During the setup phase, the technical experts would communicate and request clarification and information from school management as and when the need arose. This meant that some of the needs of the users, those of the school and those of the system to be built, were not discovered and documented so they could be incorporated in the development of the SIS at each phase of development.

In addition to the absence of a formal strategic plan and systems analysis phase, the results also indicate the lack, in most schools, of documented strategic design to capture the main structure of the SIS and the design decisions agreed to by management and the technical staff regarding the SIS. This strategic design serves many purposes but with respect to ensuring validity and verification, it is the blueprint that is referenced when making future changes or expansions to the SIS (Eels & Cripps, 2010). Instead as the results indicate, an informal undocumented SIS design was agreed to by management and the technical team. The team then implemented and installed the SIS according to this undocumented design. Thus, SIS design and implementation was technically driven rather than being planned, designed and implemented by management using existing information systems development standards and models.

A contributing factor to the above deficiencies may have been due to the lack of clarity in school strategic policies to provide guidance in setting up a SIS. At the time of this research investigation, the Ministry of Education and Training, had not yet developed a National policy for ICT in Education that would have provided the guidance that schools needed.

Systems Support

As detailed in the literature in Chapter 2, system support is required in order to operate and maintain an information system as well as provide support to the users (Satzinger et al, 2012; Shelly & Rosenblatt, 2010). The research results in this aspect indicate that system support for the SIS was weak in most of the schools involved in the research.

There was a shortage of technical expertise both to advise management on setting up a SIS and then to operate and maintain it once it was deployed for two main reasons. Firstly, there was a dearth of technical experts available in the community. Secondly, it was more difficult for schools to recruit technical experts because the salaries offered were not attractive, and many ICT experts would rather work in towns than rural areas. The results from the laboratory observations show that in terms of technical support staffing, there was a mix of full-time technical staff and teaching staff who had been given ICT training, teaching staff who volunteered to provide technical support because of their background ICT skills and volunteer technical staff made available by non-governmental organisations. As a consequence of the weak level of technical support staffing, most schools were only able to provide basic level technical support. More advanced technical support was provided by external technical support agents that were mostly based in Port Vila and Luganville, the two main towns in the nation.

With respect to SIS system support policies and procedures, the results reveal that in most schools these were informal and undocumented rather than formally documented. In particular, the results show that most schools did not have a documented policy that covered such aspects as system use, user support, data storage and backups, system safety, and system security. As well, the responsibilities of technical staff were seldom explicitly documented. With the weak level of technical support in the schools and a dearth of access to technical expertise, the lack of formal policies and procedure was perhaps to be expected. Furthermore, the absence of a National ICT Policy for Education from government meant that there were no guiding principles for schools and so each was left to formulate their own.

In terms of access to technical resources, the results show that procuring SIS hardware equipment and getting them serviced was difficult, especially for rural schools for several reasons. Firstly, the equipment was relatively expensive and shipping costs were high because most computers and peripheral devices were bulky. As well, there was usually a long turn-around time for servicing equipment especially when they had to be shipped to other islands. These costs and delays increased the more remote the schools were from the computer equipment vendors and service centres.

As a final note, funding resources have an impact across all aspects of developing and operating a SIS. In this respect, the results indicate the availability of funding has a significant impact on procuring and upgrading system hardware and software and in carrying out the technical support activities. Of the 14 schools investigated only one had a separate SIS budget. The other school SIS were funded from the main school budget.

6.4 Consideration for Research Question 2

Research Question 2: In what ways are Vanuatu schools adapting to accommodate ICT into the school?

This section brings together the research results concerning the ways in which schools were planning and preparing to host a SIS, as well as changing and adapting to accommodate the requirements imposed by a SIS.

6.4.1 Application Domain

Introduction

As discussed in the literature in Chapter 2, the management of the organisation setting up an information system must work closely with ICT technical experts to ensure that the goals of the information system align with the organisation's strategic goals, that adequate resources are provided for the project, that the strategic design captures all the functionality that is required and that all the system, organisation and user requirements are clearly identified. The results in this research identified four main aspects to be addressed from the perspective of the school as the host of the SIS, and its roles and responsibilities in setting up and operating a SIS. These aspects were highlighted in the themes of ICT Capacity Building, Leadership, Pattern Language and Funding presented in Chapter 5. In this chapter, these themes have been integrated into the Application Domain category as shown in Figure 6.1. The remainder of this section discusses the results from Chapter 5 concerning the school as the organisation that is adapting to accommodate the operation of a SIS. Theme names have been used as sub-headings.

ICT Capacity Building

The discussion about school ICT capacity, as the literature in Chapter 2 indicates, tended to focus more on building ICT capacity for content development and pedagogy,

as well as for developing core information technology skills for instance (UNESCO, 2018; Ng, Miao & Lee, 2009; Romeo, Lloyd & Downes, 2012). These aspects of capacity building focus on the integration of ICT into the curriculum. The findings of this research on concerning ICT capacity building on the other hand are related to technical aspects of the system, computer literacy and funding resources. The technical aspects are discussed in the System Support section and so will not be further elaborated on here.

As discussed in the System Support section, the lack of technical support staff in schools had a negative impact on system support. However, this was not only a technical issue but also an ICT capacity building one as well. Of the 15 technical staff members identified in the schools around a 1/3 were full time and 2/3 were teachers who were assigned part-time technical support roles. The results also indicate that access to technical expertise was limited in rural schools because it was more difficult to recruit technical staff to work there.

With respect to computer literacy in schools, the results indicate that none of the schools investigated had a computer literacy program for its staff. This was mainly attributed to the lack of funding sources for training. Nonetheless as pointed out in the Systems Processes section, formal system development standards were not followed in building a SIS in most of the schools. Therefore, the design and functionality of the system's components were not explicitly defined and documented. In such cases, it would be difficult to put together a computer literacy program because it would not be clear what components or functions of the system to train the staff on.

. The results for ICT capacity building as described above are similar to the experience of other island nations in the Pacific region. For instance, the University of the South Pacific ICT Capacity Building project (2005) carried out a study on ICT

capacity in secondary schools in nine Pacific Island nations and identified the following as the main ICT capacity issues: lack of proper ICT infrastructure, high costs of computer equipment and maintenance, lack of or difficulty in retaining technical experts, high telephone and electricity costs, isolation and harsh environment for computers. In this case the focus of ICT capacity building was on technical aspects and components of the system. By contrast, schools in countries like Australia and New Zealand which are better resourced, have stable ICT infrastructures and services (MCEETYA, 2008; Johnson,Wood, & Sutton, 2014) and so ICT capacity building focus is more on issues such as the integration of ICT into the curriculum and using ICT to address deficits in the curriculum.

Leadership

It is well documented in the literature that strong leadership and management skills are important in setting up and operating an information system. Strong leadership is needed to provide a vision for the system and its place in the school system, a strategy for implementing the system and to obtain the support of the staff for the undertaking. Good management skills are needed to plan, organize, control, monitor and regulate the setting up and operation of the SIS.

The research findings identified several issues regarding leadership and management of a SIS in the schools. Firstly, in most schools, the management did not have access to expertise on information systems development. However, this expertise was difficult to access, because there was an absence of ICT experts available and there was no funding or limited funding within the school budget to recruit them. Apart from the availability and accessibility of IT expertise, there was also the issue of the kind of leadership required to initiate and carry forward a SIS project. The results indicate that the management in many schools was proactive in getting the SIS set up.

This tended to occur in terms of taking the initiative to begin the project, getting the support of the staff, seeking project funding from aid donors and seeking out project implementers. There were, however, some schools whose management was not proactive, preferring instead to stick to traditional school management functions and focussing on current issues and leaving SIS related issues to individual staff and students.

Secondly, the results indicate that there was generally a reluctance among staff in coming forward to accept a leadership role unless it was assigned to them by management. In the researchers view, an explanation for this attitude can be found in the traditional values and attitudes held by Vanuatu staff. In Vanuatu and other Pacific Island countries, society is socially stratified (Thaman, 1999) and people have been socialised to respect persons because of their rank. It is thus considered disrespectful to put oneself forward for a position or rank unless asked to or invited to by authority, which in this case was the school management. With respect to SIS management and operation issues, the research has found that there was a lack of proper management and operation of SIS activities in most schools. Proper management and operation require following standard information systems management and operation practices (Satzinger, Jackson & Burd, 2012; Gido & Clements, 2012). The results show that most schools did not have an ICT section as there was no budget or only a limited budget for it. In these schools, there was no formal ICT organisational structure into which staff were allocated roles, responsibilities and accountability. Instead the results indicate that when the SIS was deployed, staff were then allocated roles and responsibilities as and when the need arose. SIS role descriptions and responsibilities were not clearly defined nor were SIS operation policies and procedures. Evidence for this was found in the way operational matters were carried out. It was found that SIS

tasks in most schools were carried out in a casual and ad hoc manner in response to needs, thus scheduling of tasks did not seem to be a high priority. As well, tasks were usually considered completed when they were done and not according to a schedule with firmly set deadlines.

Pattern Language

In order to automate a particular business requirement of an organisation, it is important to first understand the requirement in the language of the organisation before carrying out the translation of these into systems functions (Robertson & Robertson, 2013; Eeles & Cripp, 2010). The process requires a thorough understanding of the procedures in the language of the domain of application, which in this case is the school system. The next step is to accurately translate procedures to precise and unambiguous business rules which can then be coded into SIS application functions and modules (Robertson & Robertson, 2013). Following this logical procedure ensures that SIS functions are derived from school policies and procedures as they should be rather than driven by the technology.

The research findings for this aspect shows that schools had informal policies and procedures in place but not much of it was formally documented and communicated among the staff. As a result, many teachers felt they had no or limited guidance on how to use the SIS to carry out required tasks. As well, the absence of technical procedures documentation also made it difficult for technical staff to carry out some tasks and fix errors to parts of the system that had been replaced, updated or newly installed.

The lack of policies and procedures resulted in the implementation of a SIS by persons who were not school staff, and it gave them the discretion to make some decisions on their own about how certain system components should function and therefore how the technical solutions should be shaped during the development phase

of the SIS. There were incidences where some procedures were documented, but only directly onto the current system and copies of them were not kept externally. When the new version of the system was introduced or when the system was replaced, the documentation of the procedures was lost.

As a final note, there was general agreement among staff in the schools that national standard SIS policies and procedures be provided by the Ministry of Education and Training. This was considered by school staff to be essential in setting up and operating a SIS.

Funding

Funding is a main cross-cutting concern to the development and operation of any information system. It can have either an enabling or constraining impact on the final product and its operation (Gido & Clements, 2012; Satzinger, Jackson & Burd, 2012). The literature on school ICT funding indicates that in most developing nations funding is a major constraint (UNESCO, 2004a; USP ICT Capacity Building Project, 2005; Williams, Kato & Khan, 2004; Va'a, 2015, Chandra, Chandra & Nutchey, 2014; ADB, 2018). The findings of this research are consistent with that reported in the literature and revealed that funding or the scarcity of it had a major constraining influence on SIS development and operation. SIS funding issues in Vanuatu schools include the following aspects:

Difficulty in securing SIS funding. Sourcing funds for a SIS was difficult for a number of reasons. Firstly, most schools were generally poor having only school fees as their major source of income. Secondly, the Ministry of Education and Training, which provided most of the funding for public schools, did not have at national level, a budget for ICT in schools. Thirdly, the communities close to the schools on which schools could rely on for fund raising activities were small, mostly dependent on a subsistence way of life and poor people. On the whole, Vanuatu like other Pacific

Island nations, is not a wealthy nation. In 2017, its Gross National Income (GNI) per capita was USD2,920 compared to USD51,360 for Australia and USD38,970 for New Zealand (World Bank, n.d).

Impact of funding constraints. As has been highlighted in previous sections, scarcity of funding was a cross-cutting concern and had a constraining influence across the major SIS activities. These include:

- SIS development and deployment,
- SIS operation and technical support,
- getting access to ICT technical expertise, and
- providing computer literacy training programmes.

As the results indicate, funding constraints was given as part of the reason why SIS development and deployment in most schools occurred in stages in an emergent manner rather than following a top-down master plan. However, the lack of access to expertise for the development phase was also attributed to funding constraints. As well part of the reason why formal methods were not used for checking the 'fitness for purpose' requirements of the SIS was attributed to a lack of funding. Funding constraints also restricted the quantity of computer hardware and software that schools could afford resulting in high student to computer ratios and staff to computer ratios. At the operation and maintenance phase of the SIS, the results indicated that most schools did not have a SIS budget and could not afford to recruit fulltime technical staff. As well, for most schools, but particularly the remote schools, technical support costs were high and because funding was scarce, maintenance and upgrade activities were poorly performed. None of the schools in this research had a funded and ongoing computer literacy training program for their staff due to the scarcity of funds. Thus, training needs were carried out in and ad hoc manner as and when funding became

available or when a stakeholder organisation sponsored a training course. In most schools, training was often left as the responsibility of individual staff.

Stakeholder support. In respect to the foregoing, the results show that this was where donor agencies had stepped in to assist by donating equipment, providing technical expertise, software and training. This aspect is discussed further under the considerations for Research Question 3.

6.5 Considerations for Research Question 3

Research Question 3: *How does the context in which ICT is implemented impact the use of ICT in schools?*

This section brings together the findings of the research concerning ways in which the context in which a SIS is located, impacts its development and operation.

6.5.1 External context issues

Although the context in which a system is developed and operated is important for all information systems, this research has found that for Vanuatu, certain context issues have a significant impact on the development and operation of a SIS. These issues concern:

- physical constraints: these as highlighted in Chapter 1 include the small size of islands, isolation, remoteness and vulnerability to natural disasters,
- Vanuatu culture, and
- the school stakeholder community.

Chapter 5 presented the results concerning these three issues under the themes: *Physical context and ICT Accessibility, Cultural influence and Partnerships*. In this chapter these themes have been integrated into the External Context category and are shown in the outermost circle of Figure 6.1. The rest of this section discusses the

research results concerning these issues and how they impact the development and operation of a SIS. The discussion is organised under sub-topics with the theme names.

ICT accessibility

Overall, the findings concerning *ICT accessibility* confirm that remote schools generally experience poor access to ICT services, resources and technical expertise (Chan Mow, 2014; Va'a, 2015). The findings of this research shows that schools experienced ICT accessibility issues in the following ways:

Remoteness and Isolation. The findings show that for schools in remote or isolated areas, high air and land transportation costs contributed to increased computer hardware costs, technical support costs and electricity fuel costs. As well, irregular and infrequent shipping trips to schools in those areas often resulted in long wait times for some SIS components including electricity fuel. Consequently, those schools were less able to afford computer hardware, technical support and access to technical support services which became less frequent and less reliable. As well, the high cost of electricity fuel forced many of those schools to restrict access to electricity power supply which meant less access to computers for teaching and learning, administration and access to the Internet. In comparison, schools in urban areas were connected to the town power grid and so electricity power supply was not an issue. Telecommunication is required for Internet access as well as for obtaining access to technical expertise and for facilitating SIS activities. The findings in this research show that remote and isolated schools had higher telecommunication costs and therefore higher Internet access costs compared to urban schools. Furthermore, the quality of telecommunication reception was unreliable and the bandwidth for Internet access was low in these areas. In comparison, urban schools had better telecommunication reception, but their bandwidth range was only marginally higher.

Small Islands. In terms of the impact of island size on SIS development and operation, the findings show that smaller islands that were further away from urban areas did not have many resources that would attract businesses such as computer service agents or shop outlets that sell SIS components. It was not economically viable to operate such businesses in these small islands because the market was very limited. Thus, the small size of islands added to the challenges of operating a SIS.

Vulnerability to natural disasters. The islands are vulnerable to natural disasters, particularly tropical cyclones. The findings of this research show that factors such as high humidity and exposure salt spray from the sea added to the problems of providing technical support. This is because the salt spray and high humidity corrodes SIS equipment faster than would otherwise be the case in a normal environment. The findings show that some schools SIS succumbed to these adverse climatic conditions.

Cultural Influence

The literature on information systems development and operation focuses mostly on technical aspects and less on aspects such as its impact on culture or the impact of culture on it. However research by Hofstede (Hofstede, 1984; 2001) and the GLOBE Research Project (Terlutter, Diehl & Mueller, 2006) for instance, provide evidence that the cultural setting in which an organisation is located does have an impact on the way work is undertaken in that organisation. According to Hofstede, this impact occurs as a consequence of the cultural values, attitudes and behaviours that workers from that culture bring with them to the work environment. The findings of this research indicate that the cultural values, attitudes and behaviours of Vanuatu school staff do have an impact on the development, operation and use of a SIS. Some of the ways in which these cultural values, attitudes and behaviours impact a SIS are revealed in the following work practices which staff brought to the work environment.

Slow pace of work. Part of the reason for the slower pace in which SIS activities were undertaken could in part be attributed to technical problems. For instance, delays in transporting equipment to remote schools or the breakdown in communication between the school and computer vendor due to faulty telecommunication equipment. However even in the absence of technical related issues, the pace of work was in general still slow. The findings concerning this issue, from interviews and observation of it by the researcher as well his own experience growing up in the islands, strongly indicates that the slow pace of doing work is part of culture. This issue was briefly discussed in Chapter 1 regarding the research background. Completing tasks according to schedule is important in the work of a SIS because many school activities that depend on the SIS are scheduled and have deadlines. The slow pace of work in SIS activities thus impacts school activities by making them less efficient and effective.

Ad hoc rather than systematic approach to work. The findings show that a casual, ad hoc approach rather than a systematic approach was adopted in relation to carrying out technical SIS activities. This was evident in system support activities where in most schools there were no formal processes put in place for systematically coordinating and carrying out tasks according to a schedule. Problems were dealt with as they arose each in their own unique way rather than being dealt with in a consistent manner following a well-defined process. As technical training was not provided on a regular basis in most schools, this casual ad hoc approach to work may in part be attributed to a lack of experience in standard system support practices. However, it is the researcher's contention, taking into account the interview and focus group results as well as the infrastructure observations and his cultural background, that the casual ad hoc approach observed was also due to cultural influence. In Vanuatu, traditional

community-based activities are usually done in a casual, social and leisurely atmosphere and social participation is considered more important than stringent schedules and deadlines.

Focus on current concerns. The findings show that in developing and operating a SIS, the management of some schools had an attitude of focussing only on current issues and resolving those, rather than making long term strategic plans and activities. Making strategic plans provides a sense of direction of where the SIS is heading and therefore one can control its continuing development and operation. The lack of technical expertise, advice and understanding of information systems development methods were cited as reasons for management not following systems processes which included strategic planning. But this explanation does not exclude the possibility that traditional leadership styles contributed to this attitude. The results from interviews and the researcher's reflection on his Vanuatu cultural experience suggest that this is the case. Traditional leadership style in Vanuatu tends to focus on dealing with current concerns and issues. These are typically concerns about fixing current problems, concerns about maintaining good relations at all times with extended families and tribes, concerns about what activities need doing in the current season and so on. It is a reactive rather than proactive style of leadership. Focussing and being pre-occupied with current concerns leaves less time and energy for strategic planning, which is important in SIS development and operation. An important property of an efficient information system is predictability both in terms of reliability and availability and in clearly laying out the long-term plan for the system (Sommerville, 2011). Without forward planning, it is difficult to sustain such a system.

Context oriented perception. The results from observations of the computer laboratories and comments from technical staff show that when it came to learning

about and using the SIS, staff in some schools often had difficulty transferring the skills they learned from one software application to another even though they have the same family of functions and the software interfaces were supposed to be intuitive. An explanation given by one technical staff in a laboratory observation session was that those users tended to view the system as primarily consisting of individual physical components connected together rather than seeing the functional properties of those components and how they work together in a logical manner. That is, they saw the physical system but not the logical one. It is the researcher's contention based on the results and his Vanuatu cultural experience that the difficulty experienced by the staff referred to above, may in part be due to their cultural experience of perceiving objects in the world. In Vanuatu culture as in some other Pacific Island cultures, the perception of an object or thing out there in the real world is usually recognised in the context of its immediate physical environment, and the object's relation to that environment forms part of the perception of the object. If the object is moved out to a different environment, then it must be recognised in the context of this new environment. This adjustment of seeing the object again in its new context takes time for some and for others they may be unable to see it (Thaman, 1993; 1999; Huy & Bisun 2008). It is acknowledged in the literature that being able to understand the logical system underlying the physical system allows one to see the invariant components of the system, its logical structure, the relationship between components and the logic that governs the flow of information between functions within the system (Sommerville, 2011; Eeles & Cripps, 2010). It follows that in Vanuatu schools, with the development and operation of a SIS, this understanding is important for management staff, teachers and technical staff.

Partnerships

As revealed in Table 5.11, the most active stakeholders in the schools were aid donor agencies notably AUSAID coordinated by the Australian embassy, the PEACECORP Foundation, the French government through its embassy, JICA and JOCV through the Japanese embassy and the New Zealand government. The finding of this research reveals that the activities of aid donor agencies have concentrated mainly on:

- providing funding of equipment for the SIS,
- providing technical expertise for SIS development, deployment and operation,
- providing local capacity building by training local counter parts,
- providing SIS equipment, and
- building software solutions.

The findings show that the Ministry of Education and Training usually negotiated with the aid donor agencies on behalf of the schools needing support but there was no standard policy for creating partnerships with aid donors in a consistent manner. As well, since most schools did not develop clear SIS strategies, plans and designs, they could not specify their needs so that they could be better targeted by the aid donor agencies. In this respect, the results show some aid donor agencies were hesitant to provide aid for equipment unless they could evaluate the benefits for the school and the longer-term sustainability of those aid components.

The results concerning stakeholder partnerships show that with vendors and external technical support agencies, the partnerships were only of a business-customer type.

In this respect, the Ministry of Education and Training is a special stakeholder because it governs and administers the schooling system in the nation. As the results

show, the Ministry of Education and Training did not have a national budget for ICT in schools because it could not afford to. Given this situation it would seem doubtful if it can make provision in its budget for ICT in schools in the near future. Thus schools in Vanuatu will continue to depend to a large extent on stakeholder support for SIS development and operation.

6.6 Summary of the Discussion of Results for Research Questions 1, 2 and 3

The following summaries highlight the key results from the discussion presented in this chapter. As such, the key discussion points are presented under each category from Figure 6.1.

6.6.1 Summary of results for SIS activities

Systems Processes

- Standard models and methodologies for information system were not followed in developing and operating the SIS.
- There is a lack of strategic planning to align the goals of the SIS to those of the school.
- Funding constraints affected many SIS activities.

System Fitness for purpose.

- There is a mismatch in aligning SIS goals to school strategic goals
- There were no requirements analysis done to capture all systems, organisation and user requirements.
- Systems development was technically driven.

System Support

- There is a lack of formal technical policies and procedures and staff roles and responsibilities are not clearly documented.
- There is weak technical support and advice due a lack of funding and a dearth of technical support base in community.
- There are high costs in maintaining the SIS and difficulty in servicing system components especially in rural schools.

- There are funding constraints on recruiting ICT experts and providing ongoing technical support.

6.6.2 Summary of results concerning domain of application issues

ICT Capacity.

- ICT capacity issues mostly concerned technical aspects of the system including the evaluation and monitoring of the procurement and utilisation of system components and infrastructure components.

- The level of technical support was weak and needs to be evaluated and strengthened

- Computer literacy programs were not offered and the reason for this appears to be a lack of focus on what it should be about. This lack of focus is a consequence of the SIS not being developed according to standard systems development methods.

- Literacy programs for all categories of staff do not seem available

Leadership:

- Management in most schools did not have a clear focus with respect to leading SIS development and operation because they did not have sufficient information systems expertise, and expertise advice was often not available when needed.

- SIS leadership in most schools was seen as proactive in initiating a SIS project, obtaining staff support and in actively seeking funding for it while in others management was not seen as proactive. Rather it tended to focus on current school issues and left ICT related issues to individual staff.

- SIS management and operation practices in most of the schools was done more on a casual and informal basis rather than following standard practices. This aspect was evident in the lack of systematic procedures for task allocation, scheduling and monitoring.

Pattern Language:

- In almost all the schools, the business rules and functions to be incorporated into the SIS were not clearly articulated, documented and communicated to the staff

- As a consequence of the above, many staff members said they had no guide. Thus, the teaching staff said they had no guide on how to make good use of the system, and technical staff said that they had no documented procedures for carrying out many of their tasks.

- Since there was no clear documentation of business rules and functions to be incorporated into the SIS, the external agents involved in the implementation sometimes provided their own technical solutions to those business rules and functions. In this way, SIS development was technically driven.

SIS Funding:

- The results reveal that the scarcity of funds had a constraining influence across all phases of the SIS life cycle. It was difficult to raise funds for a SIS because schools were generally poor, the Ministry of Education and Training did not provide SIS funding for schools, the local communities on which schools depended for fund raising activities were generally poor as most live an island subsistence lifestyle.

- As highlighted above, the scarcity of funds had a constraining influence on the following:
    - recruitment of full-time technical staff and on accessing the services of technical experts,
    - carrying out proper requirements analysis activities and validation and verification activities and on building proper SIS infrastructure,
    - the purchasing of SIS equipment including hardware, software and the upgrades of the same,
    - providing enough computers for teaching staff; on setting up and operating a budgeted IT section, and
    - the quality and efficiency of SIS servicing costs and providing a continuing SIS literacy training program for staff.

The results show that in view of the above situation, the stakeholder community, in particular, external donor agencies, stepped in to assist SIS by providing funding, computer equipment, volunteer technical staff, technical training for local staff and other technical assistance.

6.6.3 Summary of findings concerning external context issues

Physical context and ICT accessibility:

- Transport costs between islands were relatively high contributing to higher costs for equipment (computer hardware and software), technical support services and electricity.

- For rural schools, access to technical resources was more restricted. This included access to technical experts or technical expertise information, reliable technical support services, telephone services and access to the Internet and computer literacy training programs run by private companies.

- By comparison, urban schools also experienced the same issues but to a much lesser degree.

- The small size of remote islands did not attract ICT types of businesses and this added to the challenge of accessing SIS resources and expertise for schools in those islands.

- ICT physical networks and infrastructures for all schools were vulnerable to the adverse effects of tropical weather conditions including humidity, salinity and the damaging impacts of tropical cyclones.

Cultural Influence:

- Cultural values, attitudes and behaviours that staff brought with them to the school environment affects the work they do.

- In schools, SIS related work was done at a leisurely pace as with other school activities. In relation to operating a SIS this attitude can slow down work and make the SIS less effective because it interferes other functions of the SIS.

- Technical work tended to be carried out in an ad hoc manner than following a systematic approach according to schedules and timelines. This is a Vanuatu cultural behaviour. Since a SIS works in logical manner, it has to be operated in a logical and systematic way. Failure to do this results in unsustainable system.

- There appeared to be a focus on current concerns in management rather than on long term strategic planning. This is a Vanuatu cultural style of leadership.

- There appeared to be a context-oriented perception of the SIS both by management and other staff which focusses on seeing the physical view of the SIS rather than the logical view of it. Context-oriented perception is a Vanuatu cultural way of seeing things in the world.

Stakeholders

- Aid donors played an active role in supporting the SIS in many schools.

- Schools were not able to specify their SIS needs clearly so they could be better targeted by aid donors.

- The Ministry of Education and Training played a role in negotiating aid for schools but it did not have a policy for dealing with for schools in a consistent manner.

- The Ministry of Education and Training as a special stakeholder did not have a national budget for ICT in schools nor did it have a National ICT for Education Policy to guide schools in setting up and operating a SIS.

This Chapter has provided a discussion of the results presented in Chapter 5. The discussion has been done in the context of the first three research questions posed in Chapter 1. The discussion was organised around the ten themes identified in Chapter 5 and according to the model derived in Figure 6.1. The results of the foregoing discussion are used in the next Chapter to draw the conclusions of this research and to frame a set of guidelines and an implementation strategy for establishing a sustainable SIS in Vanuatu.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter presents the conclusions and recommendations arising out of an examination of the use of ICT in secondary schools in the Republic of Vanuatu. The previous chapters have provided background information on this investigation and examined the literature on ICT in schools in different contexts and on information systems development models. The data from the investigation have been compiled and analysed and the results discussed in Chapter 6.

In this chapter the presentation of the conclusions in combination with the synthesised literature presented in Chapter 2, have been used to present a model for a sustainable School Information System (SIS). Also presented is a set of guidelines and recommendations for the implementation of a sustainable SIS in the Vanuatu secondary school context.

The Chapter begins by considering the scope and limitations of the research. The main conclusions are then drawn from the research and are articulated in the context of the Research Questions posed in Chapter 1. The guidelines and recommendations are then presented and finally, suggestions for further research are provided followed by concluding remarks.

7.2 Scope and limitations of the research

The scope and limitations of this research were highlighted in Chapter 1. In terms of scope, this research was conducted in secondary schools in the Republic of Vanuatu. It did not consider primary schools or tertiary institutions and it did not investigate related issues such as the national ICT support base or ICT infrastructure in the nation both of which are associated with the study. In terms of limitations, this study focussed more on the development and operation aspects of a SIS and less on issues such as the integration of ICT into the curriculum. This was because at the time of this investigation the main issues in the integration of ICT into schools were of a beginning level; thus, the focus was more on technical aspects of a SIS rather than on productive use of the SIS for teaching and learning. The second limitation of the study was that although stakeholders were involved in SIS development activities, only the views and perceptions of staff in the schools and a number of staff from the Ministry of Education and Training authority were solicited. Time limits did not allow the researcher to interview other stakeholders such as the aid donor agencies and non-governmental organisations who made contributions to school SIS activities in several ways. Information about the activities of these stakeholders were provided by school staff. Thus, the viewpoints of stakeholders concerning their involvement in SIS activities were not solicited. The third limitation is that at the time of the investigation, access to ICT services including telephone, the internet and the availability of newer digital devices were more limited and less affordable. Now, newer digital devices that are lighter in weight, more portable and more accessible. As well, faster and more affordable telecommunication and ICT services are becoming available in the regional areas of Vanuatu. These newer technologies are likely to have an impact on the integration of ICT into schools in ways this research was not able to investigate.

Based on the foregoing, it is recommended that future research seek to broaden the study to include primary as well as tertiary institutions to determine whether the findings in this research apply to the broader education system setting in Vanuatu. As well, it is recommended that future research seek the views of other stakeholders in the Vanuatu education system including aid agencies, non-governmental agencies and other agencies involved in implementing school information systems.

7.3 Main conclusions

This section presents the conclusions of this research investigation. Each research question presented in Chapter 1 is considered in turn by drawing together the findings from the literature in Chapter 2 and the results discussed in Chapter 6.

7.3.1 Research Question 1

Research Question 1. *What are the current practices for integrating the use of ICT into secondary schools in Vanuatu?*

This research question focusses on the technical aspects of setting up and operating an ICT system in Vanuatu schools. In this respect, the findings reveal that in most schools there was a general lack of understanding among staff on how an information system functions, a lack of understanding of the standard processes for developing and operating an information system, and a lack of clarity on the resource implications for the system's development and operation.

As highlighted in the literature in Chapter 2, four perspectives of an information system include the user, conceptual, internal and physical perspectives (Satzinger, Jackson & Burd, 2012; Sommerville, 2011; Coronel & Morris, 2019). An understanding of the user perspective is important for seeing how each category of users will use the system. An understanding of the conceptual perspective is also

essential as this represents the view of the whole system with components connected according to an architectural design in order function as intended. The findings reveal that school management did not fully understand the user, conceptual, and internal perspectives of an information system. Although this general lack of understanding was to be expected of management staff in most schools as many did not have an information systems background, the findings revealed that many schools also did not have access to ICT expertise advice when they were setting up the school information system (SIS). Furthermore, the national education authority, which is the Ministry of Education and Training (MOET), did not have a national 'ICT for Education' policy that would have guided schools in setting up the SIS. The consequences of these shortcomings were that management in most schools did not understand how to develop a strategic plan for the system which considered the system and user requirements, the strategic design, implementation and operation plans, as well as the resource implications for the whole project. Also, the findings reveal that in many schools most of the SIS development activities were left to the agents that were given the contract to set up the systems. In this respect, SIS set up in most schools was mostly technically driven and happened in stages as and when funding and other technical resources could be acquired. There were four schools, which had their SIS implemented as part of a development aid project. These SISs were planned, developed and implemented according to standard systems development models. In all of these four schools, the systems were operated and maintained well for a few years after project completion, but because there was no long-term plan for sustaining the systems, and as components became obsolete and they were facing a lack of funding, the system support weakened and the systems began to deteriorate. Thus, even with properly implemented SISs provided by aid, the findings reveal that

funding for the long-term operation and sustainability of a SIS was not taken into consideration during the planning stage.

The findings concerning the practice of setting up a SIS revealed that in those schools where the management took the initiative to set up the system, standard models for information systems development were not followed. As highlighted in Chapter 2, information systems need to be set up using standard models because they are complex, artificial and require many components and resources. As well, they need to be constructed to meet a set of business functions (Robertson & Robertson, 2013; Eeles & Cripps, 2010). Several standard information systems development approaches were discussed in the literature in Chapter 2, the most common of which was the systems development life cycle (SDLC) model (Satzinger, Jackson & Burd, 2012; Sommerville, 2011). It is recognised in the literature that this model is ideal for information systems where the business functions of the application domain are standard and well known in advance. The five phases of this information systems development cycle include: planning, analysis, design, implementation and operation. The information systems development cycle is normally carried out in the form of a standard information systems project (Gido & Clcments, 2015). The findings reveal that most schools did not follow this systems development approach. It revealed that although at the top level, school management worked with the contractors in planning the SIS, most of the systems development tasks were left to the contractors. As a result, the goals of the SIS were not fully aligned to those of the school in terms of where the SIS fits into the overall operation of the school. The findings from this research indicate that the analysis phase was not carried out according to standard methods. Thus:

- user and system requirements, especially those of the teaching and administration staff, were not captured to be built into the SIS functions,
- there was no strategic SIS design to capture the conceptual perspective of the system, which is essentially the blueprint of the system. Thus, over time, the original design and design decisions were forgotten,
- the implementation phase was left to the contractors, and finally
- there were no policies and procedures for technical operation and user support.

With respect to SIS operation and support, the findings revealed that not only were there no documented technical policies and procedures but the level of technical support in almost all the schools was weak. Most schools had one or two technical staff. Only basic technical support was provided in many of the schools as the availability of technical expertise was scarce. Technical support in rural schools was especially weak as access to expertise advise and support was scarce and technical support costs were high.

7.3.2 Research Question 2

Research Question 2. *In what ways are Vanuatu schools adapting to accommodate ICT into the school?*

This research question focusses on the school as an organisation that is setting up or intending to set up a SIS. This focus is in terms of how, as an organisation the school is integrating the SIS into its overall school operations while at the same time adapting itself to accommodate the operations of the SIS. As indicated above, information systems development standards were not followed in developing the SIS in most schools. This meant that certain phases of the development cycle were not carried out properly and consequently, the SIS either did not operate as expected or

operated well for a while and then its performance degraded. As pointed out in Research Question 1, most schools lacked technical experts to develop the SIS inhouse, so SIS development was either outsourced to a third party or developed as part of a school aid project. Though this would imply that the contractors were solely responsible for the problems reported in SIS operations, there were other factors involved from the school organisation perspective. In this respect, the findings revealed four main factors from the school perspective that negatively impacted the development and operation of a SIS. These include:

- a school management team that lacked ICT expertise advice,
- a lack of clarity of school policies and procedures in as far as they affect the development and operation of a SIS,
- a lack of ICT capacity building programs for the staff to use the SIS, and
- the financial constraints faced by schools.

With respect to the leadership of school management in setting up a SIS, the findings indicate that the management team in most schools was proactive in getting the SIS project started. What they lacked most of in planning for the SIS was necessary ICT technical advice on information systems development and operation standards. Although SIS development was outsourced to contractors in most schools, it was important to explicitly state in the contract all the services required of the contractor. Typically, in any information systems development project, these services would include:

- a proper feasibility analysis to determine if the system would be technically or economically feasible,
- a full analysis of the system requirements,
- the development of a strategic design,
- implementation of the system according to schedule,

- training of staff if necessary, and
- the signing any of technical support service level agreements that were required.

The foregoing activities would require the contractor to work closely with management of the organisation under the advice of information systems experts (Gido & Clcments, 2012, Sommerville, 2011). As there was little ICT technical advice for school management, the services given to the contractor were not clearly specified. As would be expected, the findings revealed that most of the activities of developing and deploying the SIS were left to the contractor's discretion. Thus, the risk of losing control over the development and operation of the SIS in many schools to the technical experts, the contractors, was high.

With respect to technical leadership in operating the SIS once it had been deployed, the findings indicate that there was a lack of proper management and operation of SIS activities. There was general weakness in the areas of planning, task scheduling, task assignment and monitoring of task progress in a systematic manner. This was evident in the casual and ad hoc approach technical staff took to carrying out their duties. As the literature makes clear in Chapter 2, proper management of operations is required in an information system. This is mainly because there needs to be coordination of activities so that the system functions smoothly, that is, it operates with optimum performance, users are supported, maintenance problems are resolved in a systematic manner and system upgrades are performed on a regular basis and software licensing issues are resolved (Burgess, 2003; Langer, 2011). The findings revealed three reasons for this operations management weakness:

- there were no clearly documented policies and procedures for SIS operation and support which would guide the technical staff in carrying out their duties,

- due to funding constraints there was no separate SIS operation budget and therefore no SIS technical section,
- from the researcher's observations, the casual and ad hoc approach to doing work is a culturally oriented attitude that is typical of the leisurely lifestyle of Pacific Island cultures.

The lack of clear policies and procedures that was evident at SIS operation level was also evident at the school organisation level. At the school level the findings reveal that although school policies and procedures existed, much of this was not documented. School policies and procedures would have guided in the elucidation of SIS requirements which would then be translated into business rules and built into the functionality of the SIS. As these were not clearly documented, they were not fully captured during the analysis phase of systems development resulting in a SIS whose functionality did not reflect that which was required. This compromised the SIS's fitness for purpose. The findings of this research reveal that there was general agreement among staff in most schools that the Ministry Education and Training should provide SIS standard policies and procedures to guide schools.

Concerning the implementation of a SIS, the research findings identified ICT capacity-building as an important aspect of a school's ability to adapt to accommodate the operation of a SIS. Much of the literature on ICT capacity building in schools focusses on the integration of ICT into the curriculum (UNESCO, 2004b; Koehler & Mishra, 2005). The findings of this research reveal that at the time of data collection there were no organised programs for ICT capacity building. Furthermore, the need for capacity building was not for ICT integration into the curriculum, but for basic information systems literacy for teaching staff, basic training for technical staff and ensuring that technical and funding resources are built up to sustainable levels.

As alluded to above, funding or lack of it had significant impacts on SIS activities in each of the Vanuatu schools investigated. The research findings revealed three reasons for this:

- the national government did not provide funding to schools for SIS development and operation, so schools had to find their own funding sources,
- most schools were generally poor depending mostly on school fees as their major source of income for school operation, and
- the communities close to the schools on which the schools depend for fundraising activities were also poor.

The research findings revealed that funding constraints impacted SIS development, operation, technical support, ICT capacity building activities and access to technical expertise. It is unlikely that Vanuatu's economic status will improve much in the long term, because it does not have much in the way of natural resources, the islands are scattered over large distances and have small populations. As well Vanuatu is vulnerable natural disasters. Thus, the nation has limited opportunities for large scale economic development. These impacts must be taken into consideration when developing future SIS.

7.3.3 Research Question 3

Research Question 3. *How does the context in which ICT is implemented influence the use of ICT in schools?*

It is well documented in the literature that the context in which an information system is used has an impact on it and so it needs to be taken into consideration during the planning and development stages (Burgess, 2003; Langer, 2011; Satzinger, Jackson & Burd, 2012). This research investigated three aspects of the Vanuatu context which

were considered to have an impact on the development and operation of a SIS in Vanuatu schools. These aspects include the Vanuatu physical and economic context, Vanuatu traditional culture and the stakeholder community. Each of these aspects will be addressed separately under each of the research questions posed.

Research question 3.1 *In what ways do the physical and economic context of Vanuatu influence the use of ICT in schools?*

The findings of this research reveal that the nature of the physical context of Vanuatu had an impact on the operation of the SIS in most schools in several ways. A major influence is the relatively high transport costs between islands for the distribution of SIS equipment, technical support services and SIS infrastructure. SIS equipment and technical support services were expensive because most computer service agents that supplied SIS equipment and provided more advanced technical support services were based in the two main town centres of Port Vila and Luganville. The research findings revealed that not only was technical service provision expensive but there was typically a long turn-around time for such service provision. Furthermore, SIS infrastructure costs which included electricity and telephone services were high for rural schools because the main operators of these services were also located in the two main town centres. In some schools, these costs translated to the restriction of electricity use and telephone services. The findings reveal that in general, the costs increased the further away schools were from the main centres where most SIS technical resources, computer service agents and technical expertise were located. With respect to impact of the physical climate on a SIS, the research findings revealed that adverse tropical weather conditions did affect the SIS in many schools. This was in terms of the high levels of humidity and salinity experienced in the islands throughout the year. Due to the proximity of many schools to the ocean, humidity and

salinity tended to corrode computer equipment at a much faster rate than would otherwise be expected. Furthermore, tropical cyclones are regular in the islands and these exacerbated the problems. The researcher's observations of school computer laboratories revealed that most schools were not built to fully protect SIS equipment from these adverse weather conditions.

In the previous section, the difficulty faced by schools in providing reliable funding for the SIS was highlighted. With respect to the effects of the national economic context on the operation of a SIS, the findings of this research show that indeed there is a link, albeit an indirect one. The funding constraints faced by schools is linked to low levels of national incomes due to the weak socio-economic status of Vanuatu as highlighted in Chapter 1. As indicated in RQ 2 above, these funding constraints will be experienced by schools over the long term.

Research question 3.2 *In what ways does the Vanuatu cultural context influence the use of ICT in schools?*

Geert Hofstede's cultural dimension theory (Hofstede, 1984; Hofstede, 2001), provides a framework for cross-cultural communication, that is able to inform this research in the broader sense. Although the dimensions of national cultures that Hofstede identified were not the subject of this research, the researcher's interest was in whether the effects of the traditional cultural values, attitudes and behaviours of school staff, who are from Vanuatu, influenced their work attitudes, behaviours and performances. The research findings do indicate that Vanuatu cultural values held by staff influenced their attitudes, behaviours and work performances in several ways. Firstly, the slow pace and ad hoc way of work, as reported by some teaching staff in the provision of technical support services, reflects the leisurely pace of work in traditional Pacific Islands societies (Mara, 1997). In relation to operating a SIS, the

slow and ad hoc pace of work makes the SIS less effective because it interferes with other functions of the SIS. Since a SIS works in systematic manner, it must be operated in a logical and systematic rather than ad hoc approach, otherwise coordination of activities between various components of the system become less efficient and effective. Secondly, the research findings indicate that in some schools, the management as well as technical staff seemed to be pre-occupied with current concerns and have less time for long term planning for the operation and sustainability of the SIS. This focus on current concerns is typical of the Vanuatu traditional style of leadership (Bolton, 1998). Thirdly, the findings indicate that in many instances, management and other school staff when planning, discussing SIS issues or working on the SIS tended to focus more on the physical perspective of the system rather than on the conceptual perspective, that is, they tended to have a context-oriented perception of the system. It is the researcher's contention that this way of perceiving the system by the staff can be attributed to their traditional cultural view of perceiving objects in the world. In this view, the background through which an object is viewed is important in understanding the object (Thaman, 1999). Having a context-oriented view of the SIS can sometimes blind one from viewing the system as a whole. It follows that understanding the conceptual perspective of the SIS is important as explained in Research Question 1.

Research question 3.3 *In what ways does the school stakeholder community assist in integrating ICT into schools?*

School stakeholders are those groups and organisations out in the community which have an interest in the uptake of ICT in schools. The findings in this research identified several stakeholder groups including aid donor agencies, the government, the churches, community groups and other private philanthropic groups. Aid donor

agencies included the governments of Australia, New Zealand, Japan, France, the US and Canada as well as volunteer organisations from those countries. The aid provided was in various forms: from full SIS project provision, targeted funding for SIS equipment, the direct provision of equipment, provision of technical expertise, provision of particular software packages and training of local staff. The research findings indicate that the provision of SIS aid for schools did not follow a consistent policy from government. Some aid donors used their own discretion to directly provide what they considered was needed by the schools. Indeed, the government did not have a set policy about provision of aid for SIS in schools that ought to have guided the aid donors and thus it did not deal with aid donors in a consistent way. On the other hand, as most schools investigated did not have a clearly laid out plan for the development and operation of their SIS and the required resources, they could not clearly describe their requirements in sufficient detail so that aid donor agencies could better target them for aid.

With respect to Vanuatu government support, although it did not provide direct SIS funding assistance to schools, it negotiated aid and mediated between aid agencies and schools in the provision of SIS aid. The church stakeholder groups mainly focussed on providing SIS aid to the schools that they run. Community groups provided limited support to the schools mainly because they lacked funding sources. To conclude this section, this research has found that for Vanuatu, the physical and socio-economic context, Vanuatu traditional culture and the stakeholder community have a significant impact on the development and operation of a SIS.

7.3.4 Research Question 4

Research Question 4. *What do the current school ICT `practices, school adaptation experiences and Vanuatu contextual factors elucidated in RQ1, RQ2 and RQ3 reveal about guidelines for integrating sustainable ICT systems in Vanuatu schools?*

The findings concerning RQ1, RQ2, and RQ3 reveal that overall, the current practices of integrating ICT into those Vanuatu schools investigated have not resulted in SISs that could be sustained over the long term. The main factors contributing to this have been explained under each of the research questions. The findings for RQ1 concern SIS issues from the perspective of an information system. Findings for RQ2 concern those SIS related issues from the perspective of the school as an organisation setting up a SIS and findings for RQ3 concern SIS issues from the perspective of the external context in which the SIS is set up. The findings, revealed from the three perspectives, are distinct and imply that when developing guidelines for integrating SIS into schools in Vanuatu, information systems issues, application domain issues and context issues must be clearly identified, delineated and considered together when formulating the guidelines.

7.4 Guidelines for developing a sustainable SIS

7.4.1 Introduction

In this section, a set of guidelines that will form the foundation for the development of a sustainable SIS in Vanuatu schools is provided. The guidelines were derived from the synthesis of issues identified in the literature in Chapter 2, the results discussed in Chapter 6 and the conclusions drawn from these as discussed in the preceding section.

7.4.2 Guidelines

The literature in Chapter 2 identified two possible models that can be utilized for developing and operating a sustainable SIS. The UNESCO model identified five essential dimensions of sustainability for a school ICT system. The living systems theory model identified six inherent characteristics of a living system that enable it to survive sustainably in its habitat. There are parallels between the characteristics of a living system and those of a SIS. The findings of this research and the two models for ICT system sustainability have been used to formulate the guidelines. Of the many types of systems identified in systems theory, the theory of living systems has been selected as one main component to model a SIS. The main rationale for selecting this is that in Vanuatu, people can relate well to a living system. Most people in Vanuatu live a subsistence lifestyle close to the land and sea where living systems form an integral part of their lives. To view a SIS as a living system is to imply that it is a system that is alive, growing, evolving and adapting to its environment so that over time it becomes sustainable. Viewing a system in this way assists in understanding how a SIS can be developed and operated in a sustainable manner in Vanuatu.

The purpose of the guidelines presented below is to provide the essential elements for consideration in establishing a sustainable SIS in Vanuatu. The guidelines have been grouped into eight broad aspects as follows:

Guideline 1. The school as a system – a system view of the school is important. It views the school as a system operating within the boundaries of external environment systems. In turn, it operates subsystems such as the SIS which contains further subsystems nested within.

Guideline 2. SIS resources – the SIS requires technical, financial, electrical energy and other resources to enable it to operate.

Guideline 3. SIS internal self-regulation – the smooth operation of a SIS requires strong leadership and management, appropriate policies and procedures, and a skilled and dedicated team with assigned responsibilities.

Guideline 4. The SIS as an open system – a SIS should be responsive to changes in its environment including advances in technologies, changes in education policies, relevant changes in the national economy and relevant changes in the community.

Guideline 5. SIS growth and adaptation – over time, as a SIS grows, it needs to learn to adapt. It can for instance, document and use best practices for SIS management, operation, technical support and SIS use for teaching and learning.

Guideline 6. Education oriented SIS development – SIS activities should be developed and organised around the educational objectives of the school and not be technology driven.

Guideline 7. Build SIS capacity – unlike a living system, a SIS is an artificial system and needs to be operated and used by trained staff. SIS capacity building programs are thus needed for all categories of staff in the school.

Guideline 8. Build partnerships – in order to support the SIS, a school needs to build partnerships with stakeholders in the community and networking relationships with other schools in order to leverage expertise, useful information, technical support and funding.

Each of the guidelines, their purpose and reason are summarised in Table 7.1 below. Together, the guidelines cover the themes identified in Chapter 5 that were considered important in the development and operation of a sustainable SIS. The themes identified include the following:

- Systems processes
- System support

- System fitness for purpose
- Leadership and management
- Affordability
- Pattern Language
- ICT Capacity
- ICT infrastructure
- Culture
- Partnerships

Table 7. 1 Guidelines for the development of a sustainable SIS

Guideline	Aspect	Purpose	Reason
1	The school as a system	Understand structure of school as complex system Design SIS with system view in mind Use standard information systems development models to build the SIS	To identify links between the school and environment. To identify the links between school, SIS and subsystems. To identify the interdependencies and interaction between systems and subsystems. To design SIS with required functionality. To develop a well-designed SIS that can be operated and sustained.
2	SIS resources	Assess and source technical, financial and expertise resources	Appropriate technical resources including hardware, software and electricity are required for SIS development. Appropriate funding is required for all SIS activities. Expert advice and information are needed by staff.
3	System internal self-regulation	Strong leadership and management are needed Develop required policies and procedures	Strong leadership and management are vital for the success of a SIS. Policies and procedures that guide development and

		Develop strategies for optimising SIS operation	operation of a SIS are needed for successful implementation. Optimisation strategies ensure that the SIS operates efficiently with minimum cost and disruptions.
4	The SIS as an open system	SIS should be responsive to changes in external environment – technical, education policies, economy Build in SIS feedback loops so staff can monitor operation Develop SIS information sharing capacity	Adaptation to environmental changes enable the SIS to be more sustainable. Feedback to staff can be SIS diagnostic in nature and provide an opportunity for in time action. SIS information sharing capacity enable usefulness.
5	SIS growth and adaptation	Include SIS growth in school strategic plan Assess resource levels and technical capacity Document and use best practices in managing, operating and using a SIS	Planned growth can be funded, controlled and sustained. Availability of resources determine SIS growth scale and rate. Using best practices enable a SIS to evolve those emergent properties such as reliability, dependability and security.
6	Education oriented SIS development	Plan and implement SIS around educational objectives, not technical ones Align ICT resources with the curriculum Get support of staff from the beginning of the SIS	Technically driven SIS operation does not lead to achievement of school objectives, whereas educational objectives will. Aligning resources with curriculum ensures resources are properly used. Staff support gives them a sense of ownership of the SIS.
7	SIS capacity building	Develop ICT training programs for staff	SIS training for teachers, technical and administration staff provides knowledge, skills and confidence.
8	Build partnerships	Build partnership with government, civil society, the private sector and with other schools	Partnerships can be used to leverage expertise, useful information, technical support and funding.

Each aspect of the guidelines identifies a characteristic of a SIS that has a corresponding characteristic of a living system or a dimension of the UNESCO school ICT sustainability model. The parallels are shown in table 7.2

Table 7. 2 Parallels between Living system, UNESCO sustainability model and a SIS

SIS Aspect	Living system characteristics	UNESCO school ICT system sustainability model
The school as a system	Organisation	Technical sustainability
SIS resources	Metabolism	Economic sustainability
System internal self-regulation	Homeostasis	Political sustainability
The SIS as an open system	Open system	
SIS growth and adaptation	Growth	
Education oriented SIS development		Educational sustainability
SIS capacity building	Growth	Political sustainability
Build partnerships	Adaptation	Social sustainability

A sustainable living system has the above characteristics that make it sustainable. The UNESCO ICT system sustainability model identified 5 dimensions of sustainability. Modelling the SIS according to these two models will make the SIS more sustainable and ensure that each aspect of the implementation of it is successful. This will be expanded upon in the next section.

7.5 Strategy for implementing and operating a sustainable SIS

The following is a recommended strategy for implementing and operating a SIS in a secondary school in Vanuatu. This strategy utilises the systems development life cycle (SDLC) model for developing an information system discussed in Chapter 2. The strategy is informed by the findings of this research and the guidelines developed in

the preceding section. This strategy assumes that the Vanuatu Ministry of Education and Training already has in place a policy for ICT in education, which it now currently has. The suggested implementation strategy is shown in Table 7.3

Table 7. 3 Implementation strategy for a sustainable SIS

Phase	Activities
Phase 1. Plan the SIS	Management with the advice of ICT experts: • Develop a vision statement to clarify the capability of the SIS and its benefits for the school. • Align school organisational goals and objectives with those of the SIS. • Carry out economic, technical and operation feasibility study. • Form partnership with stakeholder to solicit funding and other resources.
Phase 2. Develop the SIS	• Outsource development of the SIS to a contractor or Aid donor agency. • Sign a service contract that clearly specifies the services required of the contractor. • The school management, with advice from SIS experts to work closely with the contractor during system development to monitor project progress and take any corrective action. • The system developer/contractor should use a standard information systems development model such as the SDLC model to build the SIS. • Systems development activities should include: o elucidation of school, system and user requirements, o SIS design, and o system procurement
Phase 3. Deploy the SIS	• Install the system. • Train the staff. • Convert old system components to the new

	system.
Phase 4. Operate the SIS	• Position policies and procedures for SIS operation. • New business rules need to be translated and incorporated into the SIS as an ongoing activity. • Outsource some technical operation activities as required and sign contracts. • Technical activities include systems administration, maintenance, upgrades, user support. • Plan for and update for SIS growth. • Document and use best SIS operation practices. • Operate SIS around school education objectives.
Phase 5. Use the SIS	• Build SIS capacity of teachers, technical and administration staff through training programs. • Form partnerships with stakeholder community to leverage expertise and share resources. • Network with other schools to learn from SIS use experiences. • Work towards integration of ICT into the curriculum.

By implementing and operating a SIS according to the above strategy and taking into consideration the guidelines, the resulting system can be sustained over the long term.

7.6 Suggestions for future research

Based on the scope and limitations of this research and its findings, it is recommended that future research focus on the following four areas:

Partnerships. The findings of this research indicate that stakeholders, particularly the Aid donor agencies play an important role in SIS development and operation in Vanuatu. However, their participation in SIS development activities and their relationships with the government are not well documented.

Inclusion of other educational institutions. The investigation of ICT use in primary schools and tertiary institutions is another area of research. Results from such research can be used to compare with results of this research concerning the use of ICT in secondary schools.

Effect of newer technologies on SIS. Newer ICT technologies are now accessible and more affordable in Vanuatu. Research on how these have changed the way SIS operate in Vanuatu would be of value to researchers and schools.

Cultural impacts of SIS integration. This research has identified some cultural related issues in the development and operation of a SIS, but only upon observation and reflection from the researchers experience of the Vanuatu culture. Cultural issues that impact on SIS development, operation, use and on student learning is an area that is recommended for further research. The results of such investigation will be of value to schools, the national education authorities and the community.

7.7 Concluding Remarks

This thesis has documented an investigation into the current practices of integrating information systems in Vanuatu secondary schools, the ways in which schools are adapting to accommodate the operation of a school information system (SIS) and factors external to the school that have an impact on the development and operation of a SIS. From the onset, the main aim of the investigation was the identification of factors that have an impact on the sustainable use of ICT in Vanuatu schools. It has been established in this research that in the case of Vanuatu, certain ICT practices, the lack of resources, deficiencies in ICT skills and knowledge, as well as school external constraints contributed to making the implementation and operation of a SIS unsustainable.

This research has found that as a result of schools not following standard systems development processes, SIS were poorly planned, resourced, implemented and operated. With respect to schools adapting to accommodate a SIS, this research has found that the level of readiness among schools was low. This was in terms of the effectiveness of school ICT leadership, the lack of funding and technical resources, the level of staff ICT capacity and in terms of the schools establishing clear ICT policies and procedures at the various levels. Furthermore, the research has found that factors external to the school such as physical constraints, the influence of traditional culture have had a negative impact, while the involvement of school stakeholder groups have had a positive impact on the implementation and operation of a SIS.

These findings have contributed to a greater understanding of the main issues that need to be addressed in implementing and operating a sustainable SIS in a Vanuatu secondary school. As presented in the previous section of this Chapter an outcome of the examination of the findings has been the development of a set of guidelines and recommendations for implementing and operating a SIS in Vanuatu schools. The guidelines and recommendations can provide guidance for schools, education policy makers and the stakeholder community in finding sustainable solutions for integrating ICT into schools in Vanuatu.

This research employed the case study methodology to carry out the investigation on a number of selected secondary schools. As more advance forms of information and communication technologies become available in Vanuatu, more secondary schools, tertiary institutions as well as primary schools will implement a School Information System. As such, the Ministry of Education and Training has recently begun to develop a policy for ICT in Education. Future research can use the findings in this research to investigate how changes in government policies and the

availability of new technologies affect the integration of ICT into education in Vanuatu.

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Appendix A: Information sheet for research participants

A framework for the Sustainable use of Information and Communication Technologies (ICT) in schools in the Republic of Vanuatu.

INFORMATION FOR RESEARCH PARTICIPANTS

The aim of this research is to investigate factors that have a bearing on the introduction and use of computers in various organisations and educational institutions in Vanuatu and to use these to develop an integrated framework for adopting IT in Vanuatu schools. The research is being undertaken as part of a postgraduate research qualification and the data collection component will consist of interviews, questionnaires and source documents. The results of this research will be used to learn about the best approaches for establishing and using IT in Vanuatu schools and the barriers that should be avoided.

Your involvement

Your participation in the research is voluntary and any information you provide will be anonymous. You may withdraw from the study if you wish and you can do so at any time. You have the right not to answer any question if you wish to do so.

You will participate in the research either by completing questionnaires or by being invited to be interviewed. Some interviews will be taped but your permission will be sought before this is done and you have the right to turn down this request.

How we will use the information

The information you provide will be combined with the information provided by other participants and analysed to determine current trends in the introduction and use of computers in different settings and to recommend approaches for doing the same in Vanuatu schools. The information obtained will be presented in a PhD thesis and might be published. The data collected in this study will be securely stored for a period of 5 years in accordance with the Central Queensland University policy.

Your permission

We need your consent in writing to confirm your involvement. You can give this consent by completing and signing the attached 'consent' form. Signing the form means you have agreed to participate in the study but it does not stop you from withdrawing if you change your mind later on.

If you decide to withdraw, please write or telephone the researcher at the address below:

Confidentiality

All information received from you during the study will be kept confidential. It will not be given out to any one who could reveal your identity. As well, all the filled questionnaires and taped information collected in this study will be kept under lock and key. Any information that is in electronic format will also be stored safely and secured with passwords.

For contacts and further information

If you would like further information on the research you may write, telephone, fax or email the researcher:

Kenneth Fakamuria
Central Queensland University
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Tel: +61 7 49407593
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Appendix B: Consent form to participate in the research project

Title of research: A Framework for the Sustainable Use of Information and Communications Technologies in Vanuatu schools

I…… of ……confirm that:

1. I agree to participate in the following components of the research:

   a. The Interviews ☐

   b. The questionnaires ☐

   (Tick the boxes that apply)
2. The nature and purpose of the research has been explained to me and I agree to participate.
3. I understand that:
   a. the information obtained during the study will be used within a PhD thesis and may be published.
   b. If I agree to be interviewed, this interview may be recorded
   c. I can withdraw from the study at any time if I wish to do so
   d. I have the right to not answer any question if I so wish
   e. I may not directly benefit from taking part in the study and that I will not receive any payment for participating in an interview
   f. The information collected from me will be kept confidential
   g. That participation is voluntary and that I may be provided with the results of the study before publication
4. The data collected from me will be kept under lock and key for 5 years in accordance with Central Queensland University Policy.
5.
6. I confirm that I am over 18 years of age.

Signature of Participant:
……
……

Date…….

If you would like to obtain feedback about the research please fill out your contact details below:
Name…….
Organisation…….
Mailing Address
…….
…….
…….
E-mail……Telephone……

Appendix C: School Interview and Focus Group Questions

Appendix C1: Interview questions for the Principal or Senior Management of the school

Section 1: Purpose of the SIS and staff role in it.

1. What do you see as the main purpose for setting up the SIS?
2. As Principal (Senior Management Officer) of the school, what is your role in the development, operation and management of the SIS?

Section 2: Structure of the SIS

3. How was the project initiated?
4. Who were the main stakeholders involved in initiating the project?
5. What was the Ministry of Education's role in the project?
6. How was funding for the project secured?
7. Was there any formal study to determine the needs that would be satisfied by the SIS?
8. What role did school management play in coordinating and/or facilitating the analysis phase of the project?
9. What sort of system design work was carried out?
10. How was the system deployed?
11. What organisational structure is in place to support the system?
12. What SIS policies and procedures does the school have?

Section 3: Staff expertise and information for SIS development

13. What previous training and experience do you have with computers?
14. How are you keeping abreast of information on solutions for the school ICT systems?
15. What training programs do you have in place to improve staff ICT skills?

Section 4: Leadership role in the SIS

16. In what ways have you involved the teaching staff in the development and running of the school ICT system?
17. What kind of interaction/correspondence have you had with the Ministry of Education regarding the school ICT system?
18. What type of partnerships have you developed with stakeholders that support the school system?
19. What are your long term strategies for directing and controlling the development and evolution of the system?
20. What have been some of the frustrations you've experienced when working with your staff (teachers and technical), Ministry of Education, Stakeholder Partners?

Section 5: Climate of factors affecting the long-term operation of the SIS

21. What do you see as the main factors affecting the sustainability of the current system?

Appendix C2: Interview questions for the Teaching staff of the school

Section 1: Purpose of the SIS and staff role in it.

1. What do you see as the main purpose of the SIS?

2. What are your main roles/involvement in the SIS?

Section 2: Structure of the SIS

3. How would you describe the current set up of the SIS?
4. How are you currently using the for teaching?
5. How are you currently using the system for administration tasks and curriculum development work?
6. What type of support do you get from the technical support team?
7. What type of support do you get from school management about using the system?

Section 3: Staff expertise and information for SIS development

8. What computer literacy training or experience have you had?
9. What types of computer training programs does management have for staff to update their skills?
10. To what extend has management spelt out its policy on the use of ICT for teaching and learning activities?
11. How do you currently keep yourself informed of current ICT technologies and solutions for teaching and learning?

Section 4: Leadership role in the SIS

12. In what ways are you taking a leading role in assisting with the operation and management of the school system?
13. With regard to ICT operation, management and use, what are some of the frustrations you have had working with: Management, Technical support staff.

Section 5: Climate of factors affecting the long-term operation of the SIS

14. In your view, what are the main factors that affect the long-term sustainable use of the school System?

Appendix C3: Interview questions for the Technical staff of the school

Section 1: Purpose of the SIS and staff role in it

1. What do you see as the main purpose of the school ICT system?
2. What are your main roles in the system?

Section 2: Structure of the SIS

3. Describe the SIS setup from your perspective
4. Describe the way the technical section is organised
5. What sorts of tasks do you/your team carry out as systems technical staff?
6. What technical support tasks do you outsource?
7. What type of support do you provide for students?
8. What type of support do you provide for Teachers?
9. What type of support do you provide for Administration staff?
10. What has been your experience working with computer agents that supply system components or provide technical support for the SIS?
11. What has been your experience working with the Telecommunication Service Provider?
12. Are there written policies and procedures for administering and using the SIS?

Section 3: Staff expertise and information for SIS development

13. How much professional technical training do you get?
14. Do you have access to technical expertise or a technical support network?

Section 4: Leadership role in the SIS

15. What leadership role do you play in shaping the development and operation of the SIS?

Section 5: Climate of factors affecting the long-term operation of the SIS

16. What do you see as the main factors affecting the long-term sustainability of the current SIS?

Appendix C4: Focus group discussion questions

Section 1: Purpose of the SIS and staff role in it.

1. What was the main purpose for setting up the SIS?
2. What is your role in the development, operation and management of the SIS?

Section 2: Structure of the SIS

3. How was the project initiated?
4. Who were the main stakeholders involved in initiating the project?
5. What was the Ministry of Education's role in the project?
6. How was funding for the project secured?
7. Was there any formal study to determine the needs that would be satisfied by the introduction of computers in school?
8. What role did school management play in coordinating and/or facilitating this phase of the project?
9. What sort of system design work was carried out?
10. How was the system deployed?
11. What organisational structure is/was in place to support the system?
12. What ICT policies and procedures does/did the school have?
13. What were the main reasons for the system breaking down?

Section 3: Staff expertise and information for SIS development

14. What is the average computer literacy level of staff in the school?
15. How are you keeping abreast of information on solutions for the school ICT systems?
16. What training programs are/were in place to improve staff ICT skills?

Section 4: Leadership role in the SIS

17. What leadership roles do you play with respect to setting up, operating and using the SIS?
18. What kind of interaction/correspondence have you had with the Ministry of Education regarding the school ICT system?
19. What type of partnerships have you developed with stakeholders that support the school system?

Section 5: Climate of factors affecting the long term operation of the SIS

20. What do you see as the main factors affecting the sustainability of the current system?

Appendix D: Ethics Approval Letter

MEMORANDUM
From the Office of Research

Central Queensland
UNIVERSITY

Secretary, Human Research Ethics Committee
Ph: 07 4923 2603
Fax: 07 4923 2600
Email: n.turner@cqu.edu.au

23 March 2005

Mr Kenneth Fakamuria
Central Queensland University
Mackay Campus
Boundary Road
MACKAY QLD 4740

Dear Mr Fakamuria,

HUMAN RESEARCH ETHICS COMMITTEE APPROVAL FOR PROJECT H04/12-137, *A FRAMEWORK FOR THE ADOPTION OF INFORMATION TECHNOLOGY (IT) IN SCHOOLS IN THE REPUBLIC OF VANUATU.*

The Human Research Ethics Committee is an approved institutional ethics committee constituted in accord with guidelines formulated by the National Health and Medical Research Council (NHMRC) and governed by policies and procedures consistent with principles as contained in publications such as the joint Australian Vice-Chancellors' Committee and NHMRC *Statement and Guidelines on Research Practice.*

On 21 March 2005 the Human Research Ethics Committee of Central Queensland University acknowledged your compliance to the conditions placed on your ethics approval for the research project, *A Framework for the adoption of Information Technology (IT) in schools in the Republic of Vanuatu.* (Project Number H04/12-137).

The period of ethics approval is 06 June 2005 to 30 January 2006. The approval number is H04/12-137, please quote this number in all dealings with the Committee.

The standard conditions of approval for this research project are that:

(a) you conduct the research project strictly in accordance with the proposal submitted and granted ethics approval, including any amendments required to be made to the proposal by the Human Research Ethics Committee;

(b) you report immediately anything which may warrant review of ethics approval of the project, including:
  (i) serious or unexpected adverse effects on participants;
  (ii) proposed changes in the protocol;
  (iii) unforeseen events that might affect continued ethical acceptability of the project;

(A written report detailing the adverse occurrence or unforeseen event must be submitted to the Committee Chair within one working day after the event.)

(c) you provide the Human Research Ethics Committee with a written "Final Report" by no later than 28 February 2006;

(A copy of the reporting pro formas may be obtained from the Human Research Ethics Committee Secretary, Nicole Turner please contact at the telephone or email given on the first page.)

(d) if the research project is discontinued, you advise the Committee in writing within 5 working days of the discontinuation;

(e) you comply with each and all of the above conditions of approval and any additional conditions or any modification of conditions which may be made subsequently by the Human Research Ethics Committee.

Please note that failure to comply with the conditions of approval and the *National Statement on Ethical Conduct in Research Involving Humans* may result in withdrawal of approval for the project.

You are required to advise the Secretary in writing within 5 working days if this project does not proceed for any reason. In the event that you require an extension of ethics approval for this project, please make written application in advance of the end-date of this approval. The research cannot continue beyond the end date of approval unless the Committee has granted an extension of ethics approval. Extensions of approval cannot be granted retrospectively. Should you need an extension but not apply for this before the end-date of the approval then a full new application for approval must be submitted to the Secretary for the Committee to consider.

If you have any queries in relation to this approval or if you need any further information please contact the Secretary, Nicole Turner or myself.

Yours sincerely,

Associate Professor Ken Purnell
Chair, Human Research Ethics Committee

Cc: Project File
Emeritus Professor John Dekkers (Supervisor)

Application Category: A

Appendix E: Extension of Ethical Approval

MEMORANDUM
From the Office of Research

Central Queensland
UNIVERSITY

Secretary, Human Research Ethics Committee
Ph: *07 4923 2603*
Fax: *07 4923 2600*
Email: *ethics@cqu.edu.au*

09 March 2006

Mr Kenneth Fakamuria
Central Queensland University
Mackay Campus
Boundary Road
MACKAY QLD 4740

Dear Mr Fakamuria,

HUMAN RESEARCH ETHICS COMMITTEE
EXPEDITED ETHICAL APPROVAL
MODIFICATION TO PROJECT PROJECT H04/12-137, *A FRAMEWORK FOR THE ADOPTION OF INFORMATION TECHNOLOGY (IT) IN SCHOOLS IN THE REPUBLIC OF VANUATU.*

The Human Research Ethics Committee is an approved institutional ethics committee constituted in accord with guidelines formulated by the National Health and Medical Research Council (NHMRC) and governed by policies and procedures consistent with principles as contained in publications such as the joint Australian Vice-Chancellors' Committee and NHMRC *Statement and Guidelines on Research Practice.*

On 09 March 2006, the Chair of the Human Research Ethics Committee of Central Queensland University granted expedited ethics approval for the modification of extending the data collection dates to research project, *A Framework for the adoption of Information Technology (IT) in schools in the Republic of Vanuatu.* **This approval is subject to ratification by the whole committee at the next scheduled meeting.**

The period of ethics approval is 01February 2006 to 31 January 2007. The approval number is H04/12-137.1. Please quote this number in all dealings with the Committee Secretary.

The standard conditions of approval for this research project are that:

(a) you conduct the research project strictly in accordance with the proposal submitted and granted ethics approval, including any amendments required to be made to the proposal by the Human Research Ethics Committee;

(b) you report immediately anything which may warrant review of ethics approval of the project, including:
  (i) serious or unexpected adverse effects on participants;
  (ii) proposed changes in the protocol;

(iii) unforeseen events that might affect continued ethical acceptability of the project;

(A written report detailing the adverse occurrence or unforeseen event must be submitted to the Committee Chair within one working day after the event.)

(c) you provide the Human Research Ethics Committee with a written "Annual Report" by no later than 28 February each calendar year and "Final Report" by no later than one month after the approval expiry date;

(A copy of the reporting pro formas may be obtained from the Human Research Ethics Committee Secretary, Nicole Turner please contact at the telephone or email given on the first page.)

(d) if the research project is discontinued, you advise the Committee in writing within five (5) working days of the discontinuation;

(e) you comply with each and all of the above conditions of approval and any additional conditions or any modification of conditions which may be made subsequently by the Human Research Ethics Committee;

(f) you advise the Human Research Ethics Committee (email: ethics@cqu.edu.au) immediately if any complaints are made, or expressions of concern are raised, in relation to the project.

Please note that failure to comply with the conditions of approval and the *National Statement on Ethical Conduct in Research Involving Humans* may result in withdrawal of approval for the project.

You are required to advise the Secretary in writing within five (5) working days if this project does not proceed for any reason. In the event that you require an extension of ethics approval for this project, please make written application in advance of the end-date of this approval. The research cannot continue beyond the end date of approval unless the Committee has granted an extension of ethics approval. Extensions of approval cannot be granted retrospectively. Should you need an extension but not apply for this before the end-date of the approval then a full new application for approval must be submitted to the Secretary for the Committee to consider.

If you have any queries in relation to this approval or if you need any further information please contact the Secretary, Nicole Turner or myself.

Yours sincerely,

Associate Professor Ken Purnell
Chair, Human Research Ethics Committee

Cc: Project File
Professor John Dekkers (Supervisor)

Application Category: A

Appendix F: Justification for the currency of the Research Data

In this section, a justification for the currency of the data and findings in this research is provided.

The data collection for this research was carried out in December 2006. The analysis, results and results discussion are presented in Chapters 4, 5 and 6 respectively. The findings identified ten themes namely: Systems Processes, System Fitness for Purpose, System Support, Leadership and Management, Funding, Pattern language, ICT Capacity Building, ICT Accessibility, Cultural Influence, and Partnerships. It is this Researcher's claim that the data collected in the research and the findings are still current today. The following are offered as sources of evidence to support this claim.

At around the same time that data collection for this research was carried out in Vanuatu, the University of the South Pacific, in its ICT Capacity Building project (USP, 2005), released the results of a survey it carried out in Pacific Island nations concerning ICT use in schools. For Vanuatu, the report identified the following as constraints and challenges (p. 75):

- It is difficult for schools to house computers in ideal condition. Under poor conditions, the humidity can cause computers to deteriorate and break down.
- When computers break down, there are no technicians to fix them. Transporting them to Vila is expensive and often schools do not have spare computers. Maintenance is an ongoing problem.
- There is a lack of human resources to support the school ICT system.
- There are no supporting systems in place to assist schools deal with the problems they encounter.

These findings are consistent with and support the findings of this research.

In 2013, a national survey was carried out by the Prime Minister's Office (PMO), Office of the Government Chief Information Officer (OGCIO), the Ministry of Education and Training (MoET), and the Telecommunications and Radiocommunications Regulator section (TRR) on the use of ICT in Vanuatu schools (ICT in Vanuatu Schools, 2013). Primary and Secondary schools were included in the survey. The survey report identified the following issues and challenges faced by schools (p. 2-3):

- Most schools did not have computers. Only Secondary Schools had computer labs.
- There were no schools with computers that were well integrated into the classroom.
- ICT was given a low priority in most schools.
- Two main obstacles were faced by schools in ICT development: poor or no electricity power supply, and a lack of trained ICT teachers and support personnel.
- Only 5 percent of students in the surveyed schools had access to ICTs.
- The percentage of students estimated to be computer literate was 4 percent; almost all of them were secondary school students.
- The number of students per computer across all the schools was about 205, placing Vanuatu in the 4th percentile of countries reporting to the International Telecommunication Union (ITU) on this indicator.
- Only about 6 percent of schools nationwide had access to the Internet. This placed Vanuatu in the 14th percentile of countries reporting to the ITU on this important indicator.

The findings of this survey prompted the government to place a strong focus on 'ICT in Education' in the National ICT policy. The findings of this survey support the finding of this research.

Research carried out by a PEACECORP volunteer at Saint Patrick's School, one of the participating schools in this research identified some interesting issues and challenges in integrating ICT into the school (Ward, 2016). His analysis on teaching ICT to Vanuatu Students was based on Hofstede's work on Cultural Dimensions (Hofstede, 1984; 2001). His findings regarding this aspect were that cultural attitudes of Vanuatu Students had an influence on their school performance and learning. He identified the following Hofstede Cultural Dimensions about the attitudes of Vanuatu Students in the school:

- They had high Uncertainty Avoidance (UA) attitude
- High Masculinity (M) was respected and is the norm in the culture
- They were more collective in their activities rather than individualistic
- High Power Distance (PD) is the norm in the culture on the island
- Students tended to work in a leisurely pace and were stressed by stringent deadlines.

These results support the finding in this research that cultural values that students and teachers bring with them to school influence their work performance and learning.

In the research, Ward (2016) also identified the following technical challenges faced by the school:

- There were usually logistics problems and high transportation costs of ICT equipment.

- Electricity supply was unstable and sometimes restricted which meant less work got done.
- High humidity in the environment and natural disasters were obstacles to integrating ICT in the school.
- Funding for new equipment and repairs was scarce.

Again, these results support the findings of this research.

A report by Leeming, Thomson & Forster (2009) on the challenges and impacts faced by Pacific Island Nations in implementing and operating an OLPC project identified the following key aspects (p. 4):

- "Governance. Building a sustainable coordinating body that ensures government ownership of the programme and adherence to education policy and standards, but leverages partnerships with suitable "champion" organisations…" (p. 4)
- "Teacher Training. Teachers must be trained on how to integrate the laptops into their teaching and facilitate the children's learning with the laptops and associated servers and content." (p. 4)
- Power Infrastructure. Finding more reliable and affordable power sources such as solar energy should be a priority.
- "Content and Curriculum Integration. The OLPC allows curriculum departments to look at new ways of creating and pooling education resources with their neighbours." (p. 4)

Again, these findings support those of this research.

It should be pointed out that in the last six years, there have been significant ICT developments in Vanuatu, for instance:

- In 2014, the government launched the National ICT Policy and the Universal Access Policy – universal access to ICT for all
- Also, in 2014 the launching of the submarine cable linking Vanuatu to the Southern Cross Cable greatly increased ICT bandwidth.

With these developments, a number of school ICT projects were piloted. The launching of an AUSAID-funded pilot project for Rensarie School on Malekula Island is an example. Rensarie school was among those that participated in this research. The school ICT project is powered by solar and the School Network is connected to the Internet. Since 2018, there have been plans to expand the Rensarie School project model to other schools. All these initiatives are positive developments but, in the Researcher's view, they are not being carried out as part of a bigger coherent national education framework for integrating ICT into schools. Instead they are being done in piecemeal fashion and as the findings of this research show, once the project aid funding ceases, if the schools do not take ownership of the projects and sustain them, such projects will gradually become obsolete and break down over time.

Three findings in this research concerning the implementation and operation of a SIS include Systems Processes, System Fitness for Purpose and System Support. System Support issues have been highlighted in the forgoing sections. It is the Researcher's view that Systems Processes and System Fitness for Purpose issues are not being addressed properly even today. The Researcher holds this view because proper development of a SIS requires technical experts working systematically with school management to develop the right system in the right way. But as shown by the foregoing reports and research findings, the lack of technical experts is still a major issue faced by Secondary Schools in Vanuatu today.

Finally, this research has shown that the operation of a SIS in Vanuatu can be vulnerable to adverse weather conditions such as cyclones and salt spray contamination. In 2015, category 5 Cyclone Pam struck Vanuatu resulting in severe damage to many schools. Much external aid was provided in the aftermath of the cyclone to repair and rebuild damaged schools. Cyclone Harold, another category 5 cyclone, struck Vanuatu in April 2020 again resulting in severe damage to many schools. In the Researcher's view, the damage caused by these cyclones has hindered the progress in the integration of ICT in schools in Vanuatu.

To conclude, in the Researcher's view, the discussion in the foregoing sections has provided evidence that the data collected in this research and the findings are current and the Researcher maintains this position.

Appendix G: Trustworthiness of the research findings

This section explains how trustworthiness of the research and how researcher bias were addressed. Trustworthiness of this research was addressed by ensuring that the findings are credible, transferable and dependable (Carcary, 2009; Statistics Solutions, n.d).

Credibility. Credibility is the confidence that the researcher has in the truth of the findings of the research. This was established in this research in the following ways:

- After considering the nature of the problem to be investigated, it was decided that the Case Study research method would be the most suitable to adopt in that it would be the best to answer the research questions posed. Case Study is a well-established research method.
- In determining the data sample to be collected, the researcher was careful to ensure that the right type of data was to be collected, that the data sample was representative of the whole and the sample was big enough to for meaningful analysis
- Three data collection methods: interviews, focus group discussions and laboratory observations, were deliberately chosen to collect the data to answer the same research questions. For each data collection method, the same types of questions were asked of different participants in the schools. In this way the credibility of the findings is increased.
- There were frequent interactions and sharing of data between the researcher and supervisors during the period of the research design and data collection.

The feedback from the supervisors, sometimes by pointing out flaws in design and data samples, helped guided the researcher in the right direction.

- The researcher is familiar with the research context. He is from Vanuatu, knows the schooling system there and the culture and has experience teaching in the country.

Transferability. Transferability refers to the generalisability of the research findings. This was addressed in the following way. In this Case Study research, the researcher is investigating a case in a particular context – Schools in Vanuatu. The researcher does not know other settings that may wish to transfer the finding of this research. To address transferability the researcher has described in detail the research context in Chapters 1 and 2. This is in terms of the physical geography of the islands, the challenges of transportation and communication between islands, the Vanuatu national school system, the type ICT infrastructure available and ICT accessibility, the economic status of the nation and its culture. This background for understanding why some of the decisions were made in designing and conducting the research. For instance, the data samples were chosen to be representative of schools in the provinces, semi-structured interviews and focus group discussion were considered to be appropriate for data collection, the use of Bislama, the lingua franca of Vanuatu was considered more appropriate to use of interviews and focus group discussions. Secondary schools rather than primary schools were chosen for the investigation. The detailed description of this background will enable other researchers who seek to transfer the findings of this research to judge transferability.

Dependability. Dependability of the research is the extent to which other researchers can repeat the way this research was conducted and come up with consistent findings. Dependability was addressed in this research in the following ways:

- By ensuring that the research process is logical, systematic and documented clearly.
- The research design and implementation plan are clearly described in Chapter 3.
- The implementation schedule was followed
- The same protocol was used for all interviews and focus group discussions.
- Informed consent was sought from all participants before interview and focus group sessions so that no one was forced into participating. In this way dependability was addressed.

Researcher bias. The researcher has a Vanuatu cultural background and inevitably brings this background into the data generation and interpretation process. However, by using the thematic approach for analysing and interpreting the data collected as described in Chapter 4, the researcher was following a methodical technique which enabled to separate his own personal bias from the true nature of the data collected. As well, discussions and sharing of data with the supervisors during the period of data collection analysis and discussion allowed for feedback for example by pointing out personal some of the researcher's bias which helped in taking corrective action.

Appendix H. Dates for the Data collection

Dates for the Pilot phase visits

Sch. Code/organisation	Province	Location	Cat.	Date of visit
Ministry of Education	SHEFA	Port Vila	-	28/11/2005
S8	SHEFA	urban	A	29/11/2005
S7	SHEFA	urban	F	29/11/2005

Dates for data collection in the schools

Sch. Code	Province	Location	Cat.	Date of visit
S1	TAFEA	Rural	F	17/11/06
S2	SANMA	Urban	F	09/11/06
S3	SHEFA	Urban	F	14/11/06
S4	MALAMPA	Urban	F	10/11/06
S5	SHEFA	Urban	F	03/11/06
S6	TAFEA	Rural	A	16/11/06
S7	SHEFA	Urban	F	01/11/06
S8	SHEFA	Urban	A	20/11/06
S9	SANMA	Rural	A	08/11/06
S10	SHEFA	Rural	A	13/11/06
S11	MALAMPA	Rural	F	10/11/06
S12	TAFEA	Rural	A	16/11/06
S13	PENAMA	Rural	A	06/11/06
S14	SHEFA	Urban	B	22/11/06
Ministry of Education and Training Courtesy visit				30/10/06

Key: A – Anglophone school, B – Bilingual school, F – Francophone school