THE INCORPORATION OF ACTIVITY-BASED LEARNING AND REFLECTION INTO A NEW INFORMATION SYSTEMS DEVELOPMENT PRACTICE FRAMEWORK FOR BOTSWANA

By

Tjongabangwe Selaolo

Submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy (Information Technology)

in the Informatics Department

Faculty of Engineering, Built Environment and Information Technology

Supervisor: Prof Hugo Lotriet

Date: 20th June 2012

Contents

List of Figures

List of Tables

DECLARATION

I declare that the thesis which I hereby submit for the degree of Doctorate in Philosophy (Information Technology) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

SIGNED: _____

DATE: _____

ABBREVIATIONS

AT	Activity Theory
ATIG	Activity Theory Interest Group
BCL	Boundary Crossing Laboratory
CHAT	Cultural Historical Activity Theory
CL	Change Laboratory
CoP	Community of Practice
COX	Company X
CSF	Critical Success Factors
DFD	Data Flow Diagrams
DIT	Department of Information Technology
DWR	Developmental Work Research
ELT	Expansive Learning Theory
GIT	Government IT
GITREP	Government IT Representative
GUI	Graphical User Interface
ICT	Information & Communication Technologies
IS	Information System
ISD	Information Systems Development
ISDM	Information System Development Methodologies
IT	Information Technologies
ITSP	Information Technology Solution Provider
LPP	Legitimate Peripheral Participation
MCST	Ministry of Communications Science & Technology
MTC	Ministry of Transport & Communications
NDP	National Development Plan
OECD	Organisation for Economic Cooperation and Development
PEX	Public Entity X
PIC	Project Implementation Committee
PID	Project Initiation Document

PIR	Post Implementation Review
PMS	Performance Management System
PMBOK	Project Management Body of Knowledge
PRINCE2	Projects in a Controlled Environment 2
RAD	Rapid Application Development
SOUR	Statement of User Requirements
UAT	User Acceptance Testing
VB	Visual Basic
WAN	Wide Area Network

ACKNOWLEDGEMENTS

A learning journey such as the one presented in this study could not have been possible without the significant contribution of several people. I therefore wish to take this opportunity to thank and acknowledge them for the success of this study. First and foremost, my supervisor Professor Hugo Lotriet who introduced me to activity theory (way back in 2006) and also guided me through the difficult and challenging five years of this study. The confidence that he had and instilled in me made it possible for me to see it through to the end.

I wish to also thank the three external examiners Professors' Carina de Villiers, Susanne Bødker, and Sampsa Hyysalo for their sincere and direct contributions to improving the quality and depth of this final product.

I was fortunate enough during the course of the study for having been at the right place in the right time when in 2007, I attended the IRIS30 conference which was held in Tampere, Finland. It was there that I met Dr. Mikko Korpela, who took a great interest in my study and also later introduced me to Professor Paul Nleya who is the chairperson of the Activity Theory Interest Group (ATIG) in Botswana. I thank Mikko for his interest and continued support of my work. Through Professor Nleya, I was allowed membership into the ATIG and was also fortunate to then participate in a seminar facilitated by Professor Reijo Miettinen on 'The foundations of activity theory and its application to the study of development of school' which was in April-May 2008 at the University of Botswana. This added immensely to my understanding of the basic activity theory (AT) concepts and more specifically, to their relationship to learning. The ATIG played a significant role in supporting my study as not only did the members attend the change laboratory sessions, but also assisted in the organisation of the sessions as well as the videography. For the videography, I wish to give special thanks to Nicodemus Merafhe, a member of the ATIG, who volunteered his time to take the video, edit it and provide me with video data set that I later transcribed for analysis.

This study would not have been possible without the approval by the Government of Botswana and more specifically, the approval by the then Ministry of Communications,

Science and Technology (MCST). Special thanks, therefore, go to the then Permanent Secretary of that Ministry, the late Marianne Nganunu, her deputy Mrs Alicia Mokone and the then Director of the Department of Information Technology (DIT), Mrs Joyce Mpete. Joyce not only facilitated the approval of the research, but also became an active participant in the study by according me time for interviews and also directly participating in the change laboratory sessions. I thank her especially for that support and also her expressed desire to see a change in Information System Development (ISD) practice that would result in sustainable development and deployment of information systems facilitated through learning. I strongly believe that the redesigned ISD framework for Botswana will go a long way to addressing that challenge.

Participants in this study were drawn from both the government and private sector. I wish to specifically thank representatives from the following government departments: Department of Agricultural Research, Ministry of Education and Skills Development, Botswana College of Distance and Open Learning (BOCODOL), Department of Curriculum Development, Department of Building & Engineering Services, Department of Water Affairs and the Department of Information Technology. The private sector companies that I wish to thank and acknowledge for their participation are: Consult IT, Corporate Business Solutions (CBS), De Chazal Du Mee Consulting (DCDMC), and Tata Consultancy Services (TCS). I specifically wish to thank Mr Dominic Ferguson (Consult IT) and his staff for agreeing to the extensive interviews and follow ups that were needed as part of the data collection.

Last but not least, I wish to thank my family (husband Dr Edson Tsiababa Selaolo (PhD) and sons Bokani and Karabo) for standing by me throughout the course of this study. They never once complained that between my work and studies I had very little quality time to spend with them, but instead, they encouraged me to carry on until completion. I reserve special and heartfelt thanks to Edson for not only assisting with the editorial work but also pushing me to focus and complete my studies. It is to him that I dedicate this work. His love and support have carried me through the challenges that this study presented.

ABSTRACT

Studies whose focus is finding solutions to practical IT implementation issues / problems such as slow systems uptake and meaningful work improvement are few. This thesis describes how IS practitioners from government and the private sector, together with users came together to redesign the current Botswana ISD work practice in order to address this shortcoming. The result has been the incorporation of activity-based learning and reflection in current ISD practice.

The study adopted Cultural Historical Activity Theory (CHAT) as the framework of analysis as well as the associated Developmental Work Research (DWR) methodology as the research method. An expansive learning cycle was stimulated through change laboratory sessions with participants from government and industry.

The general research question for the study is: '*How should ISD as a systemic work activity be carried out to facilitate effective learning?'* The four sub-questions the thesis focuses on are: '(1) *What constitutes Botswana's ISD practice or how is ISD currently practiced in Botswana?* (2) *What are the users and developers learning and is the learning effective?* (3) *How can current practice be improved in order to facilitate effective learning?* (4) *What do users and IS professionals learn when collaborating in the review and redesign of ISD practice?'*

The study was qualitative in nature and data collection was based on interviews, archival data, observations as well as data from change laboratory sessions. Data from the change laboratory sessions was video-taped and later transcribed for analysis. Though I used CHAT as the main theoretical tool for analysis of ISD and learning, I also used additional theoretical concepts on learning to assist with the analysis and redesign of new practice. These are concepts relating to two types of learning that are found in any setting or environment i.e. conscious / learning conscious learning and unconscious / task conscious learning as well as concepts relating to reflection-on action.

Analysis of learning in current Botswana ISD practice shows that current learning is not effective because it does not provide the right balance between conscious and unconscious learning. Current learning tasks are predominantly geared towards

unconscious learning. The solution to this practical learning problem, which constitutes improvement to practice, is the incorporation of activity-based learning and reflection through the introduction of learning evaluation checkpoints throughout the ISD process. Furthermore, during the collaborative redesign sessions it emerged that: 1) learning was collective and distributed agency and 2) learning was expansion of the object in multiple dimensions.

The study makes both theoretical and practical contributions. The theoretical contribution is through the application of learning concepts such as the two types of learning (i.e. conscious and unconscious learning) and expansive learning to the review, analysis and redesign of ISD practice with the participation of representatives from government and the private sector. In terms of the practical contribution, a new Botswana ISD practice model that incorporates activity-based learning and reflection has been designed, and findings from examination of the model suggest that it has potential to address current learning deficiencies and thus contribute to efforts of avoiding IS failures.

Key words: change laboratory, cultural-historical activity theory, information systems development, learning, reflection.

1 INTRODUCTION AND SCOPE OF THE RESEARCH

1.1 *Introduction*

This research study is my personal journey of learning and exploration. Ever since crossing over from 'formal' teaching (as a high school mathematics teacher) to being an Information Systems (IS) professional and involvement in Information System Development (ISD) initially as a programmer / analyst in a government environment and now as a consultant, I have often wondered whether a lot of issues around IS failures and slow system uptake by users could not be addressed through effective learning, that is learning not just about the final technical artefact that has been developed, but also the potential innovative capacity that the Information Technology (IT) tool brings into work practice improvement. Effective learning can be achieved, I believe, if the 'learners' are aware or conscious of the fact that learning is an outcome of the task or activity they are engaged in or even that they are engaged in a learning activity – which is certainly the case in a school environment. Hence the idea of this research study was born – to study learning in ISD and more specifically to explore how effective learning can be achieved within ISD.

The research was carried out in the context of a developing country, Botswana, which like most countries recognises the strategic value of Information and Communication Technologies (ICT) and their potential to spearhead socio-economic development. There is, however, a dearth of practical IS research in the country and this is meant to address that.

The research, which adopts the developmental work research methodology, uses cultural-historical activity theory (CHAT) principles and framework for analysing current Botswana ISD practice as a work activity. CHAT or activity theory (AT) was chosen as the framework of analysis because it combines concepts of work development with learning which fits well with my research interests. In order to retrospectively analyse the effectiveness of learning in current practice, I have adopted the view of Rogers (2003) and Malcolm et al., (2003) that effective learning can be achieved if we have the right balance between unconscious (task conscious) learning and (learning) conscious learning,

which they claim are the two types of learning that are found in any setting (i.e. work or school). This view is also consistent with the components of an activity as defined by CHAT, in that an activity comprises of conscious actions and unconscious operations (Jonassen and Rohrer-Murphy, 1999; Yamagata-Lynch, 2003; Engeström, 2003; Engeström and Sannino, 2010).

Furthermore, through a collaborative redesign effort between government and private sector representatives made up of IS professionals and users, a new ISD practice model is developed that seeks to enhance learning within current practice. Analysis of the learning that takes place during this redesign effort was performed using Engeström's (1987) expansive learning cycle.

1.2 *Botswana ISD Practice as context to the Research*

Before presenting the problem statement, it is essential that some background information is provided on Botswana to set out the (social) context. Botswana is a self-governing, independent country that attained its independence from British rule in 1966. It is a landlocked country, with semi-arid climate, spanning 582,000 square kilometers and borders Zimbabwe, South Africa, Namibia and Zambia. Botswana has had one of the fastest growing economies in the region and prides itself in prudent economic management. In order to achieve this, Botswana has since independence being guided by successive National Development Plans (NDP) that normally span a six year period. The guiding principles for these plans which echo the interest areas for this research (bolded part), are stated as:

> '*… all human beings are born free and equal in dignity and rights'; 'the right to development is a universal and inalienable right and an integral part of fundamental human rights'* ***; the human person is the central subject of development;****, 'human beings are at the centre of concerns for sustainable development'; and that 'sustainable development as a means to ensure human well-being, equitably shared by all people, today and in the future, requires that the interrelationships between population, resources, the environment and development should be fully recognized, properly managed and brought into harmonious and dynamic balance'.* (Botswana NDP9 (2003 – 2009), p. 13)

The starting point for this research is that even at the micro level of ISD projects the 'human person should be the central subject of development'. Therefore a by-product of the ISD activity should be 'human development' which can be achieved through an effective learning process. Amongst the major policy thrusts of NDP 9 was the issue of public sector reform through such programmes as Performance Management System (PMS) and computerisation intended to make the public service more efficient. In order to guide these computerisation efforts, Botswana developed a National ICT policy, which notes that:

> *'The Government of Botswana is committed to developing a National Information and Communications Technology (ICT) Policy that will build on recent government initiatives and assist in achieving Vision 2016. In keeping with Vision 2016, it is envisioned that the National ICT Policy will position Botswana for sustained growth in the digital age by serving as a key catalyst in achieving social, economic, political and cultural transformation within the country'.* (Botswana National ICT Policy, p.2, 2005)

The policy Vision states that:

> *'Botswana will be a globally competitive, knowledge and information society where* ***lasting improvement*** (bolding mine) *in social, economic and cultural development is achieved through effective use of ICT'.* (National ICT Policy, p.3, 2005)

In the context of the Government of Botswana (GoB), the responsibility to develop policy and standards for deployment of ICTs in government resides with the Ministry of Communications Science and Technology (MCST) and more specifically the Department of Information Technology (DIT). A typical ISD project in the Botswana government will normally follow the ISD process as defined by Korpela et al., (2002) i.e. with four key phases: analysis, design, build and implementation. All phases are supported by project and process management. In terms of the current ISD practice for large scale projects, Government departments often procure services of an independent consulting firm to carry out the analysis work. The analysis work usually entails business process review, review of any existing systems (i.e. manual / automated and if automated this would normally include a review of the underlying technology), requirements elicitation, requirements specification that includes information processing and management,

infrastructure, training and aspects of data conversion. This specification document, known as the Statement of User Requirements (SOUR), is written in a simple business, non-technical language and used as a basis for identification and selection of an IT Solution Provider (ITSP), to supply a package solution and associated customization / implementation services or to develop the solution from scratch, as would have been determined during the Analysis phase. Because of the nature of the analysis brief, in most cases the consulting team from the 'analyst firm' would necessarily include a subject-matter expert (e.g. a roads engineer, transport management economist etc.) to assist with the 'learning and understanding' aspects by the team. In some cases, the consulting team that was engaged in developing the SOUR is engaged to provide project management services that entail supervising the ITSP during the development and implementation of the solution. This situation arises mainly when the client wants to benefit from the technical ISD understanding of the 'analyst firm'. It's important to note that in terms of this model, it is possible that the 'analyst firm' and the ITSP may use different ISD methodologies and techniques. This in some instances presents a challenge for users as the technical 'mediating tools' may differ.

1.3 *Research motivation, problem statement and questions*

ISD projects provide a good opportunity for learning / development of all stakeholders on the nature of IS and its potential for work improvement as it involves or should involve broad and extensive stakeholder consultations. This position is supported by Avgerou (2000) when distinguishing between the 'software engineering' and 'social perspectives' of systems development:

> *'Viewed from a social perspective, the development process is an intervention in an organisation to change the technical means and the information available to people's work. Such a perspective of the systems development process emphasises the importance of understanding the social dynamics that accompany the building or adopting of the technical systems and the organisational and social change related with the systems development project.* ***What matters in this approach is the improvement of the capacity of people to perform their work tasks in the context of their organisation.*** (Bold mine, for emphasis)' (Avgerou (2000, p. 569))

The importance of learning in ISD cannot be overstated and Wastell (1999) contends that:

> *'… an effective learning process is critical to the success of ISD… inadequate and superficial learning lies behind much IS failure (Lyytinen and Robey, 1998) and that the major problem in ISD is "limited learning, i.e. the limited capability to reflect upon and reframe the institutional and cognitive grounds that support habitual ways of doing things" (Ciborra and Lanzara 1994)'.* (Wastell (1999, p.581-582)

Wastell (1999) points out that the socio-technical nature of IS projects contributes to their complexity, high levels of risk and uncertainty. This is in part due to the need to accommodate interests of multiple stakeholders and the exacting cognitive demands associated with such initiatives. Learning is therefore important to address the complexities in IS projects. On the issue of what the social actors should learn, Wastell (1999) states that:

> *'Normatively speaking, ISD is a process of organisational change in which IT systems are designed and deployed to enable more effective operational practices. To bring this about, the prevailing business paradigm must be questioned with goals, processes, and roles considered afresh in the light of new technological potentialities. Both IS professionals and users must engage in an intensive learning experience, the former to develop a thorough understanding of the business domain, the latter to reflect on current practices and to acquire an understanding of the potential of IT to transform how work is done'.* (Wastell (1999, p.582)

In the 21 years that I have been involved in ISD projects in Botswana and the region, where mainly structured techniques with a mix of participatory techniques have been used, it has not been obvious that effective learning takes place. The manifestation of this problem has been slow systems uptake and minimal work improvement. Though there may possibly be other issues contributing to slow systems uptake and work improvement, non-learning is deemed to be the most critical. This research posits that if indeed effective learning does take place, it should result in higher system uptake and higher levels of work improvement. Thus my research interest is in trying to first of all understand if the current ISD practice which involves IS users, 'analyst firms', and 'developer firms' is resulting in effective learning. My problem statement reads as follows:

> *'The current Botswana ISD practice provides limited opportunity for effective learning'*

The research question derived from the problem statement therefore reads:

> '*How should ISD as a systemic work activity be carried out to facilitate effective learning?*

In terms of the sub-questions for this research, the following therefore arise:

- *What constitutes Botswana's ISD practice or how is ISD currently practiced in Botswana?*
- *What are the users and IS professionals learning and is the learning effective?*
- *How can current practice be improved in order to facilitate effective learning?*

A related question that arises from the above is:

- *What do users and IS professionals learn when collaborating in the review and redesign of ISD practice?*

1.4 *Research design and methodology*

This is a qualitative research study which has adopted Developmental Work Research (DWR) as the research methodology. As is explained in Chapter 4, DWR has been deemed suitable for this research because it is an interventionist approach that is based on CHAT concepts.

The current Botswana ISD practice description is mainly based on data from a single case project, deemed representative of ISD projects in Botswana, which was one of two projects I was engaged in at the time. This facilitated access to the project documents as well as the necessary permissions to carry out the research. I have augmented the selected case data for the initial scoping with archival data from other government reports as well as data from an interview with a representative of the government department responsible for ICT policy coordination and advice, which I have referred to as the Government IT (GIT). Further data was obtained from two change lab sessions that were held with

government and private sector representatives to analyse current practice, redesign a new model as well as examine the model prior to its implementation.

The study includes a review of literature on both ISD practice and learning, which are the two specific areas of research interest. The concepts reviewed as well as examples from similar research are used to inform the analysis of the case with regards to both ISD practice and learning. I have used concepts relating to 'conscious' and 'unconscious' learning to retrospectively analyse learning actions / tasks found in current practice and hence to come to a conclusion regarding the effectiveness of current learning. I further analyse the historicity of current ISD practice using such concepts as ISD methodologies (ISDM), technology and types of applications, social actors etc which I obtained from literature on ISD practice. The research design framework is depicted in Figure 1.

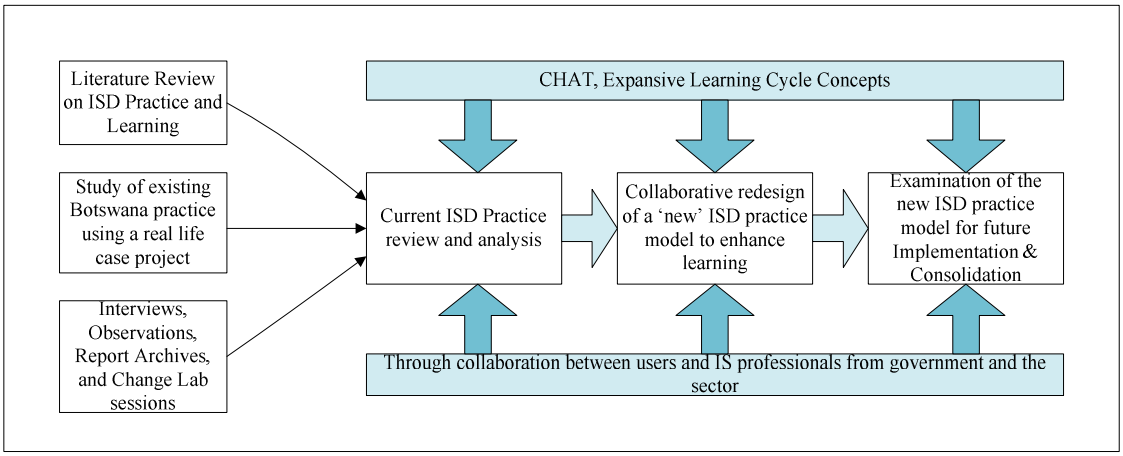

Figure 1: The research design framework

It is important to point out at the onset my combined roles; firstly as the researcher / interventionist, secondly as an IS professional who was involved in the case project as an analyst during the SOUR phase of the project, and thirdly as a Project Manager during the design, development and implementation phases of the case project. The subjectivity resulting from this involvement is acceptable for the choice of methodology and (critical) research paradigm adopted for this research (Pihlaja, 2005; Engeström, 2001). As much as possible during the course of the study I not only used my own personal observations

of ISD practice but also of other IS professionals in the field through interviews and discussions during the change lab sessions in order to enhance the validity of the findings.

1.5 *Contribution of this research*

My aim in conducting research was first and foremost to carry out research that is relevant and contributes to ISD practice. The practice contribution is threefold – firstly in providing an opportunity to Botswana IS professionals to reflect on current ISD practice as well as in redesigning and improving it. This is something that has never been done before in Botswana in a research context. Secondly, the redesigned ISD model is expected to improve practice as it is intended to enhance learning, thus contributing towards improved system uptake and avoidance of IS failure. Thirdly, the research study was expected to contribute towards learning of new ideas and concepts, such as activity theory by users and IS professionals who may not have been aware of these concepts, thereby closing the gap between academia and industry which is growing by the day.

In addition to contribution to practice, results of this research contribute to theory or scientific knowledge relating to information systems development practice and expansive learning studies. There are very few studies that address the topic of learning in ISD, especially based on studying practice in a developing country. A specific theoretical contribution is that the heuristic tool based on the two types of learning (i.e. conscious and unconscious learning) provides a useful tool to analyse learning retrospectively. A further contribution to knowledge is the lessons learnt in the application of activity theory concepts to the study of learning within ISD.

The methodology contribution is in also adding to other studies that have adopted DWR as a research methodology, especially in the context where both government and industry were viewed as participants. The challenges that such an undertaking brings is expected to inform future research. Furthermore, the use of a case project augmented by interview data rather than ethnography provides a new approach to carrying out such studies.

1.6 *Chapter and Content Analysis*

This research study is presented in seven (7) chapters with this introductory chapter outlining the scope, research context, objectives, and the research problem as well as motivation for the study. This first chapter also briefly introduced the research design and methodology as well as the contribution to practice and scientific knowledge (i.e. to theory and methodology).

The second chapter focuses on CHAT, which is the conceptual framework used to analyse current Botswana ISD work practice. The chapter surveys the historical development of activity theory starting from Vygotsky's original concepts of mediated activity to the work by his scholars Leontiev, Luria and others, through to the activity system and network of activities variations that were introduced by Engeström.

In Chapter 3, a literature review concerning the two specific areas of interest for the study is presented i.e. Information Systems Development practice and learning. The review covers key concepts and current thinking in these two subject areas and also provides examples of similar research.

In Chapter 4, the research design and methodology is presented. The chapter elaborates in detail the DWR methodology that has been adopted for this study. It also discusses the data as well as the theoretical concepts that were used for analysis for each of the research questions. The implications of my role as both researcher and IS professional who was involved as analyst and Project Manager for the case project is also discussed in this chapter.

The description of current ISD practice is provided in Chapter 5. The description is based on data from the case project, augmented by interview as well as archival documents. It is provided in the form of brief descriptions for each of the identified actions / tasks that constitute the current ISD work activity. The chapter also includes findings from the post implementation review that was carried out for the case project.

Chapter 6 presents findings and analysis of the epistemic learning actions following Engeström's expansive learning cycle. It elaborates on outcomes from the actions as well as the learning that resulted from those actions. More specifically, the chapter presents the new ISD practice model that incorporates activity-based learning and reflection.

The final chapter, Chapter 7, presents my final thoughts and conclusions on the study. It discusses the contributions as originally intended and what has actually been achieved. It also identifies areas for future research. My final thoughts are presented in the form of tracing my individual learning journey, which for me started 21 years ago when I moved from the classroom to the ICT industry.

2 THEORETICAL UNDERPINNING – CULTURAL-HISTORICAL ACTIVITY THEORY

2.1 *Introduction*

In this research study I use cultural historical activity theory (CHAT) concepts for analysis of both the ISD work activity as well as the learning that takes place during the practice collaborative redesign effort. Therefore, in this second chapter I present a brief account of CHAT from its cultural historical origins of the Vygotsky school to the activity system and network of activities developed by Engeström and is used in most mainstream activity based research.

2.2 *Activity Theory History*

Activity theory draws its roots from the philosophy of Kant and Hegel '… *which emphasised both the historical development of ideas as well as the active and constructive role of humans'* Leontiev (Jonassen and Rohrer-Murphy, 1999, p. 62). It is from this basis that the work of Vygotsky, and Engeström was developed, whose work forms the basis for the three generations of activity theory research (Engeström, 2001).

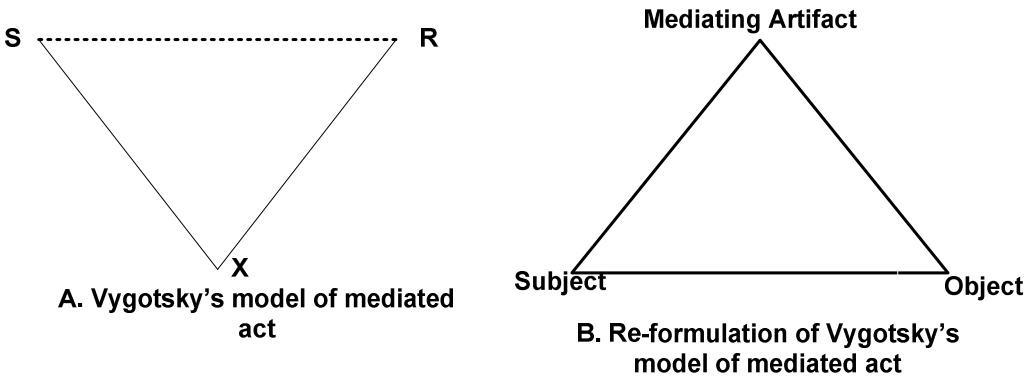

Figure 2: (A) Vygotsky's model of mediated act and (B) its common reformulation (Engeström (2001, p. 134)

The first generation of activity theorists, whose work and ideas were closely associated with the work of Vygotsky, focused extensively on the key concept of *mediation.* This was an attempt by Vygotsky to try and understand the relationship between individuals and their social environment. Vygotsky's theory was that individuals actively construct their understanding of

the environment while engaging in goal-oriented activities. According to Minick (1997) Vygotsky's motivation was that the traditional psychologists were incorrect in separating mind from behaviour in their efforts to investigate the flow of ideas, perceptions, and associations during activity. Vygotsky's contention about the separation of the study of human behaviour from mind and consciousness was that it was:

> *'simply the dualism of subjective psychology – the attempt to study a purely abstracted mind – turned inside out. It is the other half of the same dualism. There, there was mind without behaviour; here, behaviour without mind. And both there and here "mind" and "behaviour" understood as two different phenomena (Vygotsky, 1982, p.81).'* (Minick (1997, p. 119)

Activity theory was developed by Vygotsky's students and colleagues, including Leontiev and Luria, in the 1930s and early 1940s, to address this persistent issue of seeing mind and behaviour as separate and not as an integrated object of psychological research. This split between the Cartesian individual and the untouchable societal structure was addressed by these researchers through the insertion of cultural artefacts into human action.

Figure 2–A, is a pictorial representation of the relationship between stimulus (S) and response (R), which according to Vygotsky was transcended by '*a complex, mediated act*' and Figure 2-B, showing subject, object and mediating artifact is what is commonly used to represent Vygotsky's concept of cultural mediation of actions. According to Engeström (2001), based on this concept of mediation, we should no longer try to understand individuals in society outside of their individual agency in the use and production of artefacts nor outside of their cultural means. This therefore means that understanding the human psyche requires the understanding of object-orientedness of action.

The second generation of activity theory has centred on the work done by Vygotsky's student Leontiev (Engeström, 2001), who introduced the concept of collective activity in order to address a perceived limitation of the original Vygotsky model. The activity system as expanded by Engeström and incorporating the concept of a collective activity is shown at Figure 3 below.

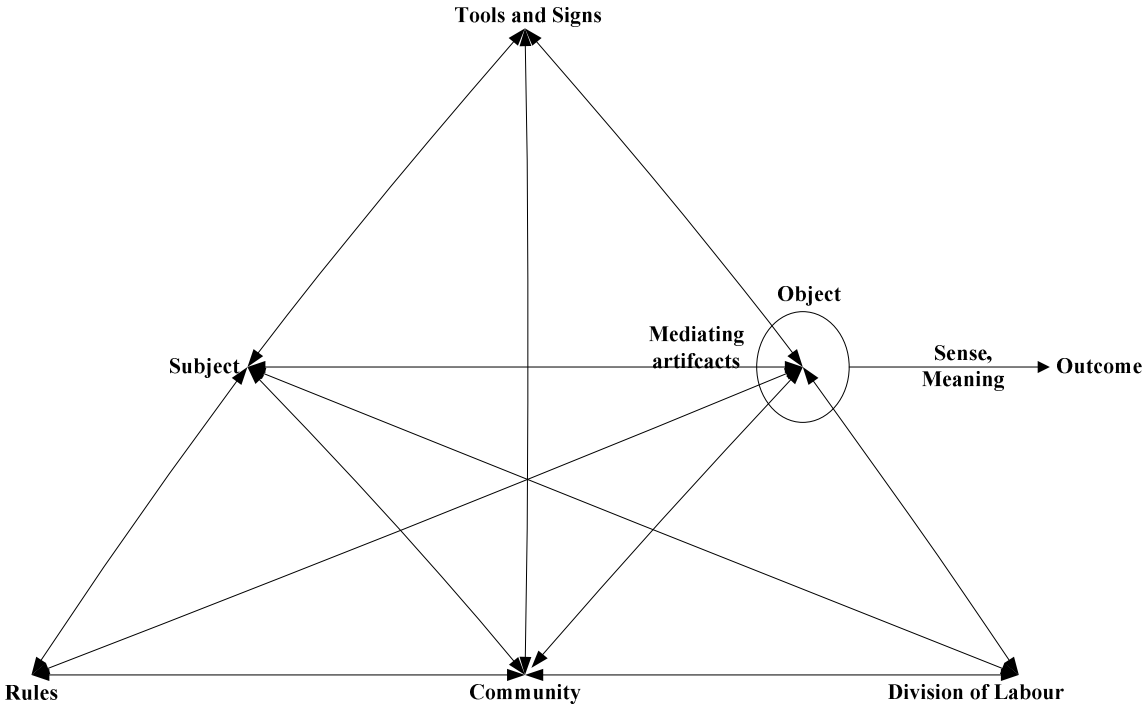

Figure 3: The Structure of a human activity system (Engeström, 2001, p. 135)

A further contribution by Leontiev was his contention that a subject's activity and its corresponding conditions, goals and means are the central link between the organism and its environment. According to Yamagata-Lynch (2003), these non-observable behaviours are linked to the observable behaviours of activity-action-operation in Leontiev's model as depicted at Figure 4.

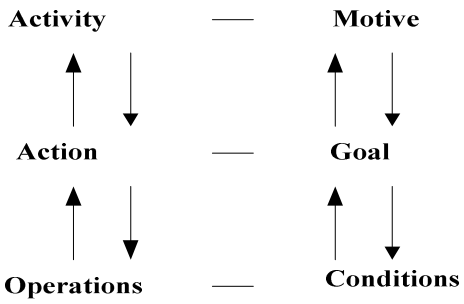

Figure 4: (Leontiev's) Hierarchical nature of activities, actions & operations (adapted from Jonassen and Rohrer-Murphy, 1999, p. 63)

In terms of this model by Leontiev and also as shown in

Table 1, the molar/central unit is *Activity*, which is collective in nature and driven by a complex motive of which the individual actors are not always aware of. Activity consists of goal-oriented individual actions in which the subject is consciously aware of what he or she is trying to accomplish (Engeström, 1990; Miettinen, 1998). So whereas activity is collective, actions are at an individual level. Actions are completed through automatic (or unconscious) operations influenced by specific conditions. And as shown in Figure 4, it is a two way transformation process between the levels whereby actions once internalised turn into automatic operations resulting from repeated practice and actions may be expanded into a collective activity. This research argues that activity / work practice needs the right balance between 'conscious' actions and 'unconscious' operations for there to be effective learning. This argument will be expanded further in the discussion on learning.

Table 1: Historical structure of activity by Leontiev (Engeström 1990, p. 197)

Unit	**Directing Factor**	**Subject**
Activity	Objective / Motive	Collective
Action	Goal	Individual or group, Conscious level
Operation	Conditions	Non-conscious

In the third generation of activity theory research, which was undertaken from the 1970s onwards as a result of interest in activity theory from outside the Soviet Union and the identified gap in understanding dialogue, multiple perspectives and networks of interacting activities, the concept of networks of activities was developed (Figure 5). One of the key contributors to the diversity, heterogeneity and multiple perspectives found in activity as a result of the cultural diversity found in society is Michael Cole (Cole, 1996 and 2005; Engestrom, 2001; Roth and Lee, 2007). The result has been that the unit of analysis of activity has been expanded to include the network of interacting activity systems.

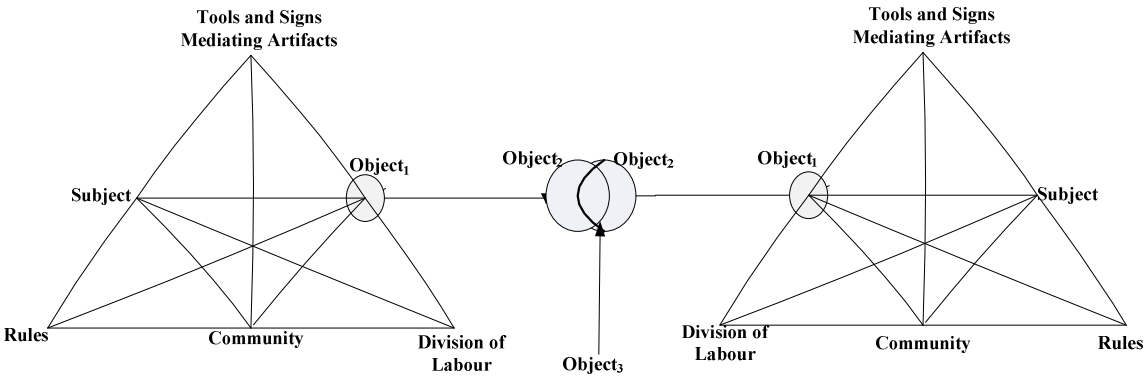

Figure 5: Two interacting activity systems (Engeström, 2001, p. 136)

The schematic representation in Figure 5 of two interacting activities shows the object moving from an initial state of unreflected, situationally given 'raw material' (i.e. object 1, e.g. the need for a system) to a collectively meaningful object constructed by the activity system (object 2, e.g. the system prototype) and finally to a potentially shared or jointly constructed object (i.e. object 3, e.g. a fully functioning system ready for testing). As shown, here, the object of activity is a moving target, which is transitional in nature.

On the basis of the foregoing historical analysis of the development of activity theory, Engeström (2001) identifies five key principles of activity theory i.e.

1) The prime unit of analysis is a collective, artefact mediated and object-oriented activity system, seen in its network relations to other activity systems
2) Activity systems have multiple voices which may result from the different actors engaged in the activity i.e. multivoicedness of activity systems
3) Activity systems are historical formations
4) Activity systems may be characterised by contradictions which act as sources of change and development
5) There is a possibility of expansive transformations in activity systems.

I will now discuss each of these principles in turn.

2.3 *Activity Theory – Key Principles*

2.3.1 Activity System as the Unit of Analysis

This first principle states that an activity can only really be understood and analysed through the components of the activity and its relationship to its network of activities. The components of an activity system (i.e. as depicted at Figure 3) are: Object (with a specific goal), subject, tools, rules, community and division of labour (Miettinen, 1998; Jonassen and Rohrer-Murphy, 1999; Yamagata-Lynch, 2003).

The *object* is the reason for, or basis on which the subject engages in an activity. Using an example of a blacksmith (subject) who uses a hammer (instrument) to mould a piece of iron (object), Engeström (1990) argues that at:

> *'... one moment the piece of iron is a shapeless chunk, at the other moment it is an identifiable, socially meaningful entity. Object is both "anything presented to the mind or senses" and "an end or aim" (Webster's Dictionary, 1987, p. 257). So the object is both something given and something projected or anticipated.'* (Engeström, 1990, p.170)

The object determines the *tools / artefacts* required to transform it into the desired outcome. Engeström (1990) in modifying Wartofsky's three level hierarchy of primary, secondary and tertiary artefacts which was modelled on Leontiev's hierarchical structure of activity , distinguishes between four types of artefacts i.e. the 'what', 'how', 'why' and 'where to' artefacts. The 'what' artefacts, which are similar to Wartofsky's primary artefacts, are fairly easy to notice and define as external physical entities e.g. a hammer required to mould a piece of iron. The first type of secondary artefacts is the 'how' artefact. These explain how a certain object is to be handled using the corresponding 'what' artefact (i.e. how should the hammer be used?). They are therefore partly visible and external but may also be internal (e.g. computer instructions and system procedures are external, but personal versions of these instructions and procedures remain internal and therefore invisible). The second type of secondary artefacts i.e. the 'why' artefacts are mostly internal and are only externalised from time to time through practical actions, gestures, words and symbols (e.g. mental explanatory model of climbing a ladder). They tell us why an object behaves in a certain way and hence justify the selection of the 'what' tools. Finally, the 'where to' artefacts that correspond to tertiary level artefacts on Wartofsky's

model are tools of vision and envisioning the future state of the object such as models, paradigms and aesthetic perception (Engeström, 1990; Miettinen, 1998).

The *subject* could be an individual or groups of individuals (in the case of a collective activity), who use the tools (i.e. internal or external) to transform the object into the desired goal or outcome. The expanded Engeström activity also includes the rules, community and division of labour components that add the socio-historical aspects of mediation omitted by Vygotsky. *Rules*, which could be formal or informal, regulate and guide the subject on the correct procedures for, and acceptable interactions with other community members. The rules can either constrain or liberate the activity. The *community* is the social group that the subject belongs to at the time of engaging in the activity. And finally, the *division of labour* refers to how the tasks are shared among the community members i.e. both the horizontal division of tasks and the vertical division of power and status.

2.3.2 **Historicity of Activity**

Activity systems represent historically identifiable ideal-typical qualitative patterns of work (Engeström, 1990, 2001, 2004; Korpela, 1994; Pihlaja, 2005, Daniels *et. al*, 2007). Victor & Boynton (1998) identify five categories or ideal types of work, which provide a useful way of identifying and analysing historical types. These are craft, mass production, process enhancement, mass customisation and co-configuration (Figure 6). Each type of work generates and requires a certain type of knowledge and learning and progress occurs through learning and leveraging of the knowledge produced into new and more effective types of work.

In craft, the work has low complexity and requires minimal specialisation for the 'individual' worker since it is mostly carried out in a small scale environment (e.g. workshop) with close supervision and tight control. The subject here is an individual worker or a small group of workers who use simple tools and tacit knowledge to transform the object. This tacit knowledge that the workers have about the product and processes derives from their personal intuition and experience about the customer, the product, the process and their use of tools. The tacit knowledge 'in the head' of an individual worker, is transferred to the other workers through on-the-job apprenticeship. The learning and experience that the workers acquire allows them to describe the details of how they do the work. The description typically covers the steps or

processes of how the products are made or the services delivered. The resulting articulated knowledge can be used to instigate the mass production of the former craft products or services.

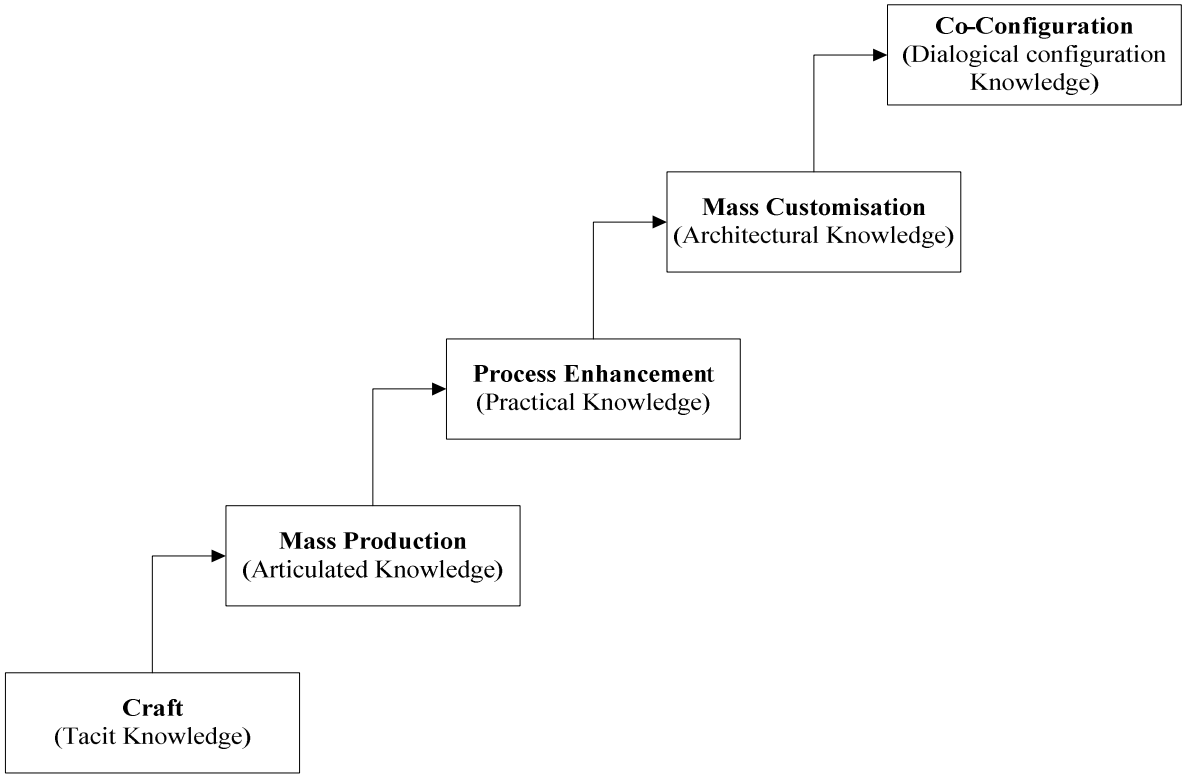

Figure 6: Historical Forms of work (adapted from Victor & Boynton, 1998)

Mass production is an upgrade to craftwork in that there is increasing complexity such as can be found in an industrial factory. But with increased complexity comes high centralisation and bureaucratic control because of the apparent need to maintain efficiency. The division of labour is more heirarchised due to the bureaucratic control and workers use the codified articulated knowledge from craftwork to carry out mass production. While knowledge is located "in the heads" of the workers in craftwork, articulated knowledge is located in the "firms head", in documents and standard procedures. The learning that results from mass production is practical knowledge which the workers accumulate from doing a job over and over again.

The third ideal-typical work type, process enhancement is based on horizontal team organisation. In this type of work, workers and managers work together as creative team players ensuring that every process contributes to satisfying the customer by achieving consistently higher quality. The work involved in process enhancement is highly specified and routine, with the routines defined by the workers themselves. In process enhancement workers are equipped with the tools and techniques to apply their practical knowledge in improving the tasks and processes. The learning that results from process enhancement is known as architectural knowledge.

Mass customisation is based on product modularisation and incorporates the concept of precision alongside that of quality in the customisation of a product or service to meet ever-shifting market needs. Mass customization requires a deep understanding of the product or service so that decisions can be made on which variations create value for the customer and which are simply a source of expense and difficulty. When the available variety of options is exhausted (i.e. to customise a product for specific user needs), practices of mass customisation may be renewed. This may include returning to craft work in order to lever out new information recognizing that no universal formula can meet all client demands for precision. Mass customisation has similarities with the fifth ideal-typical work type. The crucial difference between the two being that mass customisation tends to produce finished products and services whereas the emphasis of co-configuration is on continual development of the product or service.

Co-configuration is the emerging form of work which is characterised by collaborative co-design in complex multi-professional settings. It involves the creation of customer-intelligent products or services which adapt to the changing needs of the user. About this Victor and Boynton (1998) state:

> *'The work of co-configuration involves building and sustaining a fully integrated system that can sense, respond, and adapt to the individual experience of the customer. When a firm does co-configuration work, it creates a product that can learn and adapt, but it also builds an ongoing relationship between each customer-product pair and the company. Doing mass customisation requires designing a product at least once for each customer. This design process requires the company to sense and respond to the individual customers needs. But co-configuration work takes this relationship up one level – it brings the value of an intelligent and 'adapting' product. The company then continues to work with this customer-product pair to make the product more responsive to each user. In this way, the customisation work becomes continuous.*

> *[...] Unlike previous work, co-configuration work never results in a 'finished' product. Instead, a living, growing network develops between customer, product and company'.* (Victor and Boynton, 1998, p.195)

According to Engeström (2004) and Daniels et al., (2007), a precondition of co-configuration work is dialogue in which the parties rely on real-time feedback information on their activity. The interpretation, negotiation and synthesising of such information between the parties requires new, dialogical and reflective knowledge tools as well as new collaboratively constructed functional rules and infrastructures.

Co-configuration presents a twofold learning challenge to work organisations. First, co-configuration work itself needs to be learned (learning for co-configuration). Second, within co-configuration work, the organisation and its members need to learn constantly from interactions between the user, the product/service, and the producers (learning in co-configuration). These two aspects – learning for and learning in – merge in practice. Learning in co-configuration settings is normally distributed over long, discontinuous periods of time. It is accomplished in and between multiple loosely inter-connected activity systems and organisations and representing different traditions, domains of expertise, and social languages. The learning that takes place is therefore both personal and organisational.

The historical evolution of ISD can also be modelled using these ideal-typical types of work. For example in ISD there has been transformation from craft work development where the 'techi's' were involved with limited user involvement, to what is now termed agile development using such methodologies as Rapid Application Development (RAD). RAD represents a methodology where prototyping is used for co-configuration with users.

Another important point about historicity in activity systems is that it may take a long period of time to transform an activity system, and that the problems and potentials of any activity system can only be understood against its own history and how it has evolved over time. On how this history can be studied, Engeström (2001) suggests:

> *'History itself needs to be studied as local history of the activity and its objects, and as history of the theoretical ideas and tools that have shaped the activity. Thus medical work needs to be analysed against the history of its local organisation and against the more global history of the medical concepts, procedures and tools employed and accumulated in the local activity'.* (Engeström, 2001, p. 136-7)

In line with this thinking, in Chapter 3, I have presented a summary of the historical evolution of ISD practice globally and later on, in Chapter 6, I present the local historical analysis of current Botswana ISD practice.

2.3.3 **Multivoicedness of an Activity System**

Activity systems are historically and culturally made and as such they represent multiple layers, multiple viewpoints and multiple voices. Each component of the activity system has a different history that it brings into the activity system, thus adding to the multiple perspectives. The subjects and community members are different and have different perspectives on things; the division of labour introduces levels and positions of power and politics that may also result in different perspectives. This multivoicedness extends to the network of interacting activities and it can be a source of contradictions that may lead to the change and development of an activity (Virkkunen & Kuutti, 2000; Engeström, 2001). Multivoicedness is evident in ISD as a result of the different voices from the different actors (e.g. users, user management, and developers) involved as well as the interacting network of activities (e.g. user activity, user management activity, and developer's activity etc.). This brings in different perspectives to how ISD should be carried out.

2.3.4 **Internal contradictions**

On internal contradictions, Engeström (1987) identifies four levels of contradictions within an activity system. The *first* level or primary level contradiction arises as a result of the dual nature of commodities and therefore the tension between the use value and exchange value. This primary contradiction can appear in different forms and may be found in each component of the activity system. This implies that each one of the activity system components i.e. subject, object, tool, community, rules, and division of labour, will have an inner primary contradiction relating to its use value and exchange value. In terms of ISD, for example, there could be a primary contradiction between the costs of developing (i.e. exchange value) a solution versus the eventual benefits (i.e. use value) of that solution to the organisation and society.

The second level of contradictions or *secondary* contradictions appear between components of activity systems. This may arise when one of the components of an activity system acquires a new quality as a result of injection or introduction of a new element into it. This new element causes tensions and 'double binds' between elements of an activity system that may lead to change. For example, in ISD, there could be a secondary contradiction between the subject and the tools used if say for instance the adoption of new tools and techniques is not in consonant with the training of subjects who are expected to use them. This may lead to a 'double bind' situation whereby subjects are unable to proceed with the development since they can't articulate and apply the tools and techniques and yet also are not allowed to revert to what they know and have used in the past. Another example here would be a situation where, despite specific rules or standards existing, subjects implement the rules and procedures in an inconsistent manner. Tensions resulting from this contradiction may lead to a change of rules or a change of subjects.

The third level of contradictions are known as *tertiary* contradictions, and these are found '... *between the object / motive of the dominant form of the central activity and the object/motive of the culturally more advanced form of the central activity*' Korpela (1994, p. 81). This may manifest itself in the form of resistance to change from say, an old ISD practice rule to a new one. And finally, the quaternary or fourth level contradictions may be found between the central activity and its neighbour or interacting activities. A new ISD practice model, may for example cause tensions with other existing neighbour activities such as the subject-producing activity.

According to Engeström (2001), contradictions are not synonymous to problems or conflicts but rather represent historically accumulating structural tensions within and between activity systems which may result in change and development of the particular activity system. Figure 7 shows these four levels of contradiction in a network of activity systems:

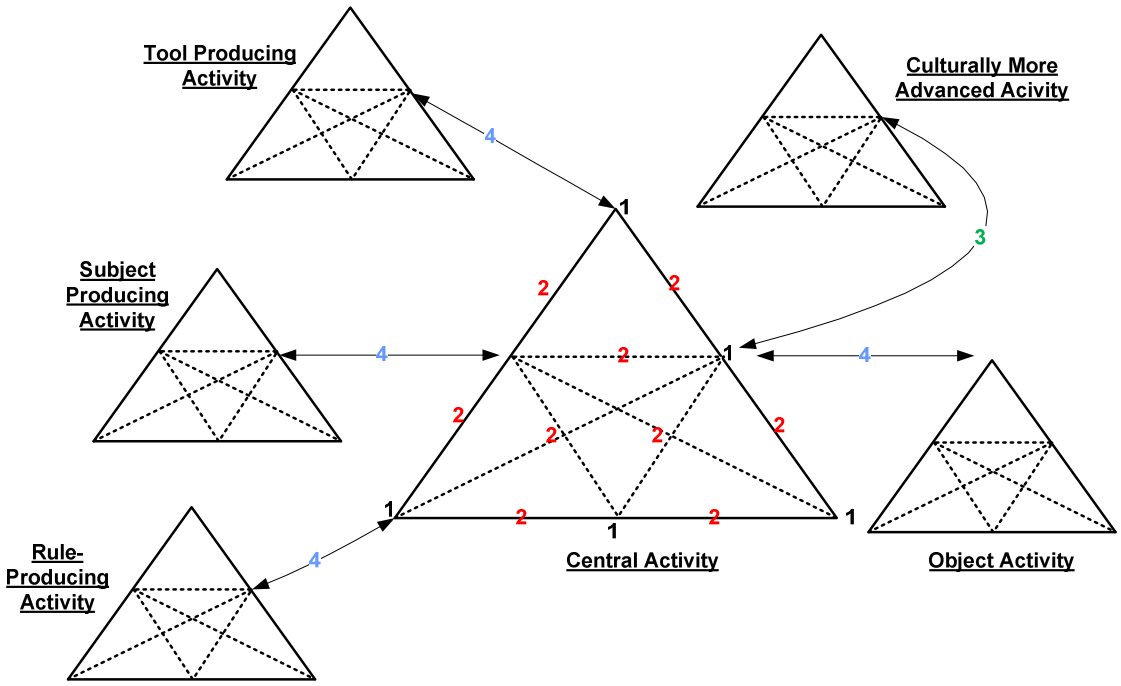

Figure 7: Four Levels of contradictions in a network of activity systems (Pg 4, Centre for Activity Theory and DWR Research, Helsinki website 03.08.2011)

2.3.5 Expansive transformation of Activity Systems

The fifth and final principle identified by Engeström (2001) as arising from the three generations of activity theory research is that of the expansive transformation of activity systems. This expansiveness arises as a result of aggravated contradictions and tensions within an activity system which may prompt the 'social actors' to want to bring about innovative change to the current activity system. This principle of expansiveness is based on Vygotsky's concept of the zone of proximal development which Engeström (2001) redefined as follows:

> *'It is the distance between the present everyday actions of the individuals and the historically new form of the societal activity that can be collectively generated as a solution to the double bind potentially embedded in the everyday actions (Engeström, 1987, p.174).'* (Engeström, 2001, p. 137)

2.4 *Conclusion*

CHAT concepts and principles have been presented in this chapter. The five CHAT principles as outlined in this chapter will form the basic framework for analysing current ISD work practice in Botswana. In chapter 3, I will discuss some of these concepts further as I look at Engeström's expansive learning theory which adopts and uses these CHAT concepts. In a similar manner, DWR, as the adopted research methodology will also be discussed further in chapter 4. These CHAT concepts provide useful tools to analyse and understand current Botswana ISD practice as it highlights issues relating to context, historicity and contradictions.

3 LITERATURE REVIEW ON ISD PRACTICE AND LEARNING

3.1 *Introduction*

This third chapter presents a review of literature on ISD practice as well as learning, which are the two central themes for this research study. Firstly I begin by looking at the historical evolution of ISD globally identifying factors that have influenced those changes over time. This analysis is important so as to inform the (local) historical analysis of ISD practice as suggested by Engeström (2001). The aim is to try and understand local historical changes to practice as set against the global context.

In the second part of the chapter I present a discussion on learning which begins with an examination of Rogers (2003) and Malcolm et al., (2003) heuristic model of learning that distinguishes between 'conscious' and 'unconscious' learning. I have adopted this heuristic model to analyse retrospectively the effectiveness of learning in current Botswana ISD practice. The section then moves on to look at the situated learning theories of Lave and Wenger (1991) and Engeström (1987). The discussion on these two representative (situated learning) theories leads to a conclusion that Engeström's expansive learning theory is most suited for this study and is therefore selected for the analysis of learning during the review and redesign of current ISD practice. Two examples from literature where Engeström's ELT was used in similar research have also been included in this section.

3.2 *An Activity based view of Information Systems Development (ISD)*

What is information systems development? Goulielmos (2004) who in reacting to IT systems failures states:

> *'… ISD should be seen as more than a technical activity. Rather it should be understood* ***as a complex social activity*** *that is influenced by the organisational context in which it takes place…In practice a variety of practitioners are involved in ISD. These people are described by using different terms – including analysts, programmers, developers, consultants, IT practitioners, and ISD professionals*(Bold – mine for emphasis).' (Goulielmos, 2004, p. 14)

This definition by Goulielmos also emphasises the fact that ISD is not just a technical activity, but rather that it is a socio-technical activity. It further highlights the heterogeneity of the activity as shown by the heterogeneous nature of the social actor's involved.

According to Mathiassen and Purao (2002, p.84), 'Curtis et al (1998), for example, saw the (information systems) development of computer-based systems **as a learning, communication and negotiation process** (boldness included for emphasis), calling for environments to become a medium for communication to help integrate people, tools and information. Waltz et al (1993) recommend active promotion of acquisition, sharing and integration of knowledge between team members'. This definition introduces an interesting element / dimension of learning to the socio-technical nature of ISD.

Korpela et al. (2002), on the other hand, emphasise the process aspect of ISD as well as include the fact that ISD should also be considered as an activity in CHAT terms:

> *'... the process by which some collective activity is facilitated by new information-technological means through analysis, design, implementation, introduction and sustained support, as well as process management.'*(Korpela et al., 2002, p.115)

In summary, these definitions highlight several key elements of ISD, namely, that it is a social (and collective) activity that involves a number of practitioners and social actors i.e. different user groups, analysts, programmers, developers, consultants, IT practitioners and ISD professionals. Furthermore, that is a learning, communication and negotiation process that involves analysis, design, implementation, introduction and sustained support, as well as process management that is intended to integrate people, tools and information within a given organisational context. The learning aspect that the Curtis *et al* (1998) definition (as found in Mathiassen and Purao (2002)) brings into the definition of ISD is particularly relevant to this research, since the focus is on the learning that takes place within ISD projects. I wish to refine the definition of ISD as provided by Korpela et al (2002) and use the refined version for this research i.e. ISD is,

> *'... the process by which some collective activity,* **with a learning impetus***, is facilitated by new information-technological means through analysis, design, implementation, introduction and sustained support, as well as process management* **to integrate people, tools and information within an organisational context***.'*

The application of this definition will become clear in later chapters as a new ISD activity with learning as an objective is designed.

3.2.1 Historical Evolution of Information System Development Practice in General and in Activity Theoretical Terms

ISD practice like any other process or activity has evolved over the years. The evolution has been influenced by a number of factors including technology evolution (e.g. from centralised mainframe systems to client-server and now n-tier environments; the ever increasing hardware processing and storage capacities; the change from character based interfaces to GUI and web-based interfaces; the WWW etc) and methodology evolution (since ISDMs are intended to organise and guide the work of systems developers). According to Jayaratana (1995) as quoted by Iivari et al., (2000) there were over one thousand (1,000) such methodologies and tools in the 1990s which were intended to improve practice in one way or the other. The number has since increased.

Table 2 provides a summary of the evolution of ISD practice as obtained from Avison and Fitzgerald (1988, 2003), Lyytinen and Welke (1998), Mathiassen and Purao (2002), Kautz et al., (2007). The summary is presented using four categories the period / era, ISDMs used, technology used, main features of the ISD practice and the social actors involved in the development process. Furthermore, at Figure 8, I have depicted the evolution of ISD practice in terms of who the social actors were for the different eras.

Global ISD practice has evolved from dependence and reliance on programmers during the 1980s when mainframes were the key technology feature for processing to heterogeneous teams comprising of social actors with varied technical and other business related skills. The major technology driving force in the current scenario is the internet with its potential for developing web-based applications as well as the proliferation of

package based solutions and thus reducing the need for bespoke development. This according to Kautz et al., (2007) has resulted in the development and use of agile methodologies or Rapid Application Development (RAD) methodologies that reduce development time and cost as well as lead to more meaningful learning by users.

In activity system terms, what has changed over time are the tools used, subjects and maybe even the rules, community and division of labour. The changes in tools resulted from the proliferation of methodologies since the early 1970s. And with changes in methodologies there have been changes in the subjects or social actor's involved. From the 1970s onwards there was more emphasis on the role and involvement of users in first of all specifying their requirements and later on in testing the final product. The rules changed as a result of the use of methodologies and the social actors that now needed to be engaged – new rules were introduced in order to provide 'structure' to the ISD process.

In chapter 6 when presenting the historical development of ISD practice in Botswana, I will analyse whether any of the areas as identified here have had the same influence on local practice i.e. looking at how the methodologies used, technology, main features of practice and social actors have changed over time in Botswana and how these changes compare with practice globally!

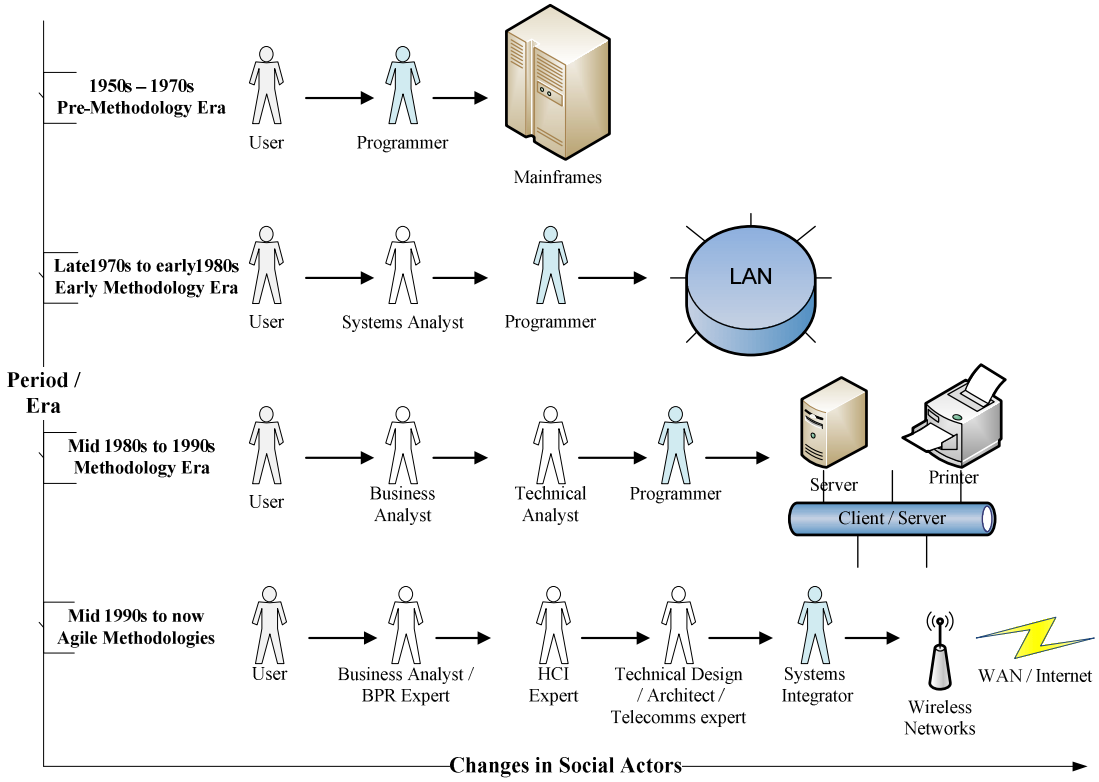

Figure 8: ISD Historical Evolution - Social Actors & Technology Changes (Adapted from Avison and Fitzgerald (1988, p. 11))

Table 2: ISD Practice Evolution by Time Period

ERA	ISDM / Tools	Technology & Types of Applications	ISD Practice	Social Actors / Subjects
1950s to 1970s - Pre Methodology Era	No explicit or formalized methodology in use **There were limitations in terms of the tools use to mediate and transform the object**	Mainframe-based computing; Batch processing & databases Mainly bespoke operational systems	No user involvement; Programmer driven development; No analysis and specification of user requirements; Little or no documentation; No documentation standards; High reliance on programmers **Very little interaction between the programmers activity system and the users**	Programmers **Very few voices**
Late 1970 and early 1980s - Early Methodology Era	Use of the Software Development Life Cycle and Waterfall Model **Methodologies now introduced as mediating artefacts**	Distribution; PC's; LANs; Graphics; Expert Systems; 4GL **New technology now available as additional mediating artefacts**	End-user computing and collaboration between professionals **Still not much interaction between users and IS professionals but instead more interaction internally within each activity system** **The use of methodologies also brought about changes to the rules**	Users; Systems Analyst; Programmer – with database design skills; Operator **More social actors involved with varied skills brings in additional voices and**

ERA	ISDM / Tools	Technology & Types of Applications	ISD Practice	Social Actors / Subjects
			and communities involved	**perspectives**
Mid 1980s to 1990s - Methodology Era	Widespread use of methodologies e.g. Structured, Information Modeling, Sociotechnical, Interactionist approaches etc. Iivari et al (2000) **A wider selection of methodologies was now available for selection and use as mediating artefacts**	Client-server based architecture	Bespoke development using various ISDMs	User; Business Analyst; Technical Analyst; Programmer; Operator **A further expansion of the actors introduces more network of activities and more voices**
Mid 1990s to now	More reflection of methodologies used; the use of Agile methodologies as suggested by Kautz et al., (2007); This includes the period that Mathiassen and Purao (2002c) term the	n-tier based architecture and Internet-based technology platform; Wide-spread availability of package solutions	Customisation of 'off-the-shelf' solutions **Integration of multi-media and component based applications; Most parts of the development process is outsourced; Web-based development**	User; Business Analyst / BPR Experts / Change Management Experts Technical Analyst / Artists / Telecomms experts; Programmers / System Integrators; Operator

ERA	ISDM / Tools	Technology & Types of Applications	ISD Practice	Social Actors / Subjects
	InterNCA era **More methodologies which have been influenced by the emergence of the internet**			**An even broader expansion of network of activities and social actors**

3.3 *Learning*

'O! this learning, what a thing it is. - W. Shakespeare, The Taming of the Shrew' (Sfard, 1998, p.4)

In this section on learning I provide a theoretical analysis on learning theories and concepts adopted for this study. A review of literature led me to a highly relevant discourse on two types of learning (i.e. formal and informal) that according to theorists (Rogers, 2003; Malcolm et al., 2003) are found in any learning environment or social setting. The interrelationship between the two has a major influence in the nature and effectiveness of learning in any situation (Rogers, 2003; Malcolm et al., 2003). I found the heuristic tool developed by Malcolm et al., 2003 which is based on attributes of the two types of learning useful in analysing the effectiveness of learning in current ISD practice because it does not lean towards any specific learning theory. In the first part of this section I present concepts related to effectiveness of learning that apply to the heuristic tool that I used to assess the extent to which the current Botswana ISD practice provides opportunity for effective learning.

The second aspect of learning that is relevant occurs during the collaborative redesign effort of current practice. In this regard I discuss situated learning theories that have been used in situated learning research similar to this one (Engeström, 2001; Boud and Middleton, 2003; Schulz, 2005; Daniels et al., 2007) i.e. Lave and Wenger's (1991), legitimate participation practice theory (which I will from now on refer to as LPP) and Engeström's (1987) expansive learning theory (which I will now refer to as ELT). I conclude from the discussion of Lave & Wenger's LPP and Engeström's ELT, that Engeström's ELT is not only relevant and appropriate for this study, but that it provides a much detailed and more easily applicable framework of analysis and hence I adopt it for use in this study.

I conclude this section by presenting two examples from literature where Engeström's ELT has been used to analyse learning. The two examples are representative of application of ELT in ISD as well as in a co-design project between government and industry which have similarities to this current study.

3.3.1 A Heuristic Model for Analysing Learning in Current ISD Practice

According to Merriam and Caffarella (1991, p.23), learning is a complex topic that '… *defies easy definition and simple theorising*'. It (is a theme that) has fascinated thinkers as far back as Plato (who is associated with rationalism and cognitive psychology) and Aristotle (who is associated with empiricism and behavioural psychology) and much of the research conducted today by psychologists and educators has been influenced by their thinking.

According to Merriam and Caffarella (1991) there are different learning traditions or thinking about learning each of which may include numerous learning theories. The value of these learning theories is, according to Merriam and Caffarella (1999) citing the work by Hill (1977), to 1) provide a vocabulary and conceptual framework for interpreting the examples of learning that we observe; and 2) provide pointers as to where to look for solutions to practical learning. Rogers (2003), on the other hand believes that the reason for the existence of different learning theories is a confirmation that learning involves an interaction of a number of elements i.e. the learner, context, process and the learning task or content of learning. He states:

> '*It is this fact – that learning involves a complicated interaction between a number of elements – which accounts for the number of different schools of learning theories such as behaviourist, the cognitive, the humanist, the social learning theories etc. each of them stressing one or at most two of these different components.'* (Rogers, 2003, p.13)

Rogers (2003), who believes that as human beings we learn all the time, argues that there is not just a single learning theory (i.e. behaviourist, cognitive, humanist, social learning) that explains learning, but instead distinguishes between two kinds of learning. He traces the argument for there being two kinds of learning from the works of Dewey as cited by Snook (2001), Freire (1972), the Organisation for Economic Cooperation and Development (OECD), and others. The distinction between his two types of learning is mainly based on the work by Krashen (1982), Vygotsky (1996), Hatch (1978) and others in their study of the development of language skills where two ways of learning a language are identified i.e. 'acquisition' (i.e. natural learning as demonstrated in the children's learning of first language) and 'learning' (i.e. formalised learning as exhibited in the learning of a subsequent language in a formal setting such as in school). Adopting this distinction, Rogers (2003), therefore distinguishes between two types of learning, 'acquisition learning or informal learning' and 'formalised learning' which he calls 'task-conscious learning' and 'learning-conscious learning' respectively. Malcolm et al., (2003) in their study where they sought to clarify the

meanings and uses of such terms as formal, non-formal, and informal learning found the same distinction being made in the 250 texts that they surveyed.

According to Malcolm et al. (2003), different authors offer a number of different but somewhat similar factors that distinguish formal and informal learning. The distinguishing factors provided by Rogers (2003) are that, acquisition learning is concrete, immediate and confined to a specific activity and therefore highly contextualised. Acquisition learning is also described as unconscious or implicit learning where the learners are not always aware that they are learning anything beyond the task at hand. Instead they are more focused on completion of the task and hence the name 'task-conscious' learning. As a result of its unconscious nature, acquisition learning may result in the accumulation of tacit knowledge or experience because of its subordination to some other activity. Acquisition learning is associated more with practical knowledge rather than theoretical knowledge because of its concern with the immediate and the concrete, and it involves imitation and play as well as exploration and discovery learning

On formalised learning Rogers (2003) states that:

> '*Formalised learning is very different from acquisition learning. As a learning of a language through formal instruction indicates (Krashen 1982), it is more concerned with general principles, with commonly accepted rules (grammar etc.) – it is decontextualised, applicable across a number of different contexts, and the learning processes also differ'*. (Rogers, 2003, p.22)

In formalised learning, learners are conscious of the learning that is that they are engaged in a learning task / activity or the task at hand is learning such as in schools (Davydov, 1999; Rogers, 2003; Malcolm et al., 2003). Formalised learning is facilitated and structured learning where the facilitator's role is to help make conscious the subconscious or task-conscious learning of the acquisition process and thereby enhance the learning. Both, acquisition learning and formalised learning may be found in both formal and informal settings and about this Malcolm et al (2003) state:

> *'Our analysis strongly suggests that such attributes of formality / informality are present in all learning situations, but that the interrelationship between such formal and informal attributes vary from situation to situation.'* (Malcolm et al., 2003, p. 315)

Learning theorists argue that both kinds of learning should be usefully brought together in different mixes in order to facilitate the most effective kind of learning (i.e.in both formal and informal settings) because each has advantages and disadvantages.

Formalised learning assists learners with the externalisation and sharing of tacit knowledge (i.e. making that which is internal external) as well as allowing for generalisation and application of concepts to new and different contexts which therefore forms the foundation for critical analysis. Acquisition learning, on the other hand facilitates the development of tacit knowledge and comprehension which we use to complete tasks. But for this tacit knowledge to be used more purposefully we need formalised knowledge because, according to Rogers (2003, 35) '... the knower doesn't know what they know and therefore cannot express it...' About this Engeström (2004) states:

> *'It is subterranean learning that blazes embodied and lived but unnoticeable cognitive trails that serve as anchors and stabilizing networks that secure the viability and sustainability of new concepts, models and tools, thus making the divided multi-organisational terrains knowable and livable'.* (Engeström, 2004, p. 137)

Acquisition knowledge is also considered to be at the core of the development of individually preferred learning styles e.g. to be activists or reflectors, to be theorists or experimenters. It, however, can also create barriers to learning, one of these barriers being the self-horizon syndrome ("I'm not a science person –can't think in that way"). Furthermore, acquisition learning has been found to be less likely to lead to critical reflection on experience than formalised learning. The conclusion therefore is that a combination provides the benefit of the advantages of both while at the same time compensating for limitations of either. Rogers (2003) makes the point that bringing in formalised learning into acquisition learning should be an objective of learning facilitators. He states:

> *'To engage in task-conscious learning through specific activities (tasks) alone without making conscious the conclusions which such exercises demonstrate is to render these activities (despite all the acquisition learning accomplished) less than fully effective.'* (Rogers 2003, p. 36)

I agree with this point completely as it actually fully captures my concerns on the effectiveness of learning in current Botswana ISD practice. The practice should not just be concerned with the end-product, but also the learning that takes place during the development of the product. Furthermore, there should be opportunities provided during the development process for critical reflection on the learning that takes place.

Malcolm et al. (2003), further argue that it is important to be able to recognise and identify these attributes of formality / informality in any learning situation and therefore understand their implications. It is in identifying and knowing them that one is able to ensure the

appropriate balance between them to enhance effective learning. They therefore propose a heuristic model / device categorised into four main areas (i.e. Process, Location and Setting, Purpose and Content) to be able to do so. Their characterisation of these four areas is very similar to that provided by Rogers (2003). Table 3 is a summary of Rogers (2003) and Malcolm et al.'s (2003) ideas on common attributes of acquisition and formalised learning which can be used as a heuristic model for analysing learning in any environment. This also includes what is recommended as the ideal for achieving effective learning, which I support. I use this model in Chapter 5, to analyse learning effectiveness in current ISD practice.

Table 3: Acquisition Learning and Formalised Learning Summary

Aspect	**Acquisition Learning**	**Formalised Learning**	**Recommended Mix of Acquisition and Formalised Learning**
Learning Environment / Location and Setting	All life situations, informal environments - contextualised	Schools, formal learning environments - decontextualised	In both formal and informal environments
Learning objective / Purpose	Unconscious of learning but conscious of the task at hand; Work is the activity and learning is only incidental to the activity	Conscious of learning since learning is the task; Learning is the activity.	Should have both unconscious and conscious learning as objective; Whether in formal school environment, workplace or other where we are engaged in a specific task / activity – we must not only be conscious of the task but also be conscious of the learning as we carry out that task.
Content of learning	Practical – concrete and specific, situated learning	Theoretical – general concepts	Combine practical with theoretical
Type of knowledge created	Tacit Knowledge and experience	Explicit knowledge	Integrate and develop both types of knowledge i.e. tacit and explicit
How its achieved	Achieved through play, exploration, and imagination	Achieved through structured learning events	Combine structured learning with play, exploration, imagination and reflection
Method of evaluation	Self assessment; Is not reflective and is less	Evaluation of application of the general concepts;	Combine self assessment with evaluation of

Aspect	Acquisition Learning	Formalised Learning	Recommended Mix of Acquisition and Formalised Learning
	likely to lead to critical reflection on experience than formalised learning; May tend to assist conformity rather than individuation	Allows for reflection	application of general concepts. Also provide for overall reflection.

3.3.2 **The Case for Situated Learning for Analysing the Collaborative Redesign effort**

This study is concerned with learning at work or in practice, the practice in this case being ISD. I have therefore chosen to take the social / situated learning view to learning as it affords me the opportunity to study learning as an integral part of what we do when developing systems. My concerns as articulated in the introductory chapter are centred on meanings people make as they are engaged in practice, not divorced from it. This unity in the way in which I conceptualise learning therefore points to the use or adoption of situated learning theories for this study.

Situated practice based learning theories grew out of the desire to address, mainly, the dichotomy presented by traditional theories that separate the mind from human action or behaviour. The major premise for these (situated learning) theories is that it is not possible to separate a person's acting from the social environment of the activity itself (Rogoff and Lave, 1984; Lave, 1988; Brown and Duguid, 1991; Chaiklin and Lave, 1993; Lave, 1996; Schulz, 2005). The concern of situated learning theorists is with everyday activity as a social and historical process. They therefore view relations among person, activity, and situation, as a single encompassing theoretical entity – as the unit of analysis (Lave & Wenger 1991, 1996, Engeström (1990, 2001), Brown and Duguid (1991). They argue that situated activity involves changes in knowledge (or knowing) and action, and this is the cornerstone of learning. When we study and analyse peoples involvement in practical action in the world, as this research study is doing, we therefore analyse learning. Learning is therefore considered as participation in practice (Brown and Duguid, 1991; Lave 1993, 1996).

Common premises among situated theorists are based on their disagreement with four specific positions offered mainly by the most dominant learning theory, i.e. cognitive theory (Lave 1993; Brown and Duguid, 1991; Schulz 2005). The first and main issue, as mentioned earlier, deals with the separation of learning from other forms of activity and thus the distinction between learning and development. The cognitive theorist's epistemology is that learning precedes development and that knowledge is a collection of real entities, located in people's heads, and that learning is a process of internalising those entities. Situated learning theorists find this position very difficult to explain, because it assumes that '... actors' relations with knowledge-in-activity are static and do not change except when subject to special periods of "learning" or

"development"' (Lave, 1993, p. 12). Their view is that knowing and learning is engagement in changing processes of human activity – learning cannot be separated from development since they occur together.

The second issue concerns the limited view about learning being transmission or transfer or internalisation of existing knowledge with no reference to how new knowledge is created and what constitutes "knowing" at any given point and in varying environments and situations. If learning is simply a transfer of knowledge then how does one explain knowledge creation during active engagement in activity? There is ample evidence in literature that knowledge is created during activity (Lave, 1993; Engeström, 1993; Keller & Keller, 1993; Suchman and Trigg, 1993). The major idea behind Vygotsky's (1978) concept of the zone of proximal development is that people can learn to do things beyond their 'developmental stage' through assistance or collaborative efforts rather than individual action and that the collaborative 'doing' may result in something completely new. As Lave (1999) puts it:

> *'... part of what it means to engage in learning activity is* extending *what one knows beyond the immediate situation, rather than involuting one's understanding "metacognitively" by thinking about one's own cognitive processes. Doing and knowing are inventive in another sense: They are open ended processes of improvisation with the social, material, and experiential resources at hand.'* (Lave, 1999, p. 13)

The third issue associated with cognitive theory is the assumption that processes of learning are universal and that both knowledge and those acquiring the knowledge (i.e. the learners) are homogeneous. The basis for disagreement with this position is based on the fact that different actors are engaged in activity together and there can be no two actors who are the same in activity – in fact actors bring their individuality, culture, 'knowing', and motives into activity. Therefore there is no homogeneity of knowledge and learners according to situated theorists. The conclusion therefore is that learners and knowledge are heterogeneous and not homogeneous as suggested by cognitive theorists.

The fourth and final issue where situated theorists have a different view on learning is concerned with what is termed the 'failure to learn'. Traditional theorists attribute the failure to learn to the inability or refusal on the part of an individual to engage in learning. But the view offered by

situated theorists is that failure to learn is normal in social locations and processes because of the nature of the tasks and the environment within which the learning occurs (Lave 1993). In such contexts issues such as communication mismatch between the different voices represented in activity could contribute to non-learning (e.g. between patients and doctors as found by Engeström (1993)), and limitations and access for observing and learning from others as described by Hutchins (1993). The context of learning provides different situations which may contribute towards failure to learn and so it cannot necessarily be attributed to an individual's inability or refusal to engage in learning.

In summary, then, the common position of situated theorists on these four issues is that (1) We learn as we engage in activity – learning cannot be separated from activity; (2) Learning is not simply a matter of knowledge transfer from a 'knowing' individual to those who do not know, but knowledge undergoes construction and transformation in activity; (3) Knowledge and learners are heterogeneous – the different actors engaged in activity bring their different 'knowing' into activity and use that to construct new knowledge; and (4) Learning in activity can best be achieved by a focus on the conditions for learning and not on the learner's refusal to learn or effective learning can be achieved through providing a conducive environment for that learning to occur.

3.3.3 **Two representative practice based theories**

In this section I provide a brief theoretical discussion on two representative practice based theories i.e. Lave & Wenger's (1991) Legitimate Participation Practice (LPP) model and Engeström's (1987) activity theory based model of expansive learning. The selection is based on the fact that they are the two most prominent in current discourse on practice based learning (Brown and Duguid (1991), Virkkunen and Kuutti (2000), Lave (1996), Engeström (2001), Jarviari & Poikela (2001), (Bould (2001, 2003), Billet, Bould & Solomon (2003), Bould and Middleton (2003), Schulz (2005), Daniel et al., (2007), Hill et al., (2007), Engestrom and Sannino (2010), and that they offer interesting alternatives to studying learning in practice. Furthermore, though both are based on Vygotsky's concept of mediation and agree on the concept of collective as opposed to individual activity, they offer contrasting and interesting views on the unit of analysis i.e. community of practice vs. network of activities.

Engeström (2001) provides useful guiding questions to structure the generic understanding of theories on learning. I have adopted these questions for the theoretical review of the two learning theories i.e. Lave & Wenger's LPP theory and Engeström's expansive learning model. The questions that will guide the discussion are, therefore, as follows:

(1) What is learning according to the theory?
(2) Who is learning?
(3) What triggers the learning – Why are they learning?
(4) What is learned or what is the content of learning?
(5) How do they learn - How is learning achieved?

3.3.4 **Lave and Wenger's – Legitimate Peripheral Participation**

Lave and Wenger (1991) developed their theory on learning as situated practice based on their study of Vai and Gola tailors' apprenticeship in Liberia, West Africa. This was an ethnographic study that was carried out during the period 1973 to 1978. The study was prompted by their disagreement with Scribner and Cole's (1973) two sided model of formal/informal education. The first concern had to do with the common characterisation between formal / informal education where formal "out-of- context" education or learning was viewed to take place in schools or formal settings and informal "context-bound" education was viewed as taking place in informal places (or workplaces), the former being viewed as having positive value or being the hallmark of good learning and the latter being viewed as having negative value.

The second issue of concern, in terms of the position held by cognitive theorists, was that creative activity and production of new "knowledge" could only happen in formal learning environments i.e. schools. Other forms of learning e.g. apprenticeship were said to only reproduce existing practices, with no new "knowledge" being created. After extended periods of observation during the field study, Lave and Wenger (1991), Lave (1993) concluded that the learning that took place during apprenticeship was much more complex than originally thought and conceptualised by cognitive theories. The learning was beyond the reproduction of existing practices with the possibility of new knowledge being created. It included much more than just learning the practice of making trousers. It included, amongst others, the learning of relations among the major social actors i.e. clients, masters, other apprentices; the learning of the different

trouser needs of their clients by social categorisation; and learning how to grow and mature as they became masters in the craft of making trousers.

Legitimate Participation Practice is said to be an analytical tool for,

'... understanding learning across different methods, different historical periods, and different social and physical environments ... It makes the conditions of learning, rather than just abstract subject matter, central to understanding what is learned' (Brown and Duguid, 1991, p. 48)

Learning according to this model is from an insider view, as part of participating in a community of practice (CoP). Knowledge is not transferred and learners do not construct abstract, individual knowledge. Instead, learners learn how to function in a community e.g. of tailors, lawyers, information system professionals, information system users, midwifes, etc and hence adopt that community's culture, norms, subjective viewpoint and language (or terminology used in the craft!). The knowledge they acquire relates mainly to the ability to behave as a community.

According to LPP, learning is therefore best understood in terms of community formation and changing personal identities, the central concern being learning how to become a practitioner rather than learning about practice. This is achieved within the community of those that are engaged in that practice. Another key concept in LPP is that of how newcomer's participation could legitimately grow in from the periphery as a result of developing understanding of the community social relations. Therefore, the most important aspect of learning is to provide the newcomer access to the community so as to legitimate their participation (Brown and Duguid, 1991; Schulz, 2005).

What then are highlighted in terms of Lave & Wenger's theory by Engeström's guiding questions posed earlier?

1. **What is 'situated' / practice learning according to the theory?**

   Learning is being part of a community of practice and learning how to become a practitioner. Learning is a process that takes place as a result of participation in a

community of practice and not in an individual's mind. Learning in this context is mediated by the different perspective as offered by the different participants.

In ISD, for example, a community of practice could be a group of users or developers. The interests of a group of users could be in learning how to use a specific module or system functionality. Therefore a user would learn through participation in activities that are carried out by that group. The situatedness of the learning would therefore be in participating in the group activities.

Another example would be that of the ATIG (Activity Theory Interest Group) who are a community of practice whose interest is in sharing knowledge about activity theory and its application. The learning that takes place within the ATIG is therefore situated and is specific to a particular subject, in this case activity theory. Participants learn by belonging to the ATIG and not outside it.

2. Who is learning?

> '*It seems that the tailors and law participants, as subjects, and the world with which they were engaged, mutually constituted each other.*' (Lave, 1996, p. 157)

Learning is by the community (i.e. the tailors, their masters, and clients) and not just the individual participant and as such the learning is distributed among coparticipants. In an apprenticeship, for example, the community of practice may comprise of apprentices, young masters who themselves have apprentices, and masters who may have apprentices that have become masters. Participation in practice takes greater supremacy than individual transformation, for it is in participation that the learning occurs. Though the individual participants are also transformed, the community of practice reproduces itself through the formation of apprentices and is thus also transformed (Lave and Wenger, 1991). In LPP, knowledge resides in the community of practice and thus it is the CoP that learns.

According to the LPP theory then, in a school context, learning would be distributed amongst all the colearners which in this case would be a group of students studying the same subject. But this learning can only occur if the teachers, students and other participants participate fully in the learning activity. In a work / organisational setting, learning would be by all those that participate in a specific work activity / process and again the learning would occur with increased participation by individual participants. In a workplace those that learn would be those informal groups that are bound together by a shared expertise and passion for a joint enterprise e.g. engineers engaged in deep water drilling, consultants who specialise in management of IT project, or receipting clerks in a large water utility. These groups would therefore learn from the sharing of knowledge and experiences e.g. for the managers of IT projects they could share on how to ensure comprehensiveness in user acceptance testing. Through this sharing members of this community would learn about how to improve on their skills of managing IT projects.

3. What triggers the learning and why are they learning?

> *'The telos of tailors apprenticeship in Liberia and the legal learning in Egypt was not learning to sew or learning texts, not moving towards more abstract knowledge of the law or separation from everyday life into specialisation of production skills or special generalisation of tailoring knowledge. Instead, the telos, might be described as becoming a respected, practicing participant among other tailors and lawyers, becoming so imbued with the practice that masters become part of the everyday life of the Alley or the mosque for other participants and others in turn become part of their practice. This might even be a reasonable definition of what it means to construct "identities in practice".'* (Lave, 1996, p. 157)

Learning is part of a social process of crafting the learner's identities (i.e. of who they are as actors, tailors, lawyers, users, IS professionals etc and becoming more knowledgeably skilled). Learning is triggered, for the apprentice, by the desire to attain or learn some sort of skill or trade e.g. becoming a tailor, lawyer, system user, IS professional and thereby craft their own identity in the community of practice.

In an organisational context what triggers the learning is the desire to do well in a specific skill or trade e.g. user learning would be triggered by their desire to master the use of a specific application.

4. What is learned?

Knowledge in the CoP is not just the technical knowledge of say tailoring or becoming a lawyer, it is also knowledge about relationships amongst participants, the activity itself and other activities that interact with that CoP. Therefore, even though what is learned according to LPP is mainly how to become a practitioner, there is also learning about practice. The contents of learning or the curriculum unfolds as one is engaged in practice and in the case of apprentices they learn more from other apprentices (or their peers) than from their masters because of the distant relationship that may exist between an apprentice and his / her master.

In school what is learnt is not just the specific subject area, but also stuff around the teaching and the learning. Students learn about how the school is run, the relationship between teachers and students, teachers and school management, students and school management. All of these are learned as students are provided the right conditions to learn about what it means to be in a school and to participate in learning.

In an organisational setting participants in a CoP would not just learn a specific skill or trade, but, depending on the learning conditions, they would also learn about the processes involved e.g. in ISD the learners would learn about the ISD process, in addition to learning how to use specific aspects of the system.

5. How is learning achieved? How do they learn?

Learning is achieved through participation in a CoP, and an individual learner moving from the periphery to the centre of the CoP as one begins to understand the social relations and culture of the practice. Being a legitimate participant in a CoP for an extended period of time provides learners with opportunities to make the culture of practice theirs. This provides a learner with an understanding of,

> *'... who is involved; what they do; what everyday life is like in the CoP; how masters talk, walk, work, and generally conduct their lives; how people who are not part of the community of practice interact with it, what other learners are doing; and what learners need to learn to become full practitioners. It includes an increasing understanding of how, when, and about what old-timers collaborate, collude, and collide, and what they enjoy, dislike, respect, and admire. In particular, it offers exemplars (which are grounds and motivation for learning activity), including masters, finished products and more advanced apprentices in the process of becoming full practitioners.'* (Lave & Wenger, 1991, p 95)

The sense of belonging as one moves from the periphery to the centre is what enhances the learning. Mastery of knowledge and skills is therefore attained by the learner or apprentice as they move toward full participation in the sociocultural practices of a community.

A community of practice e.g. of nuclear physicists, cabinet makers, high school classmates, IS professionals, users etc learns through greater participation in whatever activity they are engaged in. It is therefore important that the right conditions for learning should be provided in order for learning to occur i.e. conditions that allow learners to become 'insiders' and to function in a community of learners. The conditions of learning should be such that learners learn how to become say nuclear physicist's as opposed to abstract knowledge about nuclear physics. So more practical activities about that as well as situated / contextual learning seems to be what LPP is advocating for.

3.3.5 **Engeström's Expansive Learning Theory**

I now turn to the expansive learning theory which was developed by Engeström in 1987.The theory draws its roots from the CHAT concepts already discussed in Chapter 2 which are based on the foundational work of Vygotsky (i.e. his concepts of mediation and the zone of proximal development), Leontiev (i.e. the concept of collective activity and the hierarchical nature of activity), Il'enkov (i.e. the dialectical concept of contradictions in activity) and Davydov, who were key figures in the Russian school of CHAT (Daniels et al, 2007; Engeström and Sannino, 2010). Davydov's contribution is identified with his development of a theory of learning activity based on the dialectical method of ascending from the abstract to the concrete. According to

Davydov's theory, ascending from the abstract to the concrete is achieved through six (6) ideal-typical epistemic or learning actions. The first action is transformation of task conditions so as to reveal the universal relationship of the object under study. This is followed by modelling the identified relationship using material, graphic or literal representation. The third learning action in Davydov's theory is transformation and study of the properties of the relationship in their pure form, which is then followed by the construction of a system of particular tasks that are resolved by a general mode. The last two learning actions are the monitoring of the performance of the preceding actions and evaluation of the assimilation of the learning task. Engeström's theory of expansive learning proposes similar ideal-typical learning actions for achieving learning, albeit addressing learning outside the school and classroom environment.

The theory of expansive learning also draws on Bateson's (1972) conceptualisation of levels of learning, particularly the notion of *Learning III* and the associated concept of *double bind* or dilemmas which cannot be resolved through individual action but through joint activity. The engagement in joint activity could then result in the emergence of a completely new activity. Another theorist who has contributed towards the development of expansive learning theory is Bakhtin (1982), who is identified with the concept of multivoicedness. Expansive learning is viewed as a multi-voiced process of debate, negotiation and orchestration resulting from the heterogeneous nature of the social actors.

ELT as stated previously rejects the acquisition metaphor of learning as suggested by cognitive theory, but it also rejects the participation metaphor as presented by Lave and Wenger (1991) which does not deal adequately with the formation of theoretical concepts during activity (Engeström and Sannino, 2010). The theory of expansive learning introduces the major concept of expansion during participation in activity (Virkkunen and Kuutti, 2000; Daniels et al., 2007; Engeström and Sannino, 2010). According to Daniels et al (2007):

> *'By expansive learning we mean the capacity of participants in an activity to interpret and expand the definition of the object of activity and respond to it in increasingly enriched ways... Expansive learning involves the creation of new knowledge and new practices for a newly emerging activity: that is, learning embedded in and constitutive of qualitative transformation of the entire activity system... This type of learning may be seen as distinct from that which takes place when existing knowledge and skills embedded*

> *in an established activity are gradually acquired and internalised, as in apprenticeship models, or when existing knowledge is deployed in new activity settings or even when the new knowledge is constructed through experimentation within an established activity. All three types of learning may take place within expansive learning but these gain a different meaning, motive and perspective as parts of the expansive process.'* (Daniels et al., 2007, p. 523)

Engeström (2001) concretised his ideas on expansive learning by using a medical care intervention example from a case study in Helsinki, Finland. The issue of concern identified by the approximately sixty (60) physicians, nurses, other staff and management from primary care health centres and hospitals responsible for children's health in the area, was mainly that of lack of coordination and communication between the different care providers. Through the assistance of a group of researchers the Children's Hospital decided to initiate a collaborative redesign effort that would result in more collaborative working between the different care givers. The collaborative exercise was carried out through ten (10) Boundary Crossing Laboratory (BCL) sessions which were completed in February 1998, and the environment was setup such that all subjects of learning participated and therefore the voices of all the social actors were heard i.e. parents, practitioners etc. The analysis of the contradictions and double binds during these BCL sessions resulted in the collaborative development of a new concept of a 'care agreement' which was aimed at resolving the contradictions. This represented an expansion in the object which resulted in the creation of new knowledge and a new practice i.e. a practice that would now involve the use of the 'care agreement'.

Expansive learning is said to occur in multiple dimensions (Engeström, 2000; Hasu, 2000; Hasu & Engeström (2000); Engeström & Sannino, 2010). Engeström (2000) and Hasu (2000) have identified four such dimensions i.e. the social spatial dimensions where the interest becomes "who else should be included?", the anticipatory-temporal dimension where the questioning relates to "what previous and forthcoming steps should be considered?", the moral-ideological dimension addresses the question "who is responsible and who decides?", and the fourth dimension is the systemic-developmental where the questioning and learning is on "how does this shape the future of the activity?". In order to assess the expansion of the object the dimensions of expansion need to be specified i.e. whether the assessment will be based on the social spatial dimension or the moral-ideological or even all four dimensions as identified by Engeström (2000) and Hasu (2000).

Two other concepts associated with expansive learning are those of boundary crossing and knotworking. These relate to the occurrence of expansive learning within a constellation or network of activities. Boundary crossing occurs where social actors, as part of a creative endeavour, must move across boundaries to seek or give help. An example is that of a social actor having to act as a change agent, carrying, translating and helping to implement new ideas between one setting and other. In the medical care example, where the 'care agreement' solution resulted from a BCL intervention, negotiated knotworking was observed whereby the social actors (i.e. patients, and practitioners from different care organisations) had to work together in a collaborative way in order to plan and monitor a patient's trajectory of care. The social actors took joint responsibility for the patients overall progress and according to Engeström and Sannino (2010), knotworking refers to the,

> '*... rapidly pulsating, distributed and partially improvised orchestration of collaborative performance between otherwise loosely connected actors and activity systems (...)* ***Knotworking is characterised by a pulsating movement of tying, untying and retying together otherwise separate threads of activity****. The tying and dissolution of a know of collaborative work is not reducible to any specific individual of fixed organisational entity as the centre of control. The centre does not hold.*' (Engeström and Sannino, 2010, p. 13)

In these knotworking situations, the unstable knot needs to be made the focus of analysis.

What then are highlighted about Engeström's theory in terms of the guiding questions posed earlier as a guide to this theoretical review?

1. **What is (situated / practice) learning according to the theory?**

> '*The theory of expansive learning puts primacy on communities as learners, on transformation and creation of culture, on horizontal movement and hybridisation, and on the formation of theoretical concepts.*' (Engeström and Sannino, 2010, p. 2)

> '*Traditionally we expect that learning is manifested as changes in the subject, i.e. in the behaviour and cognition of the learners. Expansive learning is manifested primarily as changes in the object of the collective activity. In successful expansive learning, this eventually leads to a qualitative transformation of all components of the activity system.*' (Engeström and Sannino, 2010, p. 8)

Learning is the expansion of the object during engagement by social actors in an activity. Learning by social actors during this expansion of the object may occur vertically in terms of the creation of new knowledge and theoretical concepts as well as horizontally as they learn something that is not yet there but which they construct and implement during collective activity.

In terms of the ISD activity learning would be expansion or an improvement to that activity during engagement by social actors e.g. users and developers.

2. **Who is learning?**

According to expansive learning theory the subjects of learning are interconnected activity systems which are energised by their own inner contradictions to change and learn. However there may also be individual agency by the different social actors engaged in those activity systems when different individuals speaking in different voices take the leading subject position in the activity at different times (Virkkunen and Kuutti, 2000; Engeström, 2001; Engeström and Sannino, 2010). The users, developers at an individual level as well as the network of interacting activities of users and developers would be the learners in an ISD context.

3. **What triggers the learning or why do they learn?**

On the question of 'Why do they learn?' and – 'What makes them make the effort?', Engeström (2001) surmises that social actors learn not only because of their participation in a culturally valued collaborative practice which may produce something useful that could improve their current practice, but also because of the contradictions between and within activity systems. It is a key principle of activity theory that contradictions or tensions within and between activity systems brings about change and development and hence learning.

Contradictions or tensions in the ISD activity system are what trigger the learning.

4. **What are they learning?**

What they are learning will depend on the nature of the contradictions – but the principle learning outcome is a new pattern of activity based on the solutions that have been derived / designed to resolve the identified tensions and contradictions. As the new pattern of work is implemented, the subjects may also learn about the historical layering and co-existence of old and new concepts as well as the struggle between the old and new concepts (i.e. tertiary contradictions as the new pattern of work is implemented – an example of this could be resistance from some quarters of implementing the new concept). The subjects also now learn about the expansion of the object from the old object to the new object.

5. **How do they learn, How is learning achieved?**

Learning is achieved through learning actions as depicted at Figure 9. According to Engeström and Sannino (2010):

> *'The cycle of expansive learning is not a universal formula of phases or stages. In fact, one probably never finds a concrete collective learning process which would cleanly follow the ideal-typical model. The model is a heuristic conceptual device derived from the logic of ascending from the abstract to the concrete. Every time one examines or facilitates a potentially expansive learning process with the help of the model, one tests, criticises and hopefully enriches the theoretical ideas of the model.'* (Engeström and Sannino, 2010, p. 7)

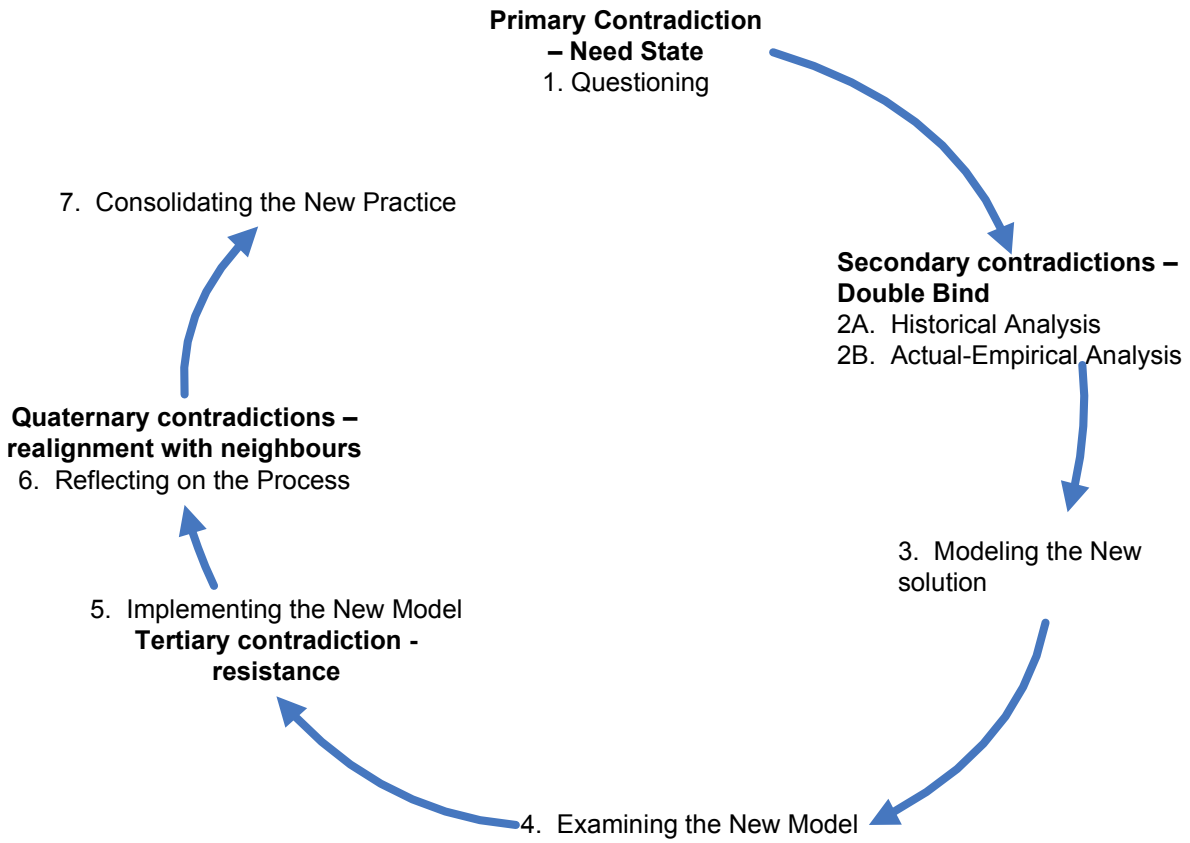

Figure 9: Strategic learning actions and corresponding contradictions in the cycle of expansive learning (Engeström 2001, p. 152)

In this ideal-typical expansive learning cycle the first action is the questioning of the current practice where there may be conflicting views / voices. This then leads to the second action which is the analysis of the secondary contradictions between the components of an activity system through a) historical analysis and b) actual-empirical analysis. The purpose of the historical analysis is to gain an understanding of the qualitative changes that have taken place in the activity system over time as well as to analyse and determine previous and current concepts that have shaped the activity. The actual-empirical analysis on the other hand is meant to reveal and describe in more detail the forms of actions and processes involved in the transformation of the object. Furthermore to analyse more specifically the extent to which specific tools, rules, actions and processes are involved in the transformation of the objects of the activity. This

should extend to how specific tools, rules and types of division of labour actually mediate the activity, and what types of disturbances or contradictions occur in current practice.

This analysis then leads to the modelling, development and implementation of a new practice model / activity system that addresses the secondary contradictions identified in the previous learning process stage. The implementation of the new model may result in tertiary contradictions which in themselves may be a source of even more learning and development. The final two stages in the expansive learning cycle are the reflection on the process as well consolidation of the new practice. Quaternary contradictions resulting from the realignment of the new practice / activity with its neighbour activities may also contribute to the learning as further solutions are found to ensure realignment in the network of activities. Engeström and Sannino (2010) therefore suggest that expansive learning should be viewed as construction and resolution of successively evolving contradictions as demonstrated by these learning actions. The resolution of contradictions at any stage of the process results in learning and development of the activity system.

The expansive cycle of learning actions has been used as a framework of interpretation in studies of relatively large-scale and lengthy processes of transformation (Engeström and Sannino, 2010), change laboratory interventions which occur over a series of several meetings (e.g. Engeström, 2001; Hill et al. 2007), as well as small-scale (e.g. in a single meeting) and short processes of transformation (e.g. Engeström, 1999).

3.3.6 **Expansive Learning Studies from Literature**

Expansive learning theory has been used in a wide variety of studies and interventions ranging from education, workplace learning, product development, and across multiple heterogeneous organisations (Miettinen, 1998; Engeström 2010). In this section I will provide only two relevant examples of its application. The first study is by Bødker & Grønbeck (1996) who studied learning in the context of information systems development, and the second example is by Hill et al., (2007) who studied collaboration between government and industry to resolve complex problems in the industry.

1) Expansive Learning in Information Systems Development

Bødker & Grønbeck (1996) applied activity theory concepts in analysing learning (opportunities) within a cooperative prototyping design approach. They state, 'Our approach to understanding these prototyping situations is inspired by activity theory, in particular the work of Engeström, wherein learning is seen as an expansion of work practice' (Bødker and Grønbeck (1996), p 130). The selection of this work is based on the fact that not only does it look at (expansive) learning, but also prototyping, which was the design approach used in our selected case study.

Bødker & Grønbeck's (1996) primary interest was in developing tools and techniques for cooperative prototyping but in the process they decided to also analyse the learning situations through an analysis of the roles of users and designers of prototypes using sample data obtained in and between prototyping sessions. The data collection was via notes, video and audio tapes and interaction analysis techniques were used to analyse the video data. On the basis of this, they identified four learning situations that their cooperative prototyping approach presented i.e.

1. Learning situations presented by the simulation of work-like actions using the prototype i.e. learning about how the future work practice will look like using the prototype
2. Learning situations presented by brainstorming and idea generation to improve the design of the prototype. In this case both the users and designers (as subjects) were using the prototype as the tool / instrument for changing the object (current version of the prototype)
3. Learning as users used the prototype as an instrument to trigger further investigation of the current work practice or as the designers gained a better understanding of the work practice. This represented, mostly, learning by the designers as they were '... listening to understand the work task, to ask questions, and to introduce relevant parts of the prototype... Focus shifts or breakdowns typically occurred when contradictions in the caseworkers' and the designers' understanding of the frame task occurred.' (Bødker and Grønbeck (1996, p148)
4. Learning situations that improved the designers understanding of how to prepare prototypes and improve prototyping tools. This resulted from breakdowns that turned the participants focus and attention towards the actual conduct of the session, the prototype or the prototyping tool (software).

The identification of these learning situations by Bødker & Grønbeck (1996), is in a way a confirmation that 1) ISD presents opportunities for learning 2) activity systems are learning 'sites' or systems 3) we can indeed 'learn as we do' as suggested by Rogers and other situated learning theorists. Though Bødker and Grønbeck identify these learning situations they do not report on any attempt to actually evaluate the learning and determine its effectiveness. This to me is a key aspect of getting the right mix between conscious and unconscious learning – the users and the designers would know which areas to focus on in terms of learning when they move on to the next stage of development. This has been pursued in this research study.

2) Expansive learning in collaborative design between government and industry

The paper by Hill et al. (2007) describes a study conducted by a New Zealand research team who during the period 2004-2006 experimented with the 'change lab' learning process to create a new method of government policy development and implementation, referred to as "practice-making". The study, which was carried out in an apple industry located in Hawke's Bay New Zealand describes an emerging process of collective sense making among industry, government and research participants, where at the time there was tension around the scarcity of seasonal labour, amid growing concerns about the possible collapse of the industry.

The study was carried out in three main research stages i.e. i) initial scoping and fieldwork, ii) laboratory sessions, and iii) pilot. This paper only reports on the first two stages since the piloting was to be done at a later stage. The objective of the initial scoping and fieldwork was to ground the co-design lab in real-world regulatory and industry activity, and to secure participants interest and commitment to the process. And as such, during this period visits were made to local orchards, warehouses and government offices. At the end of the fieldwork, the research team wrote up a resource briefing paper that was used as a stimulus for discussions during early laboratory sessions.

The second stage of the research study comprised of 12 half-day CL sessions, which were attended by about 18-24 people, in a central location in Hawke's Bay. These sessions were followed by a further period of fieldwork. Participants for the lab sessions were drawn from a cross-section of those involved in the apple industry i.e. growers, contractors, warehouse operators, exporters, quality controllers, horticultural consultants and government officials from central and regional agencies. The key in the selection of participants was to ensure representation of a wide range of activities, perspectives, knowledge and skills and also to make sure that all parts of the industry had a voice at the table.

During the lab sessions, participants were able to identify current problems and contradictions within their activity system which made it difficult for their network of activities from working towards a common purpose or goal. The researchers also facilitated the modelling by participants of the cultural and historical roots of the identified problems and contradictions, and together co-designed and tested ways of transforming their industry through finding solution to the current problems. Through this process an expanded understanding of the industry and its regulatory systems was achieved.

The lab sessions also involved the mapping of contradictions within and between elements. This was initially done using a table that the research team had developed using data from fieldwork records, videotape and team records of the sessions, white board material and participant recall. This initial approach was, however, abandoned in preference for an approach which, according to Hill et al., (2007) ensured that:

> *'...contradictions emerged from the participant's dialogue and analysis, not from "clever" facilitators, since the psychological and cognitive power of confronting contradictions is required to create expansive transformation and the collectively generated motivation (new object)'.* (Hill et al., 2007, p. 368)

This new approach involved the use of what came to be known as the 'Quality Table', which showed the quality and productivity focus that the co-design group had identified as crucial to their practice. The development of this table, using data from the lab sessions, and its placement before the participants is said to have had a significant impact on their expansive learning process in that it stimulated new ideas and innovative thinking about new possibilities.

The outcome of the co-design process was suggested innovations in four specific areas i.e. 1) a draft training strategy; 2) a path to research and development around production and labour practices, not just new apple varieties; 3) a new contractor / grower relationship, including a new division of labour; 4) a labour sourcing, supply, deployment and retention strategy including immigration policy that also included the use of ICT tools for the efficient tracking and deployment of available labour in order to minimise illegal labour practices.

Hill et al. (2007), conclude that the implication for their study was that the expansive learning approach provided a better approach to the traditional policy development approach in that the focus moved away from a linear, mechanistic process to a systemic process of discovery, creation and sharing of new knowledge. Through the expansive learning approach, the focus also shifted from the behaviour of individuals, or individual groups and institutions, to learning and development within a network of activity systems.

They further observed that participants in the study tended not to be positional when they focused on their collective motivation for the activity. They were not concerned about their power or position, but were rather more interested in sharing their knowledge and experience of different aspects of the overall activity. It will be interesting to see whether I will come to the same conclusion about participants in this current study.

During the course of the project there were a number of significant disturbances that had an impact on the co-design process. For example they did not get full participation by the senior policy bureaucrats as originally anticipated and they also had to continuously pay attention to how they managed the communication and accountability lines of the project given that there was restructuring going on at the department that was the main sponsor of their project. But despite these the project continued due to mainly the commitment of the participants to the process. Again it would be interesting during the course of this study to identify any disturbances that may occur and their impact on the process. Commitment to the process seems to have been critical to the success of this study and so one needs to ensure that it exists upfront.

The co-design project by Hill et al. (2007) had a broader impact far beyond the initial project. Many of the ideas from the project are said to have found their way into government and industry policy making. The example cited is that of a working group that was established to develop a Horticulture / Viticulture Seasonal Labour Strategy (the Strategy) which adopted some of the ideas from the co-design sessions.

Hill et al. (2007, p.374) further conclude that their study, in addition to building on existing work on activity theory and the developmental work research world-wide (e.g. New Zealand, Helsinki, UK etc) also expands the focus to address the whole relationship between business and government in a modern Western democracy.

In the current study I reviewed the case project, which was based on RAD, to identify whether learning situations as identified by Bødker and Grönbeck (1986) were evident. This was useful in building my argument that current ISD practice provides limited opportunity for learning. I also adopt the DWR and change laboratory methods that were used in the Hill et al. (2007) study, the specific interest being to facilitate a co-design process between business and government.

3.3.7 Expansive Learning Theory as a framework for analysing learning during collaborative design of a new ISD practice for Botswana

In the preceding sections I have presented a brief theoretical review of Lave and Wenger's (1991) LPP and Engeström's (1987) ELT. The two are both classified as situated or social learning theories as they postulate that learning cannot be divorced from social activity. According to these theorists, learning is not just knowledge transfer, and the learners and knowledge are heterogeneous because learning in a social setting involves multiple actors with varied knowledge and views. In the analysis using the five questions as guidelines it is clear that there are differences between them which include differences in the subjects of learning i.e. in LPP it is communities of practice, whereas in ELT it is network of activity systems as well as individuals. ELT unlike LPP provides a framework that can be easily applied to analyse learning in any setting and it also emphasises the need to understand the historical aspect of a learning activity, because transformation from current to future state of an activity requires an understanding of its history (Virkkunen and Kuutti, 2000; Daniels et al., 2007).

In this study, I will use Engeström's ELT to study learning during the design of new ISD practice because the social actors are made up of three distinct groups (i.e. three distinct communities of practice) i.e. users, IS professionals (External to government) and IS professionals (Internal to government). ELT is not restricted to a community of practice, but allows the study of learning among peers or a group of actors engaged in problem solving as they seek to find solutions to current problems and contradictions. Learning that occurs in such settings may involve boundary crossing and knotworking as described earlier and this cannot be understood through the well bounded concept of communities of practice (Bould & Middleton, 2003).

About the strengths that support the use of ELT in learning studies of this nature, Hyysalo (2009) makes three important observations i.e. that (i) the object in ELT plays an important role as a mediator as well as the collective motive of engaging in a particular activity; (ii) ELT is precise in terms of locating the action and learning in question depending on whether it is at activity, action or operation level or even at the individual or collective level. LPP does not offer the same precision. And (iii) it deals adequately with learning across boundaries e.g. between users and developers as this is considered as '... expanding capacity to transform objects and related contradictions in and between the participating activity systems' (Hyysalo, 2009, p. 732). This clarity does not exist within the LPP model.

ELT is also useful in its application to both long and short cycles of learning and development – in this study we will be looking at a short cycle, which took place in two change lab sessions.

3.4 *Conclusion*

In this chapter I have discussed ISD practice by looking at its historical development from the early 1960s to now. The understanding of ISD practice development globally provides a basis for studying historicity in the local practice. On the subject of learning, two models / frameworks that will be used to analyse learning have been presented. The first model is based on the work by Rogers (2003) and others who distinguish between two types of learning i.e. task conscious learning and learning conscious learning. This first model is used to analyse learning in current ISD practice retrospectively.

The second model adopted is Engeström's (1987) expansive learning model, which will be used to analyse learning cycles during the collaborative ISD practice redesign effort. The choice of this model over the LPP model is based on its detailed framework and applicability to this research study. I have also provided two examples from literature where the expansive learning model was used and the objective of this research will be to draw on this literature to study learning during a collaborative effort between government and industry to redesign current ISD practice.

4 RESEARCH DESIGN, METHODOLOGY AND DATA

4.1 *Research Design Framework*

This chapter presents a discussion on the research design, methodology and data. Research design is concerned with approaches to obtaining data / knowledge, its analysis and presentation. This is an idiographic study which is concerned with the study of a social phenomenon in its social setting i.e. learning within information systems development in Botswana and hence qualitative research methods and not quantitative methods which are commonly used in the natural sciences for the study of natural phenomena have been employed. According to Myers(1999):

'Qualitative research involves the use of qualitative data, such as interviews, documents, and participant observation data, to understand and explain social phenomena... In Information Systems, there has been a general shift in IS research away from technological to managerial and organisational issues, hence an increasing interest in the application of qualitative research methods'. (Myers (1999, p.1)

In this research study I used a plurality of qualitative research methods as part of the research design. According to Myers (1999), the most commonly used qualitative research methods are action research, case study research and ethnography. But lately, in activity theory based studies, DWR has been adopted as the research method. I use a single case project to obtain initial understanding of the nature and complexity of the research context (Myers, 1999). This particular project was selected for this study because findings from its post implementation review indicated that there was slow systems uptake which was consistent with my concerns about learning in current practice. The use of a single case, together with interview data from an interview with a representative of the GIT, was deemed sufficient to delineate the current ISD activity and to provide the initial data used to mirror the practice. This assisted in setting the scene for practitioners to identify problems and to begin to question aspects of the current ISD practice. The case analysis also provided me with the basis for selection of participants for the subsequent change labs. Because case study research and ethnography only allow for observation by the researcher with no intervention, I had to consider the use of action research or the activity theoretical based DWR which are interventionist approaches to accommodate the intervention aspect of the research.

Between the two, I opted to use DWR because it is based on CHAT concepts. Action research is a more generic method that can be used with any framework. Furthermore, in its attempt to ensure scientific rigour, action research requires that all the five steps have to be completed and reported on as part of the research study (Grant and Ngwenyana, 2003; Baskerville and Wood-Harper, (1996,1998), whereas DWR provides more flexibility, even in terms of the starting point and end points of the research. It's important to note here that even though we talk about steps in DWR / the expansive learning cycle, these are ideal typical steps and do not necessarily have to be carried out in that order (Virkkunen and Kuutti, 2000; Toiviainen, 2007; Engeström and Sannino, 2010). In fact, according to Engeström and Sannino (2010),

> '*… it is not a universal formula of phases or stages. In fact, one probably never finds a concrete collective learning process which would cleanly follow the ideal-typical model. The model is a heuristic conceptual device derived from the logic of ascending from the abstract to the concrete. Every time one examines or facilitates a potentially expansive learning process with the help of the model, one tests, criticizes and hopefully enriches the theoretical ideas of the model.*' (Engeström and Sannino, 2010, p.7)

Engeström and Sannino (2010, p. 3) also point to a number of studies that have adopted the use of DWR / Expansive Learning because it *'… has been found particularly useful in analyses of learning in non-traditional, hybrid and multi-organisational settings'*, which are similar to this research study.

DWR is a specific intervention methodology developed by Engeström (1987) that allows for the application of CHAT concepts as discussed in Chapter 2, to work development. DWR follows the epistemic actions as described in Chapter 3 for expansive learning and as such allows for carrying out learning activity in collaboration between a researcher interventionist and practitioners.

In DWR the role of the researcher as the interventionist is to facilitate a process of undertaking the epistemic actions and create an environment where practitioners begin to analyse the current activity based on its historical development and to think about an expansive transformation of the activity system.

The research setting for DWR, which provides practitioners with the tools for taking collaboratively expansive learning actions, is based on Vygotsky's idea of developmental experiment which is based on the method of dual stimulation. The purpose of these developmental experiments by Vygotsky was to show that potential capabilities and emerging new psychological formations in a child could be identified by analysing the formation of new meanings or new generalisations.

The first stimulus in the DWR process as depicted in Figure 10 is provided by the researcher to the practitioners in the form of data about problematic aspects of their daily activities and disturbances in them in order to trigger an identification of the need for change. This could be in the form of videotaped data or any other similar data. The general model of an activity system is used as an intellectual tool for modelling both the systemic cause of the identified problems and a new form of activity during the DWR process. This acts as a second stimulus. The third type of tools / artefacts that are used as instruments of expansive learning actions are analytical concepts and various representational means for analysing the data in the mirror and for constructing alternative solutions for specific parts of the activity.

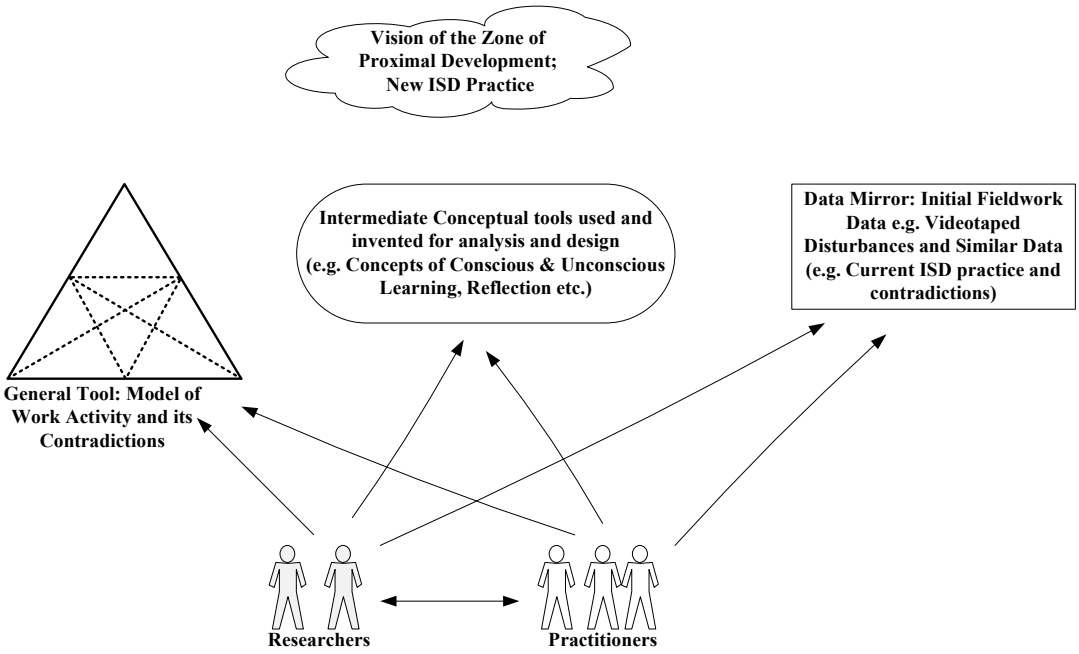

Figure 10: Developmental Work Research Schematic / Design (adapted from Engeström, 1999, p. 7)

About the interventionist and experimental nature of the DWR approach, Engeström (1999) states:

> '*This type of design requires a bold experimental attitude rather than an attitude of a casual observer and facilitator. Bringing about and traversing the collective zone of proximal development is experimentation with activity systems. When practitioners face a mirror depicting their own disturbances, they often experience them as personal failures or even crises. Powerful and unpredictable cognitive, emotional and social dissonances are triggered*.' (Engeström, 1999, p. 7)

The phases of DWR / expansive learning were presented and discussed in Chapter 3 (Section 3.3.5). The epistemic learning actions as identified there were used for this research study starting with obtaining initial field work data from the case project and using that as the first stimulus. After delineating the current activity system I moved on to the next DWR intervention phase and carried out the historical analysis and actual-empirical analyses of the ISD work activity as a historically developed local system. On the basis of this analysis a new ISD activity system was modelled tackling current challenges and contradictions. This was later examined in a change laboratory session.

The Change Laboratory (CL) method, which is commonly used with DWR interventions, is a method that was developed in the mid-1990s by researchers from Helsinki University. The CL provides an environment for the various participants to think through and experiment with new ways of working. It is particularly useful in supporting practitioners in the theoretical-genetic reflection on joint activity as well as on conceptualising new practice through interactions and discussions. The CL provides an opportunity for participants to engage in a collaborative learning activity by carrying out systematically expansive learning actions of questioning current ways of thinking and working, analysing and modelling the activity system, and conducting thought experiments concerning possible changes to their work activity. During CL sessions, participants have been observed to move from singular individual positions to the collective agent i.e. from 'I' to 'We', which therefore requires the formation of new and shared tools, rules and division of labour. In the CL the interventionist facilitates a process whereby participants move between the past, the present and the future activity (Engeström et al., 1996; Engeström, 2001; Pihlaja, 2005; Hill et al., 2007).

In the CL method, implementation of the designed new solution, which is done in the form of pilot experiments, usually starts while the CL sessions are still running. The implementation typically leads to a richer and more articulated concept as solutions addressing contradictions arising from the implementation are used to enrich the concept. The change laboratory process typically comprises of five (5) to ten (10) sessions of two (2) to three (3) hours (i.e. 10 to 30 hour sessions) and a varying number of follow-up sessions. Participants comprise of practitioners and managers and where possible, users, customers or patients are invited to the sessions in order to create the necessary tensions as their cases, problems are being looked at. Data collected from the activity setting relating to critical incidents and problems in the current work practice are brought to the CL sessions and play a major role in stimulating discussion, analysis and collaborative design efforts amongst the participants. Because the CL sessions themselves are videotaped for analysis it allows for the collection of rich longitudinal data on the discussions, actions and interactions involved in the collaborative learning activity (Engeström et al., (1996); Engeström, 2001; Pihlaja, 2005; Hill et al., (2007)).

The change lab method was used for this research study, but instead of short 2 to 3 hour sessions, I only had two sessions of seven hours and five hours respectively. I restricted myself to two long sessions because I had already anticipated that it would be difficult to get representatives from government and the private sector if I had more sessions.

Most DWR (and Expansive learning) studies that have been carried out tend to use ethnographic research for the initial field work and data collection (Hasu 2001; Toiviainen, 2003; Pihlaja, 2005; Kerosuo, 2006). Ethnographic research, which draws its roots from the discipline of social and cultural anthropology is characterised by the long period of time a researcher needs to spend in the field. The ethnographic researcher is totally immersed in the research environment as they attempt to gain a deep understanding of what people are doing as well as the environment around them. Though in this particular study I did not conduct an in-depth ethnography in terms of trying to *'… follow the people, follow the thing, follow the metaphor, follow the plot, story or allegory, follow the life or biography, and follow the conflict* (Kerosuo 2006, p. 93)' on a day to day or sustained basis, as such, I was around the project long enough ((i.e. from 2004 to 2011) to

observe what was going on. Even after the project had been completed, I continued to visit the case site to interact with the users and find out how the system was doing.

The research framework for this study was depicted at Figure 1 (in Chapter 1) and it provides a summary of the research approach. In the research framework the literature review, case project, interviews, observations, archived reports and change labs were used for analysis of current ISD practice. The literature review covers literature on current ISD practice and moves to a theoretical analysis of situated learning theories since the research is concerned with situated learning in the context of ISD. In 2006, I decided to carry out this research study and sought permission from the Government of Botswana, and more specifically the then Ministry of Communications, Science and Technology (MCST) to use ISD projects that I was engaged in as a consultant for my research. At the same time I also sought permission from the respective government departments who 'owned' the projects as well as the two private companies that had been contracted to carry out development on the two projects I was engaged in at the time and had earmarked for the research. The necessary permissions from MCST and other relevant parties were granted during the first quarter of 2007.

The literature review and more specifically the case analyses provided the basis for the collaborative redesign effort. User representatives in the analysis and redesign change labs were drawn mainly from the two projects that I was engaged in at the time and for which permission had been granted for research. This research study only reports on the analysis and redesign processes and the learning that has resulted from that. The testing, implementation and diffusion will be reported on as part of future research.

4.2 *Research Questions and the Unit of Analysis*

This research study is concerned with four research questions.

Table 4 provides a summary of the research questions, data, unit of analysis and the activity theory concepts used for analysis.

1. What constitutes Botswana's ISD practice?

   This first question seeks to understand the context of the study using the activity system concept. I identify and describe the elements of the Botswana ISD practice in terms of subjects, object, tools, rules, community and division of labour. I further analysed the contradictions within and between elements of the activity system as part of understanding the context of the study. In addition to the use of the activity system and contradiction concepts, I also use the concept of historicity to carry out a historical analysis of the activity based on archival data as well as interviews with a key government representative. This constitutes the initial fieldwork of the study.

2. What are the Users and developers learning and is the learning effective?

   In terms of the context of the study, there are two groups of subjects identified i.e. the Users (i.e. all those that represent government and therefore include functional users, user management, user IS practitioners and representatives of GIT) and the developers (i.e. those that represent the private sector). The study seeks to establish what these two groups of subjects are learning during current practice and establish whether the learning is effective. Effective learning, as argued in chapter 1, will facilitate higher levels of (user) system uptake and meaningful work practice improvement. The meaningful work improvement is something that both the users and developers contribute towards as they engage in development of a new IT artefact. The analysis of learning and its effectiveness was done retrospectively, that is post-implementation and it was carried out using a model that combines Leontiev's concept of the hierarchal nature of activities i.e. the distinction between activity, actions and operations and a heuristic model based on the distinction between formal and informal learning as suggested by some learning theorists (e.g. Rogers, 2003; Malcolm et al., 2003). Learning tasks in the case project are identified and classified as either 'conscious'

or 'unconscious'. The conclusion as to whether the learning was effective, is therefore, based on the balance found i.e. was there a good mixture of conscious and unconscious learning in the learning tasks? or was there more conscious or unconscious learning found?. The main data used here is from the case project.

3. How can current ISD practice be improved in order to facilitate effective learning?

   Once an understanding of current ISD practice and learning was obtained the study moved on to trying to come up with a solution to the current learning problem. This was done through a collaborative redesign effort with users and developers in two CL sessions where users and developers were represented.

4. What do Users and developers learn when collaborating in the analysis, review and redesign of ISD practice?

   The concept of expansion is used in the analysis of the learning that takes place during the analysis, review redesign of new ISD practice. I look at the interaction of the different social actors with the common object in terms of how they perceive what can be done to improve current practice. I study the multiple voices coming from the different representatives during the change labs / CL sessions and try to understand the ease or difficulty with which the social actors are able to create a shared understanding of what is going on in the process (Hasu, 2001). I also analysed the nature of the expansion that takes place using the four dimensions of expansion of an object as described by Hasu (2001) and Engeström and Sannino (2010).

Table 4: Research Questions Summary

Research Question	Data	Unit of Analysis	Analytical Concepts Used
What constitutes Botswana's ISD practice?	Interviews, video data from the 1st change lab session, and archive reports	Botswana ISD network of activity systems	Activity system context analysis; Multivoicedness; Historicity; Contradictions
What are the users & developers learning and is the learning effective?	Observations from the case project; Interviews with Users and Developers from the case project;	Analysis of learning actions from the ISD activity system	Activity system hierarchy; Heuristic model based on two types of learning i.e. conscious and unconscious learning;
How can current practice be improved in order to facilitate effective learning?	Video data from change lab sessions	Network of activity systems i.e. Users & developers activity interacting systems	Expansive learning; Reflection-on-practice.
What do users and IS professionals learn when collaborating in the review and redesign of ISD practice?	Video data from change lab sessions	Interacting activity system of Users and developers	Expansive learning; Object expansion in various dimensions.

4.3 *Data Collection*

I used a wide range of data sources for this study, which is consistent with the adopted DWR research method. I used interviews, observations, archives, and CL sessions for data collection. The data summary is provided in Table 5.

Interviews

Other than interviews conducted with users and developers as part of the post implementation review of the case project as well as the second project, interviews were conducted with representatives of the government department responsible for coordination and policy direction of all government IS / IT matters. From now onwards I shall refer to the government IT department as GIT and the representative from that department as the GITREP.

One interview, specific to ISD, was conducted with a GITREP sometime in 2007 soon after I had been granted permission to proceed with the research. This was intended to set the scene or get a confirmation from government on the current ISD process. The interview was open ended and based on a guideline as opposed to specific questions. I asked questions as they arose from discussions with the GITREP but with the ultimate aim of getting an understanding of the process from the government perspective.

I also used interview data from interviews conducted for the post implementation review of the case project. The PIR data used was from interviews of fourteen (14) users that were interviewed in December 2007 and due to other work commitments, the Company X (COX) representatives were only interviewed in March 2008 and even then it was only possible to interview two (2) out of the five (5) that were involved in this project. The two that were not interviewed were difficult to trace because one of them left the company immediately after the development was complete and the other one was engaged as a free lance consultant and was not a permanent employee of the company. The final member of the development team, who also was the Lead Developer / Project Manager was only interviewed after the first CL session where he was also a participant. Though the interview was delayed it worked out well for the research because it gave me an opportunity to revisit, with him, some of the points he made during the first CL session.

For both users and developer the interviews were based on open ended questions (i.e. refer to Appendix A, B and C) and though the questions were in English, for most of the users they were asked in the local language (i.e. Setswana) for ease of their understanding. The responses by the users were given using a mix of both English and Setswana, depending on the language the user felt most comfortable conversing in. I translated and recorded the responses in English.

Observations

Since I had been engaged with the project since 2004, I have also used some of my notes and observations that I made during the course of the project. These notes and observations are not extensive and systematic in any way since at that time I had not yet received the necessary permission to proceed with the research. Though not extensive, they have been found useful in providing insight into current ISD practice.

Archives / Secondary Data

Archive data has been used as a secondary data source. The archive data has mainly been used for the initial case analysis, especially as it related to historicity. I used archived research reports, minutes from project meetings and other relevant reports such as the Government of Botswana National Development Plan reports spanning the period 1966 when Botswana attained its independence to now.

Change Lab Sessions

Two change labs were conducted as part of the research study, with participants drawn from the GIT, functional users from the two projects approved for the study and all seven companies known to offer system development services and operating in the country. The first change lab, which ran for seven hours, held in November 2007 was attended by 22 participants from government and the private sector. The major objective of this first session was to introduce the research and to carry out the initial analysis of what constitutes current practice. This initial change lab was conducted differently to how most DWR lab sessions are conducted in that I opted to have different social actors make PowerPoint presentations on 1) the historical aspect of current ISD practice, 2) how they were currently carrying out ISD projects 3) current contradictions and 4) how current practice may be improved. The presentations were then followed up with a discussion by participants on current contradictions and solutions to the problem. The reason for this approach was that I wanted to garner support for my study from the participants and I also wanted them to feel from the onset that they were involved in not only the analysis of practice, but also looking for solutions. In terms of the change lab programme, I had asked participants to focus on the following discussion points:

- Specific Botswana ISD project experience
- ISD methodology, techniques used including justification for choice of methodology
- Suitability of ISD methodology to specific projects
- Meanings that users in particular assign to the ISD methodologies used
- What learning took place on the projects by the different social actors i.e. users, and developers
- Suitability of chosen methodology to system uptake and learning

- ISD practice challenges
- Suggestions for improvement

Prior to presentations and discussions by the developer firms on the points listed above, the GITREP set the scene by taking participants through the historical development of the current practice as well as outlining what in their view were the current challenges government was experiencing in ISD projects. The user representatives also then shared their experiences and what they perceived to be challenges with the current practice.

Before these presentations by users and developers I had given a presentation that explained the research problem & objectives as well as covering CHAT concepts that would be used for the research. The presentations also included a representation, based on the interview with the GITREP, as well as my own observations, of the current ISD activity system using Engeström's activity system triangle.

The second change lab, which ran for about five hours, was conducted in April 2011 and during this change lab I presented a model, based on suggestions from the first change lab as well as my own input on what the improved practice should look like. After presenting the new practice model I gave participants the following guideline questions for discussion: 1) Would this (i.e. the new model) suffice and will it address the current learning challenges; 2) How can we make it work in practice? Do we need to have a 'Learning Contract' in addition to the Memorandum of Agreement between clients (i.e. users) and suppliers (developers)?; 3) How and when can we test and implement this model? What needs to be done in order for us to implement and test this new model (e.g. does the current government IT framework need to be amended?).

This second change lab did not have the presence of a GITREP whose participation was deemed important for the adoption and diffusion of the new model. However for purposes of the practice redesign, their suggestions for improvement to practice had already been provided at the first change lab and therefore incorporated in the new model. The adoption and diffusion into practice will be pursued as a separate study and will be reported on outside of this research.

Data from both change labs was videotaped for analysis. The use of video recording for these change labs was convenient for me because I then did not need to take down any notes and it allowed me to fully participate in the discussions. The recorder captured all of the proceedings in

full and even though the video recording was done by one of the Activity Theory Interest Group (ATIG) members, I took responsibility for transcribing all the data because of my familiarity with the data and also because the transcription also included some form of interpretation and analysis.

Table 5: Research Data Summary

Type of Data	Number
1. Interviews	
• Interviews with GIT on Technology related matters	3
• Interviews with GITREP on ISD	1
• Interview with Functional Users from PEX project	14
• Follow-Up interviews with Functional Users of PEX project	5
• Interview with PEX Management	4
• Interviews with Developers of PEX project	2
• Follow-Up Interview with Developers of PEX Project	1
Total Interview Data	30
2. Observations	
• Prototyping Sessions	3
• User Acceptance Testing sessions	2
• Training sessions	2
• System Piloting / Hand Holding	2
Total Observations	9
3. Archive / Secondary Data	
• PEX Project Reports	15
• PEX Project Minutes	20
• PEX Training Evaluation Forms	14
• Selective ISD Project 2 Documentation	6
• National Development Plans	5
• GIT Document Framework Library	1
Total	61
4. Change Lab Sessions	
• Change Lab session November 2007	1 seven hour session
• Change Lab session April 2011	1 five hour session
Total	12 hours of change lab sessions (~ 6 CL's of two hours each)

4.4 Researcher Role

As stated previously, as the researcher I was also one of the consultants involved in the case project as an analyst initially (i.e. we developed the user specification) and later on providing project management support during the design and development phases. The project management role necessarily placed me on the side of the IS users and thus an active participant involved, amongst other things, in ensuring the quality of the developer firms products and services. Furthermore, I have a long standing relationship with some of the participants from the GIT, as a previous employee of that department. In recognising and acknowledging these relationships upfront, I want to ensure that the validity of the findings is not compromised in any way. But, as observed by Dwyer and Buckle (2009), in terms of the qualitative nature of the research, the '*situatedness*' of the research means that the researcher (as subject) cannot divorce herself from the research (object). Being an insider provided me with easier access to the data as well as the potential candidates for interviews and change lab sessions. But once the data had been collected I tried to distance myself from the insider role and assumed the outsider role of analysing the data. This insider-outsider role is supported by the adopted DWR research methodology.

4.5 Conclusion

In this chapter I have provided a discussion on the DWR research methodology adopted for this research. DWR was selected because it provides a detailed framework based on CHAT concepts which ties in with the objectives of this research. The chapter also provided a detailed discussion of the data that was used to address each of the research questions. The initial field data used as a 'mirror' to analyse and reflect on current ISD practice was mainly based on a single case project which I was engaged in at the time that permission was granted for me to carry out this research. In fact at the time permission was granted, the post-implementation review had just been concluded with one of the major findings being that of slow systems uptake, which I had identified as one of the manifestations of ineffective learning in ISD practice. This, therefore, made this particular project an ideal case for my research. My role as researcher, practitioner and interventionist, which is acceptable for the chosen DWR methodology, has also been explained in this chapter.

5 CURRENT BOTSWANA ISD PRACTICE

5.1 *Introduction*

In this research study I set out to involve IS practitioners from government and industry, as well as users, in the collaborative review and redesign of current ISD practice and therefore as a starting point it is important to have a detailed understanding of how ISD is currently being carried out in Botswana. The description of current practice is provided in this chapter starting off with identification and description of all the actions/tasks carried out in current practice. The description provided here is based on interview data from interviews with the GITREP, functional users and developers on the selected case project, as well as on secondary data i.e. the GIT Framework library, the case project reports, and reports from the second project that I was engaged in at the time.

5.2 *The Current Botswana ISD Practice Model*

As stated earlier, the formal description of how ISD projects are currently being carried out in government was provided by the GITREP in an interview that was conducted in May 2007 which was around the time that I had received approval from government to proceed with my research. According to GITREP, ISD projects are carried out following process steps which are aligned to the Software Development Life Cycle (SDLC) i.e. Analysis-Design-Development-Implementation, with formal sign-offs expected at the end of each stage (refer to Figure 11). The process was in accordance with the GIT framework which was developed in 1999, to support the decentralisation of IT services from the GIT to other government departments. The framework was intended to provide guidance in all important areas of IT within Government including IT Management & Planning, IT Service Management, IT Procurement, and IT Security. It also defines procedures and standards that are to be adhered to by Third Party suppliers of IT products and services to Government. For example standards have been included in the framework for production of a Project Initiation Document (PID), Statement of User Requirements (SOUR), Requirements Catalogue, Invitation To Tender (ITT), Acceptance Test Specification (ATS), Procedure Definition.

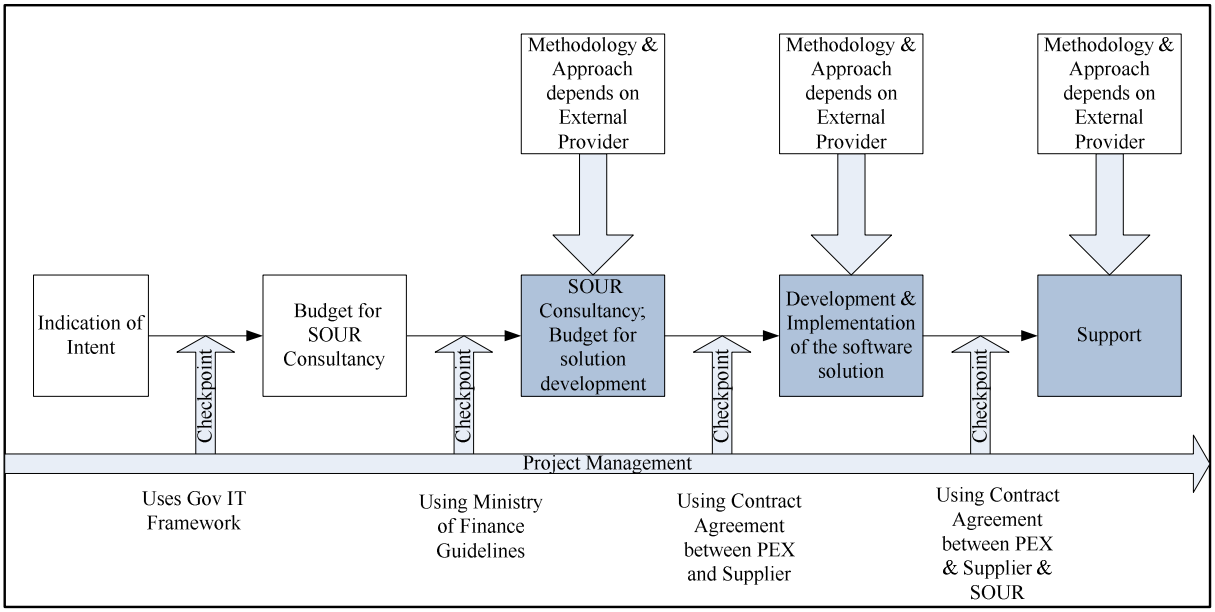

Figure 11: The Current Botswana ISD Practice Model

The trigger of any ISD initiative, according to the GITREP is the indication of intent by a User Department and about this the GITREP stated:

> *'For commitment and sponsorship we want users / clients to initiate the process, indicate requirements, reasons and benefits (for embarking on an information systems development project). But (they) go into motions of computerisation not because they understand the responsibility but because of appreciation of ICT as enabler. They believe that IT can help solve problems'*

This indication of intent is done in the form of a formal letter either to the GIT Department or their representative in the specific User Department. Depending on the nature and size of the project, this is followed by production of a budget for conducting detailed analysis of the requirements and production of the SOUR. Currently, this is an activity which is outsourced and the methodology and approach of developing the SOUR is determined by the analyst firm. But the minimum standards for a SOUR document have been articulated in the GIT Framework. The design and development of the software solution is also outsourced and here again the methodology is determined by the supplier. In terms of project management, government has

adopted PRINCE$_2$ (Projects in a Controlled Environment 2) as the project management methodology and training of all IT officers across government was to be initiated.

I will now unpack this high-level description by the GITREP using the selected case project, which is fully representative of how ISD projects are currently being carried out in Botswana, since suppliers are all expected to adhere to the GIT framework.

5.3 *The Case Project*

The selected case project was, to a large extent, carried out in the manner described by the GITREP. The case project was for a public entity X, which I will now refer to as the PEX. Before going into the details of the project itself, I will provide a brief background on the PEX organisation. This is then followed by a description based on the ISD process stages as outlined by the GITREP i.e. the Requirements or SOUR stage, Design and Development stage, as well as Support. The description of these stages is presented following the methodology as adopted by the third party suppliers.

In addition to a description of the actions during the design and development stage, I also provide a summary of the outcome of these actions i.e. the product or IT artefact that was developed because even though the quality of the product is not being analysed as part of this research study, it is indeed important to know about the end-product.

On the PEX project, though not standard practice, a post implementation review was carried out and later on in this chapter I have reported on the findings. The findings of this PIR are of particular interest to this study because they include an assessment of learning on the project.

5.3.1 The PEX Organisational Background

The core business for PEX, which is a unit within a much larger government research department, is the multiplication of seed for the arable farming community. The PEX operates from offices that are located outside of the capital city, Gaborone where they have a large land area for growing and multiplying seed.

The PEX mandate of seed multiplication is achieved through the contracting of external farmers (or seed growers) to grow the seed which is then supplied to the farmers by PEX, or through growing the seed internally, on PEX farms. During the planting-growing-harvesting period, PEX

monitors the growth and quality of the seed produced through regular inspections of the contracted Seed Growers farms or their own farms. Once the seed has been harvested it is processed and packaged ready for sale to the wider farming community.

The PEX executes its mandate through five business units, namely: Inspection (Certified Seed), Seed Laboratory, Basic Seed Production, Processing and Despatch (refer to Figure 12 for the PEX functional structure). The system that the PEX required was to support all these five business functions.

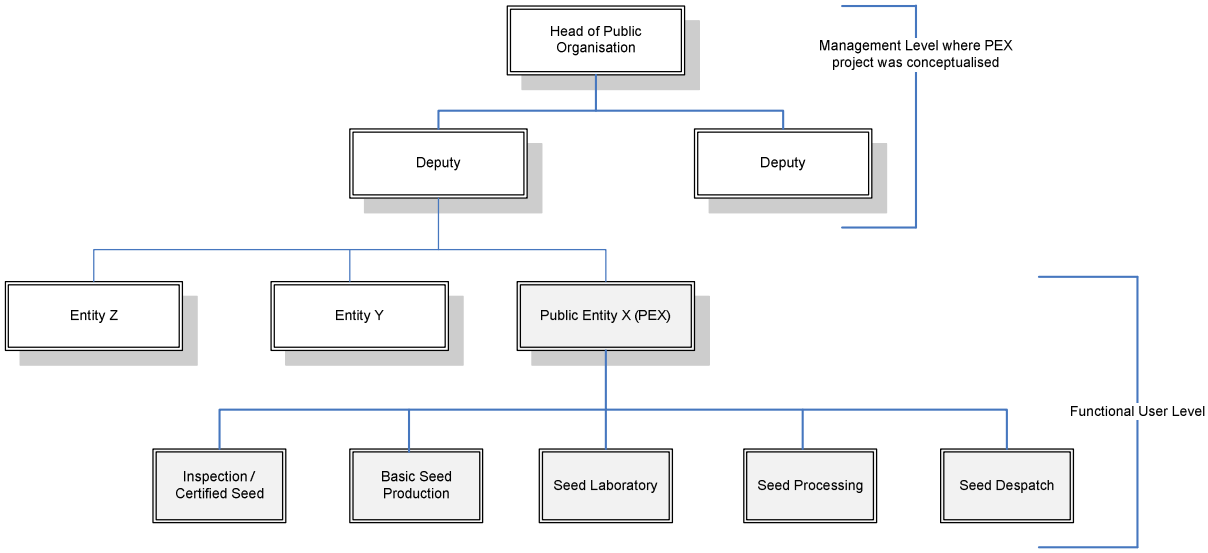

Figure 12: PEX Functional Structure

The Inspection (Certified Seed) Sub-Unit deals with the external seed growers in terms of contracting them to grow seed as well as monitoring the seed growth through the planting-growing-harvesting cycle. The Basic Seed function, on the other hand, is responsible for monitoring growth of seed that is grown internally using breeder seed obtained from an independent research arm of the same department that the PEX belongs to. Once harvested this basic seed is distributed to the external seed growers for multiplication. Seed quality is important to the PEX and this is provided by the Seed Laboratory as a support service to the Certified Seed, Basic Seed Production and the Warehouse (i.e. Seed Processing & Despatch) Sub-Units. The same services are also availed to external users from the private sector. This specialised service involves carrying out various tests, based on local and international testing standards, to

determine the quality of the seed produced. The most common tests carried out are: Purity Test, Moisture Test and Germination Tests. The Processing Sub-Unit is responsible for cleaning, grading, treating and packaging both basic and certified seed. At the time the project was carried out, the Unit had three warehouses, one open shed and one cold room where the basic and certified seed are stored for future sales and dispatch. In order to maintain the quality of the seed the storage facilities are kept clean at all times and in cases where existence of weevils has been identified, the facilities are fumigated and sprayed. The Despatch Sub-Unit is responsible for seed sales and despatch to all types of client i.e. from government or the private sector. The breakdown of PEX staff by business unit is as shown in Table 6.

Table 6: PEX Staff Profile

Business Unit	**Professionals**	**Artisans**	**Technicians**	**Farm Workers**	**Others (e.g. Stores)**	**Total**
Inspection	1		2			3
Seed Lab		2	2			4
Basic Seed Production	1		1	8		10
Processing			2			2
Warehouse/Despatch		1			2	3
Total	**2**	**3**	**7**	**8**	**2**	**22**

The table shows that most of the PEX staff comprises of technicians and farm workers. This is the pool of resources from which the functional users of the PEX project were drawn from. At the very top of the PEX structure is the Head of the Organisation and the Deputy who the PEX had direct reporting lines to. It is at this level of the organisation that the need for the PEX system was conceptualised. The analysis of how ISD projects are conceptualised will later show that there is a contradiction between the level at which decisions are made and participation in the project.

From the training needs analysis that was carried out for the new PEX system, it was concluded that users did not have sufficient knowledge of computers, and therefore as part of the delivery of the PEX system, basic computer training was to be provided first, together with basic training on desktop applications i.e. MS Word and MS Excel.

Prior to this project, the PEX or indeed the department within which the PEX was located had not been engaged in a large scale ISD project of this nature, especially with external service providers involved. This was therefore a new experience to the staff and the organisation. From the onset it was a challenge to make sure that the right people at the right levels were involved in the project. The culture was such that IT projects were for IT people and so both management and users did not think that their input was crucial.

5.3.2 PEX Project Conceptualisation

Over a number of years PEX was experiencing problems and limitations with data collection, management as well as forecasting of seed demands for upcoming seasons. The PEX was using a standalone DOS based database system that was developed in-house using Dataease (i.e. a 4GL database management system). The system had been in use since 1996 and it only provided for basic information input and output (e.g. relating to daily seed processing, receipts from farmers / seed growers, (basic) seed despatch to farmers / seed growers, etc), with access limited to one or two individuals on a standalone environment / computer. In fact what used to happen was that various forms were submitted to a central location (IT Office) where data was captured on the system followed by the production of standard reports. This movement of forms was blamed for the sometimes incomplete information as forms were lost and did not reach their destination. The limitations with the current system, together with advances in information and communications technology were cited as some of the reasons for wanting to embark on this project with the major aim being to develop and implement a more comprehensive system that would improve the PEX practice. According to the PEX IT Manager, the decision to develop a new system to improve the PEX work practices was taken by Management, and more specifically the previous Director of the organisation. At the time that I became involved with the project a new Director was in post and from the interview I held with her in May 2004, she expressed concerns about their inability to forecast seed demands and thus ensure that they always have the required seed quantities to sustain the nation for a period of time, including during drought periods. This, she

said, was one of the major reasons a new PEX system was required. These concerns were shared by her immediate deputy, who was a direct supervisor of the PEX unit, who commented that:

> '*We always need to have enough seeds for two seasons ... and so we need to be able to forecast demand. We also have to distribute seeds for free to farmers during a drought, but we do not know what the national seed requirement is. '*

The decision to develop a new system was, therefore, a management decision with little or no involvement of staff. It took ten (10) years from conceptualisation in 1997 to the PEX system implementation which was only completed in 2007. The SOUR was completed in 2004, and the design and development only commenced two years later in 2006. This time lag presented challenges in that there were significant staff movements during that period, including the departure of the Director who had conceptualised the project.

The PEX project was made up of two components i.e. the IS component and the IT or technology component which was concerned with the supply, delivery, installation and commissioning of hardware artefacts. The two project components were carried out in parallel with the hardware delivery timelines such that all equipment was in place by the time the training and testing of the PEX solution begun. The focus of this study is on the IS side of the project delivery.

5.3.3 Project Management Process

The project management process followed guidelines as provided for in the GIT framework, with a Project Initiation Document (PID) produced as the initial output outlining how the project was to be carried out, managed and controlled. The PID provided for sign-offs at each stage of the process and more specifically for each of the project deliverables. The sign-offs as specified were done religiously on the PEX projects, however, there was no assessment of the understanding of all those involved at each stage of the project. It was assumed, as was practice that everybody was on board. It only struck me that not everybody was on board when one of the users during testing of the system said:

> *'Aha ... OK ... this is what we wanted to do all along ...now I understand'*

This was a telling statement, which contributed to my decision to study learning within ISD and it also influenced my decision to use this particular project as the case project for this study.

The project structure comprised of a Project Implementation Committee, a Project Manager, and the Functional User Team supported by the PEX IT staff. The structure, as depicted at Figure 13, shows at a high level the social actors that were involved in this project. This is very typical of ISD projects in Botswana. The social actors represented here participated in the two change lab sessions to review and redesign practice.

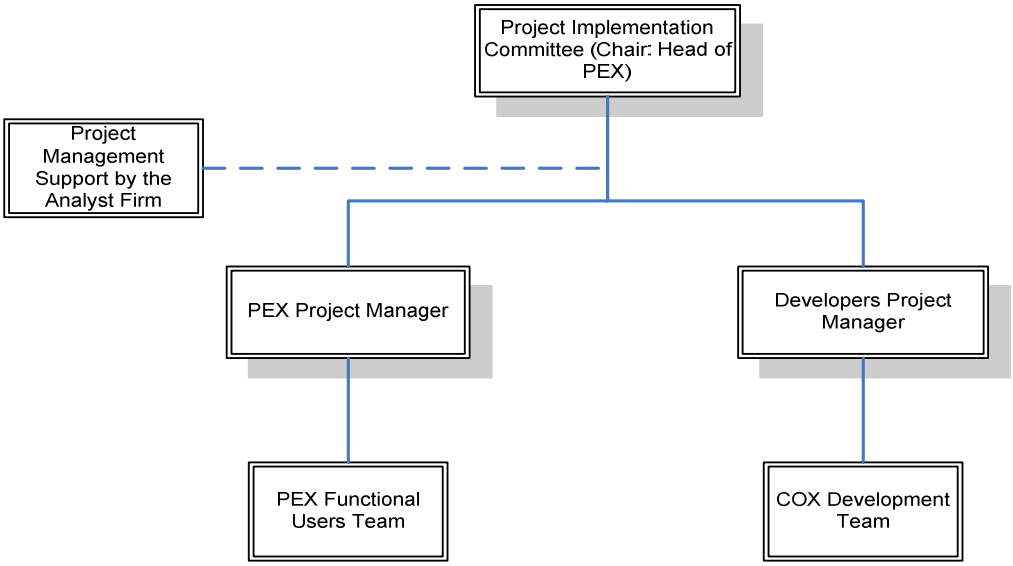

Figure 13: PEX Project Structure

The (PIC) was responsible for, amongst other things, project coordination, and deliverable quality reviews. Membership of the PIC comprised of the head of the PEX, functional users (i.e. from the five sub-unit of Inspection (Certified Seed), Seed Laboratory, Basic Seed Production, Processing and Despatch), representatives of the analyst firm, the developer firm, and representation from the IT function of the Ministry to which the PEX belonged. Though the PEX Management was not represented in the PIC, there was provision for them to receive regular briefings from the Project Manager. This, however, did not happen as regularly as had been envisaged due to their unavailability. The Project Manager was the IT Manager for the PEX, supported by the analyst firm that had developed the SOUR. The analyst project management services were provided on a part-time basis and were only for the development stage of the project – the support phase was not included. The profile of the functional users is provided in Table 7 below. The profile shows that most of the functional users had diplomas and certificates

most of which were acquired thirteen to thirty eight years ago. Selection of functional users was done by the Head of the PEX and where possible, the same team that was involved during the SOUR phase of the project was retained for the design, development and implementation. But, throughout the project it was a challenge retaining the same people.

Table 7: Profile of Functional Users involved in the PEX Project

Level of Qualification	No of Users	Year Obtained
Masters	1	2002
Degree	1	1992
Diploma	5	1988, 1990, 1998, 2006
Certificate	5	1973, 1981, 1988, 1990
None	1	N/A

In terms of project control, the PIC met fortnightly for progress monitoring and control, as well as at the end of each stage for deliverable quality reviews. There was also provision for the PIC to meet on an ad-hoc basis in case of exceptions that needed to be addressed urgently.

5.3.4 PEX system requirements

The PEX system requirements elicitation and documentation was done by an external supplier – the analyst firm, of which I was the lead analyst. The choice of methodology for development of the SOUR was left to the supplier and in this case we used a combination of the Critical Success Factor (CSF) method by John F. Rockart (1979), and structured analysis techniques through the use of data flow diagrams. The final SOUR document comprised of a description of the current system (i.e. using DFDs) as well as a simple non-technical description of the requirements. Requirements catalogues as well as a data dictionary were also produced in line with the requirements of the GIT Framework. The SOUR requirements were obtained from the PEX Management and functional users through change labs and interviews. Full day change labs were conducted for each of the PEX functions / sub-units where requirements elicitation was facilitated by the analyst firm.

The details of the PEX system requirements have been documented in the SOUR (2004) document following the GIT standard for such documentation. Requirements were specified for

each one of the PEX functions. Some of the key requirements included the ability to capture all details of a seed grower based on their application and also the ability to automatically vet the applications based on predefined criteria. The system was to allow flexibility in setting up the vetting criteria for such applications. Once the seed grower had been contracted through the system, their performance was also to be monitored through the system. This was to be carried out through the maintenance of inspection report findings captured at each stage of the growing process. In terms of the inspections functionality, a scheduler was required to assist the inspectors in scheduling inspections including having some sort of prompts or alerts for inspections that are due. In order to address the Seed Lab requirements, the PEX system was to provide the ability to receive samples through capturing sample details into the system and generating a unique laboratory number for each sample. Once the testing and analysis were complete, the results would be captured into the system and the relevant reports generated including the test certificate. This seed lab functionality was meant to support testing of samples for both internal and external seed growers.

In terms of Seed Processing, the system was to provide functionality for receipt of seed from various sources including interfacing with the existing weighbridge system as well as production of seed pocket labels for packaging the processed seed. The warehouse functionality as provided for in the SOUR included the ability to maintain warehouse details in terms of their location and size / capacity. It also included the ability to receive seeds into the warehouse, allocating it for storage in specific areas in the warehouse, issuing of seed four sale and monitoring of stock levels. In terms of the key non-functional requirements, the new system was to be modular with a Graphical User Interface (GUI) (i.e. from DOS to windows based) operating in a secure multi-user environment. Finally a number of standard reports were specified for generation by the new system (e.g. Seed Growers monitoring report, Seed Inspection Reports, Seed Testing Certificate, Seed Pocket Labels, Seed Processing Report etc.).

The new system would be made available to all PEX functional users with data captured at source. As a result there would no longer be any movement of forms for centralised data capture and report processing. Furthermore access was to be provided to management for viewing / printing relevant reports.

The requirements as specified for the new system were a significant improvement to the existing system and therefore the system was expected to address most of the user concerns and yield significant benefits (PEX SOUR, 2004). The anticipated benefits would be the ability to monitor the performance of Seed Growers, since all information relating to their contracts and findings from inspections would be in the new system. The maintenance of inspection reports was expected to help improve inspection management including ensuring that scheduled inspections were not missed since the system would provide alerts. The benefit of having a Lab Test module was viewed as an improvement in seed analysis as it ensured that international standards for testing of seed were adhered to since the functionality would be built into the new system. The enforcement of standards for say the picking sequence (i.e. in this case FIFO) when seed was being issued, would be a major improvement to current practice where the picking sequence was not consistent resulting in old seed staying in the warehouse for long periods at the risk of spoiling and being disposed of unused. A further benefit, which was of major importance to the PEX, was the improvement to seed forecasting capability based on the ability of the system to maintain up to date stock levels and demand (based on despatch data). There would also be reduction of inventory investment and purchase costs through improved inventory monitoring. Furthermore, the rule enforcement by the system would ensure better transaction controls e.g. inspections were to be carried out in sequence and the system was not to allow updating of say the harvesting stage inspection before the pre-flowering inspection had been done.

5.3.5 Design and Development

The design and development of the PEX system was outsourced to an external service provider, whom I refer to as the developer. The developer's choice of methodology was Rapid Application Developing (RAD) using prototyping. Figure 14 depicts the development process as used by the developer firm.

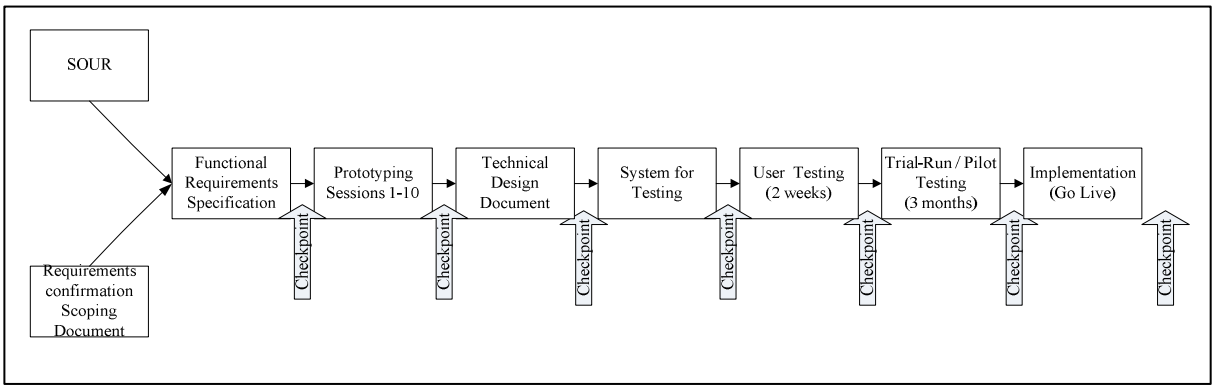

Figure 14: Design and Development process for the PEX system

The development team from the supplier side comprised of five members and the division of work was as shown in Table 8.

Table 8: Division of Labour for the Developer Team

Team Member	Tasks
Lead Developer	Analysis, Design & Quality Assurance plus project management
Developer 1	Analysis, Design & Coding
Developer 2 (Sub-Contracted)	Coding
Developer 3	Coding, User Training, Support during testing, post-implementation support
Developer 4	Coding & Documentation

Various tools and techniques were used during the design and development i.e. a combination of PMBOK and PRINCE2 were the project management methodologies with MS Project as the tool; VB studio was used for developing the GUI, FastHelp was used for the Help facility, Visio was used for documenting the data flow diagrams and entity relationship diagrams.

In the next few paragraphs I will provide a brief description of the design and development tasks. I only include tasks that were visible to the client, even though there were other tasks such as

coding, unit testing, system testing, system documentation etc. that were done by the developers independently and without the involvement of users. These tasks were carried out off-site.

Requirements Confirmation and Scoping

The first exercise that the developers engaged in was validation and confirmation of the requirements as stipulated in the SOUR document. Though requirements had been sufficiently documented and presented by the analyst firm, the developers needed to have their own in depth understanding using their own tools and techniques for requirements elicitation and presentation. This inadvertently meant that the users had to go through the whole explanation process again. The only difference being that now not only did they use their own understanding of their work practice – but the users were also using the analyst firm's representation of their work practice as documented in the SOUR. This was done through a series of change labs with the various functional user groups. The output from this exercise was the Requirements Confirmation Scoping Document. The fact that there was a detailed SOUR in place ensured that less time was spent by the developers in validating and confirming the requirements.

Prototyping

There were ten (10) prototyping sessions held even though originally there only meant to be three (3) sessions, where the functional user groups were asked to review and provide inputs to various aspects of the development. Initial change labs focused on the design and review of static screens and in the latter sessions there was some logic built into the screens for process review. The prototyping sessions were being held at the PEX premises in a room that had been dedicated specifically for this work.

The planning, coordination and control of the prototyping sessions was the responsibility of the developers. During the sessions we had the lead developer facilitating the sessions by taking the users through the screens / system using a laptop and projector. There were usually two or three other developers available to provide assistance. They kept minutes and notes of the sessions as a record of what transpired, but also as reference for any user change requests. The users were also given printouts of relevant screens to review and make changes. The prototyping sessions presented learning opportunities through brainstorming and idea generation to improve the PEX system design as well as triggering further discussion on current work practice for better

understanding by the developers. But initially it was difficult for the developers, as facilitators of the sessions to get the users to engage and contribute in the brainstorming and discussions when the analyst firm's team was not there.

Once the prototyping sessions had been completed, the developers proceeded to complete the rest of the coding and development of the PEX system.

The Developed PEX System

The PEX system was custom built and was based on an *n*-tier architecture using MS Windows 2003 Server for the operating system, MS SQL Server 2005 for its database and MS Visual Basic 2005 Edition for the graphical user interface.

The system design and functionality followed a modular, menu-driven design as was desired with the core functionality provided through five modules namely, the Seed Growers Maintenance, Crop Management, Seed Testing, Seed Processing, Seed Inventory Management, Seed Purchasing, Seed Sales and Asset Management, Maintenance and Calibration modules. These modules are a direct match to the PEX functions as shown in the table below (Table 9).

Table 9: PEX System Functionality

PEX Function	PEX System Functionality / Module
Inspections / Basic Seed	Seed Grower Maintenance Crop Management Seed Purchasing
Basic Seed	Crop Management
Seed Laboratory	Seed Testing
Seed Processing	Seed Processing Seed Inventory Management Asset Management, Maintenance & Calibration
Seed Despatch	Seed Sales

From a users perspective the most attractive aspect of the new system was that it was GUI-based and it was operating in a multi-user environment, allowing users to access functionality that was relevant to their work practice.

Once developed, tested and signed off, the PEX solution was deployed at two sites i.e. a production site and a disaster recovery site with requisite infrastructure allowing for mirroring and data replication between the two sites.

Training

Training was provided over a one week period and trainees were divided according to the system functionality groups / modules which were closely aligned to the PEX functional structure. The training sessions were formally structured and users, though sharing machines, were interacting directly with the system during training. The training objectives were outlined as:

- To familiarise the users with the whole system
- To familiarise each user group with their specific modules
- Preparation for user acceptance testing
- Introduction and finalisation of User Guide
- To make sure that all functionality required has been incorporated into the system

On completion of the training, training evaluation forms were completed by each participant and overall rating for the training and the trainer was said to be 'Good' (i.e. based on a rating scale of Poor, Average, Good and Excellent). The conduct of the training allowed for 'play-like' activities and the formal manner in which the training was planned and conducted ensured that the users were aware or 'conscious' of the fact that they were engaged in a learning activity.

User Acceptance Testing (UAT)

The testing was carried out once the system had been fully developed with the logic built into it. It was carried out by the functional users who were being supported by the developer team. A representative of the analyst firm was also available during the testing. The functional users received one week training on the system prior to commencement of the UAT. The test plan had been developed jointly between the users and developers. The users had to then prepare the test

data for use during testing. The UAT took three (3) weeks instead of the planned two weeks because it was only during the testing that users, especially from the Lab, began to understand what they were going to get system-wise and therefore took their time in the testing. As a result a lot of changes were requested by the Labs during the testing.

Once the UAT was completed and signed off by the users, the product was presented to PEX Management. The approach taken was that the functional users presented their respective modules to Management instead of having the developers do it. Management were seeing the system for the first time and not surprisingly, came up with a number of changes that they wanted incorporated into the system.

Piloting

The PEX system was piloted for a period of three months before finally 'going live'. The piloting was intended for end to end testing of the seed multiplication process in a 'live' environment using real data and not test data. All the functional user groups were involved and encouraged to use the system for all their daily transactions. The developers provided on-site support / handholding during this piloting phase.

5.3.6 Post-Implementation Support

The developer firm was retained by PEX to provide support and maintenance on the system for an initial period of two years. In terms of the support, PEX had assigned one of the (junior) developers who had been involved in the development as a dedicated support resource. But two-three months into the support contract, the designated resource resigned from the company and was replaced by a new COX recruit who had not been involved in the development. The support procedure was such that PEX users would log faults / problems with the COX help desk and depending on the severity of the fault / problem the COX would send a representative on-site to resolve the problem.

5.3.7 Post Implementation Review

5.3.7.1 Objectives and Scope

Currently conducting post implementation reviews is not part of standard practice. But in the case of the PEX project, a PIR was carried out. The review was carried out six months after

'going live', which was deemed to be sufficient time for the users to have started to confidently use the system. The main review objective was to assess system effectiveness, but in light of this research study I also added one or two questions that addressed individual impact and learning. Table 10 summarises the scope of the review.

Table 10: PEX Project Review Scope (from PIR Report, 2008, pg 7)

Review Area	Scope	Liaison With
System Effectiveness	• system features • system utilization • information accuracy and data content • processing schedules • response times • security and controls	Users
System's compliance with requirements	• Evaluate compliance against both functional & Non-functional requirements	Users Developers
Training and Documentation	• Training effectiveness • Level and type of training provided • Adequacy of training manuals / documentation • Adequacy and completeness of procedure and user manuals	Users PEX Project Manager Developers
Hardware Infrastructure Review	• Adequacy of processing and storage facilities • Adequacy of disaster recovery plan and procedures • Networking capabilities	PEX Project Manager GIT
Support & Maintenance Review	• Evaluate adherence to the SLA's • Review adequacy of support procedures	Users, PEX Project Manager Developers
Systems development process	• Methodology & Approach • Organisational Impact • Individual Impact including 'what has been learnt'	Users, PEX Project Manager Developers

The data for the review, as stated earlier, was collected through written interviews based on open-ended question formats (i.e. Appendices A, B and C) with all the users as well as the developers. I took responsibility to administer the interviews myself and at the beginning of each interview I explained that I would also be using the data for this research and therefore requested for consent.

Findings from the review are detailed in the PEX PIR report, but for purposes of this research study I have included some of the key findings and more specifically those that have a bearing on learning, which is of interest to this research.

5.3.7.2 Post Implementation Review Findings

System Effectiveness and Compliance to Requirements

Though the findings from the review suggested that the PEX system developed was consistent with the user requirements and the users were confident that it addressed business and processing requirements, even at the time of the review it had still not been fully adopted. As observed by one of the developers *'(we) have succeeded in providing the system, but the take-on is slow. (some) Users take (the) system as a burden as opposed to something that will make their work better…'* About this the PIR Report (2008) notes:

> *'It was difficult to (fully) assess system usefulness, response time, information accuracy and processing schedule because the system is not being fully utilised. The major reasons given were that the PEX was experiencing intermittent network problems. The other contributing factor was the lack of data, especially as it related to current stock. There were delays in completing the stock taking exercise and capturing the necessary data into the system. This meant that certain tasks could not be completed in the system because of restrictions imposed by the business rules.'* (PIR Report, 2008, p. 9)

The delays in completing the stock count were attributed to some user's resistance to the system and therefore not wanting to carry out their responsibilities.

Training and Documentation Findings

Though they found the training to have been good and relevant, most of the users felt that it was too short. Again this may have been because, it was only during training and testing that users interacted with the full system. One user when responding to a question on what they enjoyed most about the training said: '*Entering the real data into the system, it became much more clearer and very relevant'*.

Support & Maintenance

The change of support personnel a month into the support contract was cited as a major problem by users. This, as expected, initially brought about some challenges because the users were still learning and so was the support person. Though the users, in their evaluation had said the

training provided had been effective – most of what was happening during the support was training. As one of the developers observed when asked about the effectiveness of the support, '*... (its) very frustrating because it is more of training than support... to gain understanding of how the modules work is a struggle ...*'. This seems to suggest that even at that late stage there were issues of user learning that could be traced back to the ISD process itself.

Systems Development Process

As stated earlier the project was originally conceptualised by the management of PEX who were not even represented in the PIC. Some of the key project resources who were there at the beginning when the project was conceptualised changed during the course of the project implementation i.e. the project sponsor changed and so did the principal user and some of the functional users. This created problems with consistency and continuity since those who were there to drive and agree on the analysis phase were not there during the design phase. Also, those that came in required time to learn first about the seed multiplication work activity and then also try to catch up with the project and provide meaningful input. As one of the users remarked *' I am new in the Lab (when I joined the project) so the project / system development assisted with understanding / learning Lab work; it forced me to read so as to provide input on new screens developed; I also learnt more about the seed multiplication business processes as a whole.'* Out of the fourteen people interviewed post implementation, only four were involved in the project during the SOUR phase.

The use of slightly different representation techniques, presented a challenge for the users and as such it took quite a number of prototyping sessions before the screen designs could be finalised and accepted. As observed by the client project manager, *'The SOUR workflow was closer to users so they could follow; Design stage DFD's (were) confusing to users until the screen design, users could now follow especially once the logic was built-in; training also cemented understanding'*

One user suggested the lack of exposure to computers as a contributing factor to the slow transition from the SOUR to the design & development phases *'I understood the SOUR phase, but it was my first exposure to computers and so I found it difficult to understand the design and development process. I understood objectives from SOUR to Design & Development but the problem is in depth understanding of computers'*. As pointed out by the lead developer '...

initially they were more comfortable talking to ... (the lead analyst who also happens to be the researcher) than us ... spent a bit of time knowing each other ... learning each other .... took a while for them to trust us ...'. As a result of this the transition from the Analysis phase (tools and object) to the Design phase took some time.

The prototyping sessions provided learning opportunities in three out of the four possible learning opportunities mentioned by Bødker and Grönbeck (1996). These were in brainstorming, idea generation and in instances where the focus was on the prototype itself i.e. that was when during the demonstration there was a system error of some sort. This occurred mainly during the latter parts of the prototyping sessions when some logic had been built into the system. The learning situation presented by simulation of work-like actions using the prototype was not that evident, mainly I would think because the prototyping approach that was used was different from the one used by Bødker and Grönbeck i.e. a full prototype system had not been developed, but instead static screens and minimal logic were what was used. Furthermore, the users did not have direct interaction with the prototype – it was more of a demonstration. When asked about whether the selected approach was a contributory factor to user learning and therefore slow system uptake, the lead developer stated that they had deliberately chosen that approach because in their assessment, use of a fully fledged mock system would have distracted the users and resulted in more re-engineering work. He said '*... we look at the people involved on the client side ... if we think the fancy part (i.e. logic) would be distractive we leave it out ... from the beginning we had unease about whether we would get agreement on screens ....*' He explained that the low level of user participation during the requirements validation change lab led them to conclude that the use of a 'static' prototype would be the best approach for the PEX project.

Organisational and Individual Impact

This was an important question that was included in the PIR in order to address the concerns of this research. The following responses were given by the fourteen users and two developers that were interviewed.

Table 11: Users and Developers PIR Responses on Learning

Users

User 1

'I learnt about the v*alue of using computers, the importance of in-depth knowledge of use of the system. It puts Botswana on the map with regards to IT use and has resulted in excitement and motivation to work. It will assist towards obtaining Lab accreditation.'*

User 2

'I need more time to reflect on individual impact, but it has opened up my mind to work opportunities'

User 3

'I was new in the Lab so project / system development assisted with understanding / learning Lab work. It forced me to read so as to provide input on new screens developed. I also learnt more about SMU business processes as a whole.'

User 4

'I l*earnt how to use a computer and that it's easy to store volumes of information e.g. on a memory stick. I also learnt how to type and also that analysis translated business processes into work that could be automated which was beneficial'*

User 5

'Learnt how to manage records.'

User 6

'The system could be useful if operational and could assist with data management.'

User 7

'This was my first involvement in an IT project. I learnt the value of using the system to support business processes. I also learnt that computers are faster and more accurate than human beings. Furthermore, I learnt the value of computer storage and security provided through such storage as opposed to maintaining manual documentation'

User 8

'I learnt the ideal way of operations through automation since the system enforces business rules. But this may also act as a constraint especially as it relates to Inspection.'

User 9

' I am a previous computer user, but this current system is different from those used before'

User10

'I learnt how to use a computer since it was my first encounter with it. Creating Lots in the warehouse was a new thing.'

User 11

'I learnt how to use the system and the need to have complete information in order to process transactions.'

User 12

'I am still learning about computers. I learnt the need to capture data on time and follow process flow as defined to benefit from the SMIMS implementation.'

User 13

Blank

User 14

'I learnt how to handle people who are using computers for the first time i.e. resistant users. Also human-computer interaction. I think younger users would have enjoyed and benefited from being involved in the development.'

Developers

Developer 1

' Gained an understanding of the PEX environment and most importantly that even within the same Ministry or government environment you may require a different implementation approach'

Developer 2

'Learnt how to manage clients'

The first user response suggests that the system had brought about work improvement that may even result in accreditation of the (lab) work practice. The is the same user who only seemed to have realised what was going on in the PEX project during testing and as a result a number of changes had been requested to the system design. It would therefore appear from this statement, that understanding, even if it occurred during the latter stages of the design and development was crucial to the final outcome or artefact. I was therefore left to wonder how much more could

have been achieved if understanding of the process had been obtained earlier on in the project. I also wondered whether evaluating that understanding throughout the process could be of value. These are thoughts that I took up during the change lab sessions where, I, together with other practitioners reflected on practice as reported on in the next chapter.

The fourth user response was from a user who was involved in the project from the analysis phase of the project who observed that though when the project started they did not have much understanding of the ISD process they had learnt how from analysis you could end up with a working system which they now had.

User 5, 6 and 7 responses point to learning about specific areas of work practice that had been improved by the new artefact, e.g. management of records and data management. It's learning about the value of using computer technology to support business processes which seems to suggest that it was something that had not been anticipated especially given that the old system operated in a standalone environment and therefore most users did not interact with it much. User response 8 pointed to learning about process flow and business rules that needed to be followed as imposed by the system. The enforcement of business rules was viewed both positively and negatively. The positive aspect was that it was now possible to ensure strict adherence to procedures and standards. The negative side, according to the users, was that it could be a constraint since for example with Inspections the system did not allow skipping of stages. The response by user 9 also seems to suggest that because the PEX system offered more than what they had used before in terms of a computer application, the learning was therefore at a much advanced level.

The creation of Lots in the warehouse (User 10) was a business improvement brought about as a result of the automation. Coming up with lot numbers that could be used to identify seed from planting through to when the seed was processed, packaged and stored in the warehouse was a major challenge throughout the project. During the prototyping sessions various numbering systems were suggested and tried out until eventually the group agreed to one which they all felt would work. It was an interesting learning cycle of questioning, modelling, testing, modifying and then testing again.

In summary learning by users took place at different levels depending on their level of IT literacy. For example, for new computer users, the learning was on the use of computers, their value and potential. Whereas for users who had prior exposure to computers, learning was on how automation can be achieved through the ISD process and on business process improvement e.g. the lots example. Interestingly though, none of this learning as listed led to motivation for high system utilisation and uptake. Thus the question that still remained was why despite this reported learning there was still slow system uptake. Hence my desire to bring together IS practitioners to review the current process and suggest improvements that would enhance learning and system uptake.

At stated previously, during the PIR it was only possible to interview two out of the five developers involved in the PEX project. Though the lead developer was also interviewed, this was only done after the first change lab session and the interest then was to follow up on some of the issues raised at the change lab. However, the two developers interviewed reported learning mainly on how to manage clients in different environments. As developer 1 pointed out, despite their experience in developing and implementing systems for other government departments – the PEX project presented yet again a different environment which they needed to understand. The slow systems uptake was also a concern for the developers and this particular developer later stated his reflections on the project that:

> *'We could have done better if we had a better understanding of the environment. More change labs with the key users were required to match their expectations of where they see the system fitting into their environment'*

5.4 *Conclusion*

In this chapter I have presented a description of current ISD practice in Botswana by identifying the key actions as described by the GITREP as well as the tasks as carried out in the case project. The findings from the post implementation review confirm my concerns about slow systems uptake when the actions /tasks are carried out in a manner described in this chapter. Though there are a number of interesting factors such as the prototyping methodology used, and the profile of the functional users that one could conclude as having contributed to slow system uptake, I chose to leave the analysis to a wider group of users and practitioners. This way

whatever new ISD practice model was arrived at would have wider acceptance and applicability within the government system. I therefore set out to engage as many practitioners and users as was possible in the review and redesign of practice. I also wanted to establish whether this was a problem experienced in other government ISD projects and if it was, to find a solution that could be implemented across all government projects. In the next chapter I report on how a group of users and developers came together in two change lab sessions to review and redesign the ISD practice in Botswana.

6 COLLABORATION IN ISD PRACTICE REVIEW AND REDESIGN

6.1 *Introduction*

This chapter presents answers to the four research questions as IS practitioners from government, the private sector, and with users, worked together in the review and redesign of current practice. In Chapter 5, I partly responded to the first research question (i.e. "What constitutes Botswana ISD practice?") by presenting a description of current practice based on interview and archival data. In this chapter the description of current practice is further extended using CHAT principles as I stimulated the expansive learning cycle through questioning of current practice, and analysis of its historical development as well as the primary and secondary contradictions.

The second research question (i.e. "What are users and developers learning and is the learning effective?"), is responded to in sub-section 6.3 where the analysis of learning on the case project is carried out retrospectively based on Rogers (2003) classification 'task' conscious learning (conscious learning) and 'learning' conscious learning (conscious learning).

As I continue this chapter, response to the third research question, (i.e. "How can current practice be improved in order to facilitate effective learning?"), is provided through modelling of a new solution and examining the new model during the change laboratory sessions. The new ISD practice model is presented together with how it was conceptualised.

Finally, throughout the expansive learning actions of questioning, analysis, modelling and examination of the new practice model, the chapter analysis provides response to the fourth and final research question (i.e. "What do users and IS professionals learn when collaborating in the review and redesign of ISD practice?").

6.2 *Learning action 1 - Questioning*

I triggered the initial questioning through guideline questions that were provided to the different participants as preparation for the initial change lab session. The guidelines provided a 'mirror' for participants to use for introspection, reflection and dialogue on the current practice. I asked the developers to use the following themes for reflection:

- Specific Botswana ISD project experience
- ISD Methodology, Techniques used including justification for choice of methodology
- Suitability of ISD methodology to specific projects
- Meanings that users in particular assign to the ISD methodologies used
- What learning took place on the projects by the different social actors i.e. users, and developers
- Suitability of chosen methodology to system uptake and learning
- ISD practice challenges

In terms of preparation for this first change lab, I asked users to prepare to share and dialogue on their specific project experience, lessons learnt, challenges and recommendations for the future. The idea for these questions was to try and get users to talk about problems they were having with the current ISD process as well as suggest improvements. The GITREP on the other hand was asked to prepare on the historical development of current practice as well as the reasons for the changes over the years. It is worth noting here, that at this initial stage I did not use any activity theory based terminology e.g. such words as 'contradictions', 'dilemmas', 'double bind' because at this stage, other than the ATIG, I had assumed that none of the participants were familiar with these or even with activity theory. But it was interesting that because the invitation letter mentioned that I would be using AT as a lens, some of the participants and more specifically practitioners from the private sector did their own research on activity theory which at some point during the discussions they wanted to share with the group. This in itself constitutes learning by individual subjects through self initiated acquisition of knowledge.

I started the discussions at the first change lab through a presentation of my research objectives and summary of the key activity theory principles. I also presented my initial analysis of the current Botswana ISD activity system. This I later developed into the network of activities depicted at Figure 15, showing subject producing activities as the PEX organisation, GIT, analyst firm and developer firm, and the rule producing activities as the GIT, Finance and Procurement activities. However, in this study the main focus is on the PEX, GIT and analyst firm representing users and the developers. Though recognised, the other activities such as Finance and Procurement activities have not been analysed in detail.

This was then followed by a discussion on the historical development of current practice that was triggered by a presentation by the GITREP. Again the questioning of current practice continued with presentations from two user representatives (i.e. one from the PEX project and the other from the second project that I was engaged in at the time) and three developer representatives (i.e. one was the developer of the PEX system, the other was the developer of my second project and the third one was just another IT industry representative). Discussions and interventions were allowed throughout the presentations.

The presentations and discussions on the historical development of current practice were quite insightful as they offered a perspective on how we arrived at the current state of ISD – it provided a useful context within which to understand and analyse the 'current' through a look at the 'past'. It was also interesting to see through the questioning the different motives of the three subject groups i.e. departmental users, GITREP (government IS practitioners) and the developers (private sector IS practitioners) – it was quite evident from what they identified as being challenges that they had different interests as a far as the ISD activity system was concerned (again this has been discussed in chapter 5). But despite there being some divergence in thinking in some areas, there was overall agreement on the current ISD process as well as agreement on the problem areas as identified for this research i.e. learning. In fact, what was presented as representing current practice was consistent with the initial ISD activity system model that I had presented earlier to kick-start discussions.

A major observation from this initial session was that there was enthusiasm from participants to engage in this exercise of questioning and reflecting on what they do. And so what started of as individual questioning by myself as the researcher and interventionist ended up being a collective action by all participants.

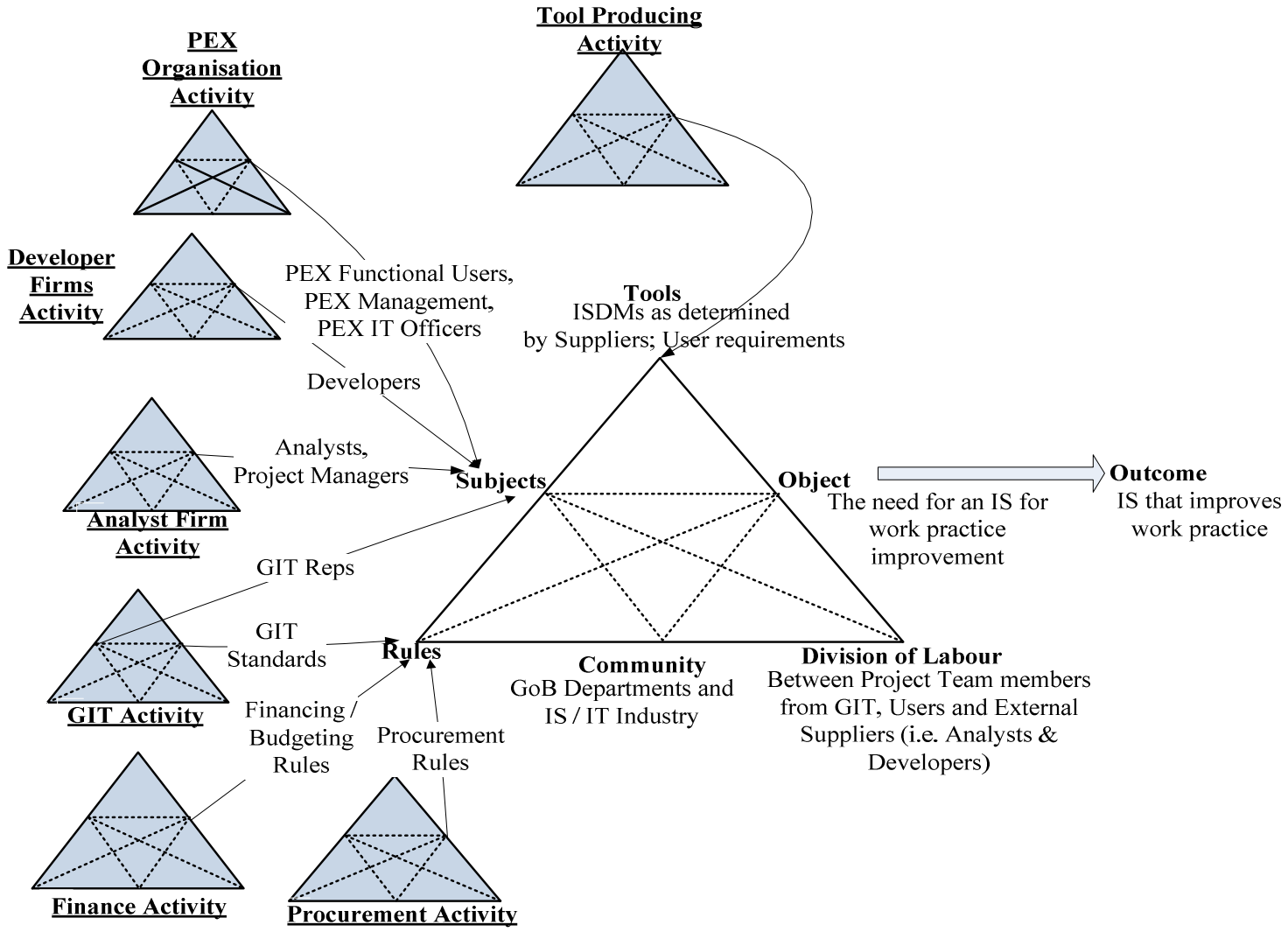

Figure 15: Current Botswana ISD Network of Activities

6.3 *Learning action 2 – Analyses of Historicity, Contradictions, and Learning*

6.3.1 **Historical Analysis**

According to Engeström (2001), *activity systems are shaped by their history,* and it's important to study that history in order to *understand the activity systems problems and potentials*. In this regard the history and evolution of ISD practice was presented in Chapter 2.

Tracing of the historical development of the practice was triggered through a presentation by the GITREP. This particular GITREP was the ideal candidate to take participants through this because she had been an employee of the GIT since its early years, whereas most of the practitioners attending the CL had only been around since the 1990's, including myself.

The presentation started as far back as 1969 when the GIT was still part of the Ministry of Finance and Development Planning, up to 2010, at which point the GIT was part of the Ministry of Communications Science and Technology. As I write this research report in 2011, the GIT is yet again part of a different ministry.

The key points of her presentation and discussions held at the change lab, together with findings from archival research (i.e. mainly National Development Plans) are presented at Table 12. I present this local history using similar categories as used in Chapter 3 i.e. Time period / Era, Technology Type & Applications, ISD Practice and Social Actors. This local historical analysis will help in understanding the current contradictions as will be discussed in the next section.

Table 12: Botswana ISD Practice Historicity Summary

NDP Period	Technology & Types of Applications	ISD Practice (includes ISMM / ISDA)	Social Actors
NDP 1: 1966/7 – 1967/8 NDP 2: 1968/69 – 1972/3 NDP3: 1973/4 – 1977/8 NDP4: 1978/79 – 1981/2 NDP5: 1982/3 – 1986/7	Mainframes Unix OS Real time and batch processing systems developed using Cobol utilising the IDMSX DBMS; and Oracle Tools supported by the Oracle DBMS were introduced later	GCB started in 1968 under MFDP; Management of IT centralised via GCB which was then part of the MFDP Mainly In-house development by GCB	Mainly the GCB with minimal user involvement
NDP6:1987/8 – 1991/ 2	Same as above – with also some Dbase based systems slowly being developed by user departments	Some IT staff at Ministries were deployed – especially the larger ones SSADM adopted as standard methodology but not really cascaded to Ministries Ministry systems largely not documented User departments mainly developing internal systems if they had expert developers on-site	Still mainly GCB Reliance on donors for funding projects, minimal use of external contractors
NDP7: 1992 / 3 - 1996/7	Computer imports rose in government from P43m in 1994 to P51m in 1995; IT budget rose from P26m in 1992 to P65m in 1996/7 Systems for Voters Roll, Payroll and Vehicle registration had been completed and systems for taxation, supplies, national registration, HRM and police were in the pipeline; Over 5000 computers had been installed in government offices country wide	Systems were either outsourced or undertaken by GCB. There was generally a shortage of IT resources and GCB could not retain skilled IT resources - this was a major constraint for IT service delivery, especially given the growing expectations in Government of IT, and an accelerating appreciation for the significant contribution IT can make to the improvement of service delivery. The government budget for IT in NDP 7 was P65 million of which only P51 million was spent due to the inability of both the private and public sector to make adequate resources available to meet demand. As a result of lack of separation between Development, maintenance and application support activities there were operational difficulties due to unclear responsibilities. Project Management was not formalised Dev of Govt IT Strategy initiated in mid 1995 intended to guide IT initiatives in the next plan – dev coordinated by the Gov Comp steering committee (GCSC). In addition a	Centralised approach to IT service delivery Mainly DIT for large government systems like payroll and accounts Some DIT staff now placed at Ministries Slowly User Departments were getting involved

NDP Period	Technology & Types of Applications	ISD Practice (includes ISMM / ISDA)	Social Actors
		government-wide IS Needs Analysis was carried out by PwC to assist budgeting for NDP8 GCB Reform project, which was done by KPMG was initiated in Sep 1996 and was completed March 1997; The purpose of the reform project was to facilitate the effective management of IT during NDP8 and beyond, taking decentralisation of IT, growing demand for IT, and other factors fully into account.	
NDP8: 1997/8 – 2002/3		IT budget grew from P 61 Million during NDP7 to an estimated P 300 Million[1] during NDP8. 86 high priority information systems within Ministries, seven of which were identified of critical importance due to the need for implementation across Government were included for development during NDP8 ICT Strategy was finalised in 1996 to guide ICT initiatives Decentralisation of IT services to Ministries and establishment of Ministry IT Units Devolution of IT budgets to Ministries Outsourcing now formal strategy to speed up projects and ISD	DIT User Department External IS Professionals comprising of mixed teams i.e. Analysts, Design Architects, Domain Experts, Programmers, Infrastructure engineers etc.
NDP9: 2003/4 – 2008/9		Development of the National ICT Policy (and Master Plan) Main emphasis on production of SOURs before any system can be developed	
NDP10: 2008/9 – 2015/16	N/A	NA	N/A

[1] Based on findings of Price Waterhouse project: Information Needs in Government of Botswana, 1996

In terms of what is presented in the table above (Table 12), the period 1968-1995 (i.e. 27 years) was characterised by centralised, in-house development of systems based on structured techniques where possible. This was more of a craft activity in terms of the ideal typical historical activity types described by Engeström – with low complexity of systems and high levels of centralisation. The tensions and contradictions that brought about the transformation from this craftsman-like ISD practice to the current practice were mainly 1) user demand for more IS / IT and 2) efficient delivery of IS / IT services. As a result of that the improved ISD practice during the period 1995-now (i.e. 16 years) is characterised by decentralisation of IS / IT services, and outsourcing of development with the decision of methodology mostly left to the developers. Furthermore, unlike in the previous period there is greater involvement of users and other expertise that can now be brought into the ISD process as a result of outsourcing. In terms of the ideal typical historical work activity the current practice fits into the humanised type with high complexity of systems and decentralisation of services as well as outsourcing. The historical development of these two main era's (i.e. 1969-1995 and 1996-now) is modelled using the activity system model in Figure 16. As stated previously the object that brought about the change was the high user demand for work improvement through IT. As shown in Figure 16, the subjects changed form just being the in house GIT staff to now include users and external consultants as a result of the outsourcing. The tools changed from just the piecemeal application of ISDM's to the application of tools and methodologies as determine by the developers, together with the statement of user requirements as produced by the analyst firm (another third party provider). In terms of the rules, in the new era, almost all the rules and procedures followed were specified in the GIT framework, which had to be adhered to by user departments and external suppliers. The community for the ISD activity now included the IS / IT industry and the division of labour, as expected now included division of responsibility between user teams and supplier teams. Though the object remained more or less the same, the outcome changed somewhat.

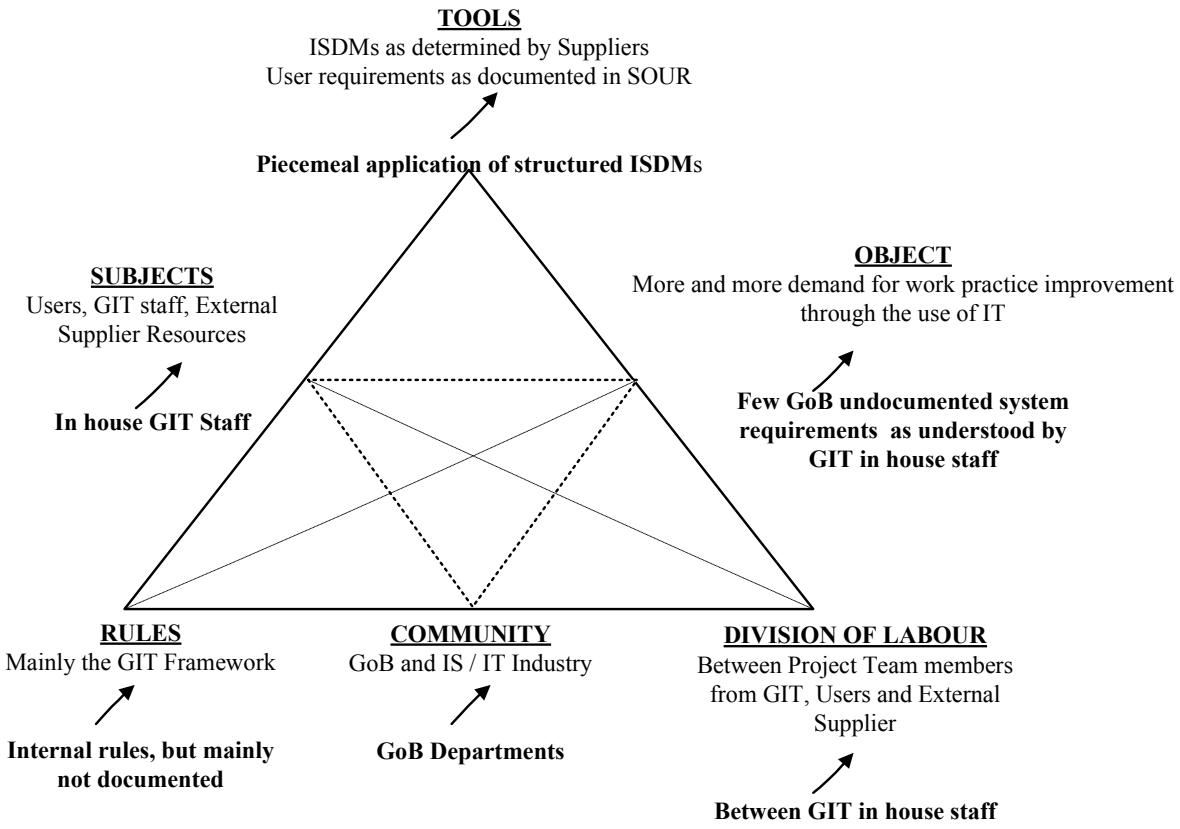

Figure 16: Historical Development of Botswana ISD Practice from 1969-1995 to 1995-now

The changes (as shown from the bold to the regular black) from one period to the next for most if not all of the activity system elements were mainly of a qualitative nature e.g. the change in rules from undocumented to documented standards and procedures through the GIT framework that were to be adhered to all those carrying out government ISD projects (i.e. internal or external); and the change in subjects from just in house GIT resources to now include users and external suppliers etc. However, it is significant to note that these qualitative changes were mainly brought about by the quantitative change in the object in terms of higher user demand for IT systems.

6.3.2 **Analysis of Contradictions**

In the first change lab there was also an analysis of the current contradictions as presented by the different participants representing the multiple voices in this network of activities which make up the current Botswana ISD practice. Each of the voices as represented by the user and developer

subject groups had their views on what the current challenges were. These different perspectives have been summarised in the table below (Table 13).

Table 13: Summary Perspectives of Current Challenges

USERS	DEVELOPERS
GIT Perspective • Enforcement of standards is a problem especially as it relates to hosting • Management of external suppliers is a challenge as GIT does not have seasoned project managers • System integration problems and too many silos of information as government ministries are all doing their own thing • '*Learning (on what IT could do) lagged behind automation that is why we have these problems*' • Methodologies employed were fossilising the manual system whereas ISD should produce results much quicker than the current 3 years it takes to develop and implement a system	• Decentralised with no proper coordination • Management not playing its role in terms of directing projects despite their role in initiating them; management disappear, but human nature is such that if 'big brother' is not watching users also disappear • Lack of harmonisation of implementation into a global organisational strategy – since users may be measured on performance on other areas, and not specifically on the system • Rigidity in Time, Cost, and Quality VS learning in an environment where the IS / IT implementation is being done for the first time • Lack of continuous user education through such programmes as ICDL • Life cycle split between multiple vendors – i.e. Analyst firm and Developer firm creates problems for understanding by users • Lack of well balanced project team – representatives are selected without considering the value the people would add to a project • Low level of user IT literacy and understanding of ISD e.g. somebody in team who does not know how to use a mouse – but are in Project Committee to make decisions • Insufficient job knowledge and processes – the fact that you are doing a job does not mean you know the job. May not understand the processes and business rules behind the job • Governments desire to have world class systems VS reluctance to make the necessary funds available - development does not come cheap!–
Departmental Users Perspective • Management level have clarity as to what the systems are to do – but at an operational level people were lagging behind and there was lack of buy-in • Slow system uptake due to lack of preparedness even in terms of availing the necessary data for meaningful system use • Level of preparedness as well as generating interest on the project; Lack of situational analysis before engaging in projects • Management visibility and role as change agents • Time factor – took ten years from project conception to SOUR and then another two years for design, development and implementation • Staff movements – originators of system have all gone and other staff members have either been transferred or gone for training – this has affected	

continuity and learning on the project as it always seems we are starting again • Package Vs Bespoke – solution we have now has never been tried anywhere else – reliance on one supplier • Supplier and PM contracts did not run for the full length of the implementation – challenge of resources • Data – have been struggling for months to get the baseline data; • Had not budgeted for some items which contributed to delays; • Management support – was there but was affected by staff movements • Need to constantly re-train our users since users may only use functionality seasonally • Need to find ways of getting people to not revert to manual system – force them to learn – force them to use system • Network connectivity problems • Project funding	• In-house Vs package – development resources are in the decline, guys out of university don't want to do development, there are more interested in hardware and network support • Lack of user uptake • Inadequate change management and lack of change champions in all process areas

The GITREPs perspective on challenges is consistent with her role as a government IT advisor and enforcer of standards (and therefore at a higher level) whereas the perspective of the departmental users and developers was system and project specific. For example, challenges identified at the government-wide level were integration, enforcement of standards and overall learning whereas at the system or project level challenges identified included data availability, involvement of management and users in projects and learning at a system or project level. What we see here are hierarchical (and vertical) level of challenges depending on the level at which a particular subject group is performing. This may suggest that within a network of activities there are (vertical) hierarchies of contradictions that may lead to different levels of learning similar to those identified by Toiviainen (2007) in her study of inter-organisational learning across levels. Furthermore, one can identify from this hierarchy of challenges the motives of the different subject groups as stated earlier. It provides another way of looking at the vertical dimension of

learning than that of power and subordination. This of course will have to be subjected to further empirical research.

I used these identified challenges, discussions from the first change lab and data collected from the initial interviews with the GITREP as well as the users and developers, to analyse the inner contradictions in the current ISD activity system in activity theoretical terms. Though there were different views on what the current challenges were, there was agreement with my initial assessment that learning and slow system uptake were major challenges in current practice.

The learning reported by users during the PIR interviews seemed to be inconsistent with the low system utilisation / uptake – one would have thought that what users had reported to have learnt would motivate them even more to use the new system even more – but that was not the case. This represents a **Subject Vs Object** contradiction because for as long as low user uptake persists there can be no meaningful work practice improvement, which was the desired outcome of the project.

Transition from work practice representation using the analyst firm's tools & techniques (i.e. ISDM) to representation using the developers tools & techniques was not easy for the users to follow initially and therefore it took some time for them to become active participants in the object transformation process. This represents a **Tool Vs Object** contradiction as well as a **Subject Vs Tool** contradiction. The RAD and more specifically the prototyping approach expect active participation of users through different iterations of the product – the active participation can only be achieved fully if the subjects understand the process fully and, in this case, the understanding was very slow. The RAD, as the word 'rapid' implies, anticipates a shortened development timeline – but in the PEX project there were delays in the prototyping which had a knock-on effect on the subsequent phases i.e. UAT, Piloting etc. resulting in an overall delayed implementation.

In addition to the two contradictions stated above, which result from the current standard practice of splitting the ISD process services between two companies (i.e. the analyst firm and the developers), there is also a **Division of Labour Vs Object** contradiction. Developer firm representatives who participated at the first change lab could not agree on whether this was the best approach to achieving the desired outcome as it contributes to confusing the users. One

asked – *'Why should the work be split between two companies? What purpose does it serve?'* And yet others felt that it is the correct approach because the analyst firm basically assumes the role of client and is there to assist the client to produce a specification that will be understood by both the client and the developer. Furthermore, this initial analysis is intended to help in scoping the project and coming up with a budget estimate. Given the current government setup and capability it would not be possible for them to carry out this work without external assistance.

As stated earlier, GIT has overall responsibility for advising, directing and coordinating all IT matters in Government. Though GIT wants to enforce the use of the GIT Framework and other rules and procedures their officers did not make themselves available on the PEX project to do so. During the initial change lab, this was highlighted as a common problem in other projects. Related to this, was the point made by the GITREP, that there was inconsistent use of the framework. This presents a **Rule Vs Object** contradiction.

The unavailability of GIT representatives also presented challenges for the analyst firm, as they now had to assume some role in ensuring adherence to government standards by the developers – this assumed that the analysts were well versed and up to date with regards to what those standards and procedures were. This is a **Subject Vs Rule** contradiction because the subjects (i.e. the analyst firm actors) who were now expected to ensure adherence to the rules were themselves not necessarily fully conversant with all the rules. An example of this had to do with domain integration whereby through a new GIT project all government departments were to be integrated into a single network domain and therefore there were new procedures developed in this regard which the PEX IT Manager, the analyst firm and the developer firm were not aware of for some time.

There was a top-down approach to the PEX project conceptualisation, which is quite common within current ISD practice. The full automation of the seed multiplication processes was an idea that came from Management and IT. They are the ones who identified the contradictions, tensions and problems with the current work practice and so they initiated the development of the PEX system to address these problems. As one of the User representatives at the change lab observed '*Reasons for and Benefits from ISD solution are often crystal clear in the mind of Management; Operatives at times struggle to appreciate the usefulness of ISD solution in their context*'. Furthermore, after conceptualising the project, Managements involvement on the PEX

project was minimal. They were consulted extensively during the analysis phase, but during the design and development they only availed themselves towards the end, when the final system testing was being done. Their input in the design at that late stage resulted in some rework to the system. This represents another **Subject Vs Object** contradiction in that not only did the transformation of the object not benefit from the input of all key stakeholder, but the operational users (as subjects) are the ones who are expected to actively engage in transforming the object into the desired outcome when they may not themselves fully understand what the desired outcome should be or even fully embrace the motive for the activity.

In a similar manner, the PEX clients input was only obtained during the piloting of the system, albeit in an informal way, and yet those that conceptualised the project identified them as key stakeholders. This is another **Subject Vs Object** contradiction.

There were instances when the Functional users did not appear to fully understand their own work practice. As observed by one of the participants at the change lab one of the challenges they experience in ISD projects is *'Insufficient user job knowledge and processes ... the fact you are doing a job does not mean you know the job. (Users) may not understand the processes and business rules behind the job.*' For example in the PEX project, we would go through a session with the Functional Users, only for the PEX Head to come and say *'... No that's not how it is done ... this is what they are supposed to do ...'* Again this presents a **Subject Vs Object** contradiction since the users were expected to contribute towards transforming a work practice which they did not fully understand. This delayed learning of the user domain by the developers. It also delayed learning by the users at it took time to get to their eventual system.

According to one of the developers / suppliers – the classical approach is preferred by government as opposed to their preferred iterative approach. But this is not consistent with what was explained by GITREP – the choice of methodology is currently left to the Supplier. This misconception and misunderstanding of what is the actual practice concerning this issue is a **Rules Vs Object** contradiction.

Developers at the change lab identified a double bind in the need for learning and the three criteria for successful projects i.e. time, cost and quality. They questioned how learning could be achieved when they have to deliver within a set time and budget. This represents a **Tool Vs**

Object contradiction because the choice of methodology as well as timeframes for completing projects is left to the developers. Furthermore, their preferred iterative approach is supposed to encourage learning.

At around the same time as government developed the ICT Strategy, a Performance Management System (PMS) initiative was introduced, which emphasised the need for strategic planning and execution of initiatives within set timeframes. Despite this you still have projects like the PEX project which took ten years from conceptualisation to implementation. As a result of this the project experienced high human resource attrition rates. For example only 29% of the users who started the project were there when it was completed. This could be classified as a **Rule Vs Object** contradiction where the Key Performance Indicators (KPIs') as defined in the Strategic Plan, and project timelines as defined in the Project proposal document (i.e. submitted when funds were being requested) are the rules that set out the timeframes within which the object transformation should have been completed for meaningful impact. About this issue one of the participants observed:

> *'Where people are measured and performance measured on specific areas we have hardly seen IT included in the scorecard and therefore the focus of the user / project team has not been on the system but other things i.e. what they are evaluated against. That is a challenge for learning because their mind is elsewhere.'*

The desire by government to decentralise IT services and to grow / develop the ICT sector on the one hand versus the desire to maintain high system integration standards as well as adherence to common standards across government is a major concern and contradiction as expressed by the GITREP. The desire to not only grow the sector and develop local (citizen) capacity through outsourcing Vs the need to complete projects as quickly as possible. As the GITREP put it *'Software development is critical to be done and finished as quickly as possible.'* What has happened instead is there is no growth in local (citizen) developers, as outsourcing is to mainly foreign-owned companies who prefer to bring their resources from outside. This is a **Rule Vs Object** contradiction since the rule was to use more citizen resources – but that was not achieved.

Figure 17 is a representation of my interpretation of contradictions within the current activity system. Though not discussed in much detail there are primary contradictions in the use value and exchange value in the Subject, and Rules elements of the current activity system. For example, there are reported instances where the user's clients (e.g. farmers in the case of the PEX project) are consulted during the ISD process and instances where they are not. The other inner contradiction is where a representative of the analyst firm as Project Manager assumes the role of user during the design and development of some projects and not others. The same applies to the inconsistent application of the Rules where in some instances a PIR is carried out at the end of the project and instances where it is not deemed to be part of the process. This may be because the PIR is not part of the GIT framework.

Overall these identified contradictions contribute to the current learning problems and slow system uptake as they shift the focus from the object of the activity.

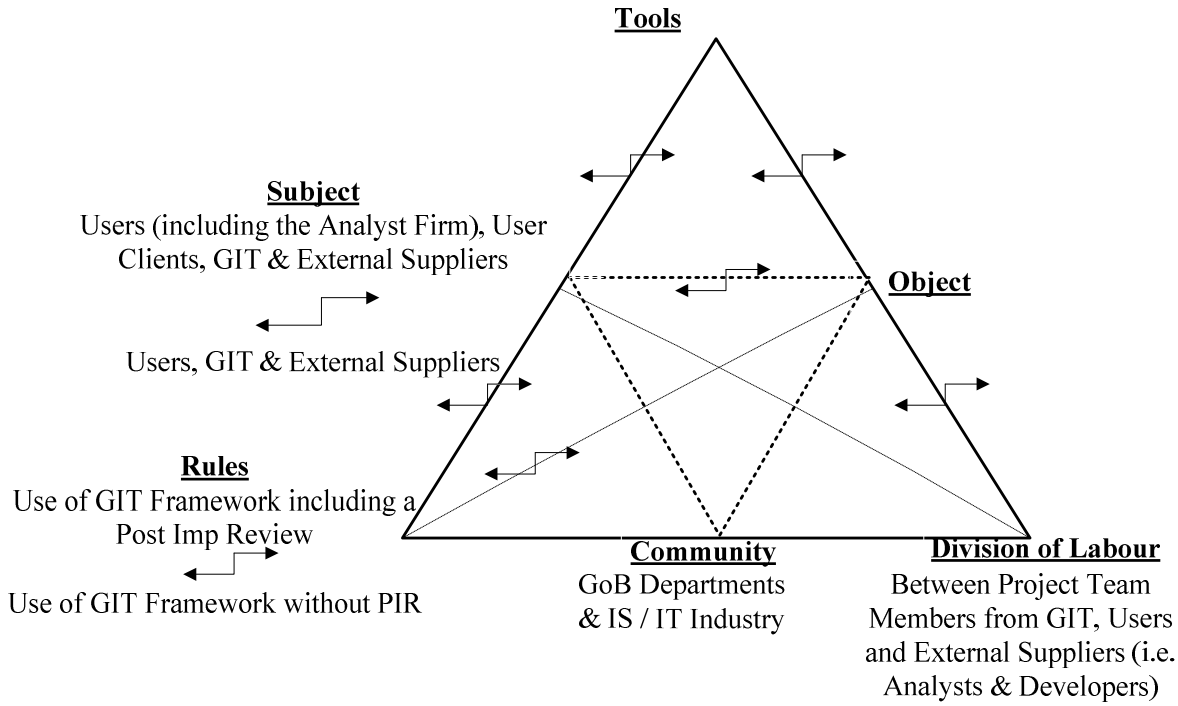

Figure 17: Representation of Primary and Secondary Contradictions

The question that now arises is – how has the historical development of the Botswana ISD practice discussed earlier contributed to these current tensions and contradictions? It would appear that the decentralisation of IS services, as demanded by User Departments, and as provided for in the 1996 ICT strategy, contributed to the challenges and contradictions identified above in that there doesn't appear to be sufficient capacity to monitor adherence to GIT standards and procedures. There is also, as highlighted by the GITREP, a major issue of systems integration as each government department seems to be doing its own thing. Furthermore, there is major issue of effective learning within current ISD practice, which is the subject of this research study. Figure 18 shows a hypothetical analysis of these contradictions based on the historical analysis presented earlier.

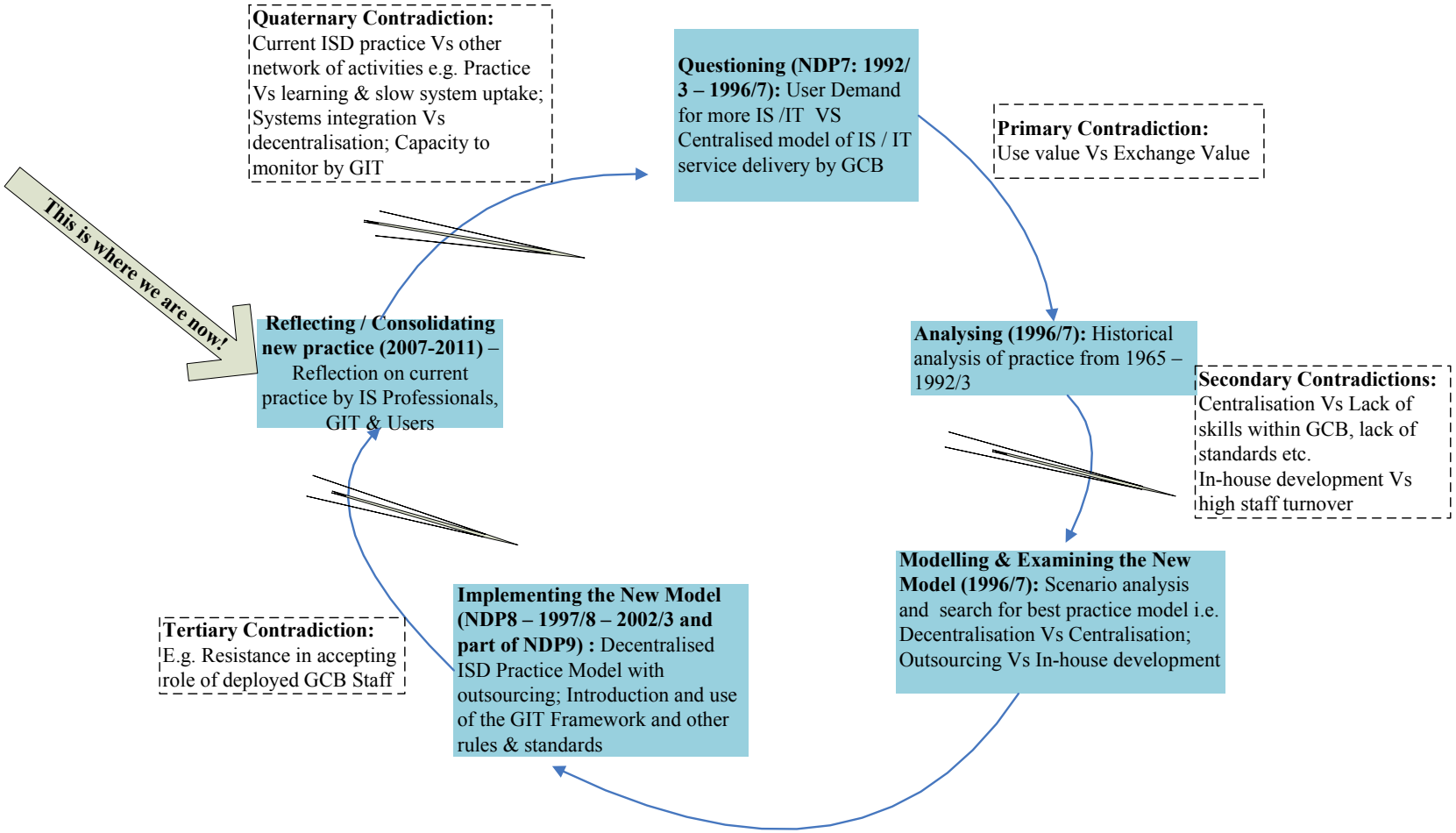

Figure 18: Historical and Hypothetical Analysis of Contradictions in Current ISD Practice

6.3.3 **Analysis of Learning**

Though as observed by some of the participants, the contradictions and identified challenges contribute towards problems of learning and slow system uptake, I felt that it was necessary to still carry out a retrospective analysis of learning on the PEX project. This has been done by identifying the conditions and means for learning as well as the type of learning using Rogers (2003) classification i.e. whether an action presented an opportunity for task conscious learning (unconscious learning) or learning conscious learning. This analysis is presented in Table 14 below. The analysis shows that most of the learning actions may be classified as facilitation mainly task conscious learning. This leads to the conclusion that in the PEX project, which is a typical example of most GIT ISD projects – learning opportunities were not being fully exploited to achieve both task conscious and learning conscious learning, which Rogers (2003) states facilitates effective learning in whatever learning environment. Furthermore, on the PEX project, learning was only evaluated at the end of the project and only as part of the post implementation review. There was no evaluation of learning at the end of each action. Therefore one is left to wonder whether there would have been benefits if the evaluation had been done at the end of each action, especially that, according to Rogers (2003), evaluation of learning focuses reflection – it makes that which was unconscious conscious.

Table 14: Learning Analysis based on Rogers (2003) classification – 'Task' Conscious Learning or 'Learning' Conscious Learning

ISD Stage / Activity System Action	Learning Opportunity / Actions (i.e. what were the learning tasks?)	Subjects / Social Actors / Actors Involved	Conditions (i.e. Under what conditions were the learning tasks carried out)	Means ((What means were used to carry out the specific learning action e.g. Were experiments used, games or some creative tasks etc.?)	Type of Learning Task / Action / Opportunity	
					Learning Conscious	Task Conscious (Unconscious Learning)
Indication of Intent	Preparation of the formal letter of intent requires an understanding of the ISD process and discussions with GIT on that	PEX Management PEX IT Personnel GITREP	Report writing in office environment	Guidelines provided with minimal interaction – maybe that is why GITREP said they were just going through the motions of computerisation		✓
Budget for SOUR Consultancy	Preparation of the budget requires drawing info from different sources, and calculations that could be using some tacit knowledge. Putting together the budget document is an externalisation of the budget guidelines – making tacit knowledge explicit.	PEX IT Personnel GITREP	Report writing in office environment	Again here, guidelines are provided with minimal interaction		✓
Procurement of SOUR dev services	This also requires drawing info from different sources i.e. GIT for the IS side, Procurement body guidelines etc.	PEX IT Personnel GITREP Procurement Personnel	Report writing in office environment	Again here, guidelines are provided with minimal interaction		✓
Production of SOUR & Budget for Solution Development	Interviews / Change labs with Management, Functional Users, PEX IT to illicit requirements; An explanation of the process and approach was an opportunity for them to learn about how ISD projects were carried out	PEX Management PEX Functional Users PEX IT Personnel GITREP Analyst firm	One-on-one interviews; Group change labs organised by PEX Units i.e. Labs Workshop; Inspection Workshop etc.	Facilitation by Analysts using the CSF approach which allowed reflection on work practice and current issues / constraints; There was dialogue & discussion amongst the Users		✓
	Analysts production of the SOUR document provided them with an opportunity to externalise in writing what they understood to be PEX's work practice and system requirements	Analyst firm PEX Management PEX Functional Users PEX IT Personnel	Report writing in office environment plus interaction with PEX stakeholders during the review process	Some dialogue and discussion to confirm understanding of work practice as SOUR was being produced		✓
Design, Developmen	Workshop with Developers to confirm requirements which was	PEX Management Developers	Workshop and dialogue facilitation; Report writing in office environment	Dialogue to allowed users confirm their understanding of their work practice and		✓

ISD Stage / Activity System Action	Learning Opportunity / Actions (i.e. what were the learning tasks?)	Subjects / Social Actors / Actors Involved	Conditions (i.e. Under what conditions were the learning tasks carried out)	Means ((What means were used to carry out the specific learning action e.g. Were experiments used, games or some creative tasks etc.?)	Type of Learning Task / Action / Opportunity	
					Learning Conscious	Task Conscious (Unconscious Learning)
t, Testing & Implementation of the Solution	being facilitated by the Lead Developer and production of the Requirements Scoping Document	PEX Functional Users PEX IT Personnel Analyst firm		the developers to learn about the users work practice		
	Developers production of the Functional Design Specification and other technical documents allowed them to externalise in writing what they had learnt & understood to be the user requirements;	Developers PEX Functional Users PEX IT Personnel Analyst firm	Report writing in office environment plus interaction with PEX stakeholders during the review process	Some dialogue and discussion to confirm understanding of work practice as SOUR was being produced		✓
	Users review of the FDS (or any other document) was an opportunity for them to learn about different documentation standards and techniques – but because they found it difficult to understand – it may have created a barrier to learning	Developers PEX Functional Users PEX IT Personnel Analyst firm	Desktop reading exercise, feedback provided in a meeting environment	Reading through document and having discussions amongst themselves.		✓
	Prototyping sessions provided learning opportunities through brainstorming and idea generation for redesigning the new work practice	Developers PEX Functional Users PEX IT Personnel Analyst firm	Workshop environment with a facilitator	Presentation of prototype and facilitation of brainstorming / idea generation sessions. Users did not play (hands on) with the prototype – only viewed it as well as signing off hard copy versions of the screens. The focus by both Users and Developers was on getting the design right.		✓
	Lab Testing – involved play as used got to interact with the system hands on and using different data sets allowed them to play with results / expectations	Developers PEX Functional Users PEX IT Personnel Analyst firm	Users were asked to do this as functional groups i.e. Labs brought their data, Inspection their data etc.	Play and direct, hands-on interaction with the system; Objectives were outlined. Though the focus was on the task, the conditions and the means allowed for play and reflection which are	✓	✓

ISD Stage / Activity System Action	Learning Opportunity / Actions (i.e. what were the learning tasks?)	Subjects / Social Actors / Actors Involved	Conditions (i.e. Under what conditions were the learning tasks carried out)	Means ((What means were used to carry out the specific learning action e.g. Were experiments used, games or some creative tasks etc.?)	Type of Learning Task / Action / Opportunity	
					Learning Conscious	Task Conscious (Unconscious Learning)
				associated with conscious learning		
	Training – formal, classroom training with objectives outlined in advance and an evaluation of the training / learning at the end	Developers PEX Functional Users PEX IT Personnel Analyst firm	Training room set up at DAR with computers shared by trainees, user training manual was developed and used during training; exercises used	Play and direct, hands-on interaction with the system; Training objectives outlined and evaluation done at the end	✓	✓
	Piloting - Real-life practice of the new work practice using the new computer-based 'tool'- presented an opportunity to learn about the new work practice and any challenges that may arise	Developers PEX Functional Users PEX IT Personnel Analyst firm	Carried out at each of the PEX officers site e.g. the Lab, the Warehouse etc.; Real, live data was being used and there was interaction with the clients	Direct interaction with the new PEX system.	✓	✓
	Go Live - Developers can learn about the technical operating environment of PEX and how to make the system operate as per the agreed performance standards	Developers PEX Functional Users PEX IT Personnel Analyst firm	Technical system operating environment; User operating environment	Developer with machine; User in interactive environment with clients		✓
Support	Direct assistance to a user on an application / system functionality – sometimes turned to training the user on that functionality	Developers PEX Functional Users	One-on-One assistance	Sometimes used system walkthrough	✓	✓
Post Implementation Review	A review and evaluation of the whole project together with an evaluation of the learning – Was there a learning opportunity here?	PEX Functional Users PEX IT Personnel Analyst firm Developers	One-on-One interviews	Opportunity to reflect on the project as a whole including the learning	✓	✓

6.4 *Learning action 3 – Modeling the new solution*

The main objective of this research study was to find a solution to the current learning problems that manifest themselves in slow system uptake and lack of meaningful work practice improvement. In this section I will present the solution design.

The questioning and analysis of contradictions and learning in the earlier sections confirmed my initial concerns about limited learning in current Botswana ISD practice. As the GITREP put it *'Learning (on what IT could do) lagged behind automation that is why we have these problems'*

In the initial change lab session some of the factors contributing to slow systems uptake and learning were said to be the lifecycle split between multiple vendors i.e. between the analyst firm and the developer firm, the lack of well balanced project teams where you have a mix of seasoned professionals and artisans, the low level of user IT literacy, insufficient job knowledge and processes, lack of management visibility and assumption of role as change agents, and timing of the system implementation. As one of the users put it:

> '*Could it be timing of system that contributes to slow system uptake – maybe in our case we may have started the process too early. The Department could have done other things to ready itself first before introducing the system ... at Management level there appears to have been clarity as to what the new system was to do – but at an operational level people were lagging behind – this leads to other problems – particularly on this type of project which requires data to have high level of uptake and the data can only come from the people in the organisation – consultants will not know where the data is.'*

From the initial change lab, it would appear that the choice of methodology used was not the issue or reason for slow system uptake because all three companies represented suggested the use of an iterative approach which was intended to encourage learning. It was suggested that a readiness assessment should be carried out prior to starting any ISD project to look into such issues as data availability, network availability and the IT skills level of users. Developers suggested that a due diligence of the user requirements should also be carried out prior to design and development of a system.

Both users and developers suggested that change management should be incorporated into the ISD process. The argument here was that though there was recognition that there were change

management activities carried out on some projects, there was need to ensure that change management was an integral part of all ISD projects and that capacity needed to be developed to be able to carry out the change management activities both internally and externally. Another suggestion made which was common to both users and developers was the need to enforce the use of any new system by management. Lack of management push and enforcement was as contributing towards slow system uptake. Other suggestions from the developers were that client resources must be involved from the beginning to the end and that two user acceptance tests should be carried out to address pre and post pilot implementation. The developers' argument for these two UATs was that it would help with the user learning curve and could therefore potentially assist with user uptake of the system. The suggestions are tabulated in Table 15 below.

Table 15: Summary of suggested Improvements

User Suggestions	Developer Suggestions
Readiness Assessment	Change Management
Change Management	Due diligence on needs analysis to ensure Department is ready
Enforcement of system usage	Enforcement of system usage from top Management
	Client resources must be involved from the beginning
	Carrying out two User Acceptance Tests to address pre- and post pilot implementation

Though I agreed with these suggestions I also thought that the main problem is that learning was not a primary objective of the ISD process and because of that, there were no learning 'check points', in a similar manner to having sign-offs at each phase / stage of the process. The learning checkpoints would allow for reflection at each stage of the process in terms of not only what had been achieved in terms of deliverables but also the learning that had been achieved. The idea of introducing some form of reflection was adopted from the concept of reflective practice introduced by Schön in 1983 which can also be traced back to the work by Dewey on exploration of experience, interaction and reflection (Bould et al., 1985). Reflective practice enables one to reflect on their actions and thereby achieve learning. And this according to Schön (1983) can be achieved in two ways i.e. reflection-in practice and reflection-on practice. Reflection-in practice

involves reflecting on ones actions whilst they are acting or doing something, and reflection-on practice refers to reflection after the fact, that is reflection on actions or tasks once they have been completed. It is the latter which I have used to inform the new model. The model also addresses the vertical as well as horizontal dimensions of learning as suggested by Vygotsky – the vertical in terms of the knowledge acquisition at an individual level through reflection and the horizontal as users and developers interact and dialogue during the evaluation sessions (Engeström 1999). Reflection in this collaborative manner brings about expansion in learning through the collective unconscious – through bringing the individual unconscious knowledge to the fore through dialogue and discussion during the 'learning evaluation session'. It would be expansion through activity!

As the interventionist in this research study, I therefore set out to propose a new model that included learning checkpoints for presentation and discussion at second change lab session. The existence of checkpoints enhances learning consciousness during all the project tasks than was originally the case – which is currently what is missing from current practice. The suggested model, as depicted at

Figure 19 and Figure 20 also takes on board the two suggestions which were common to the two subject groups i.e. Change Management and Readiness Assessment.

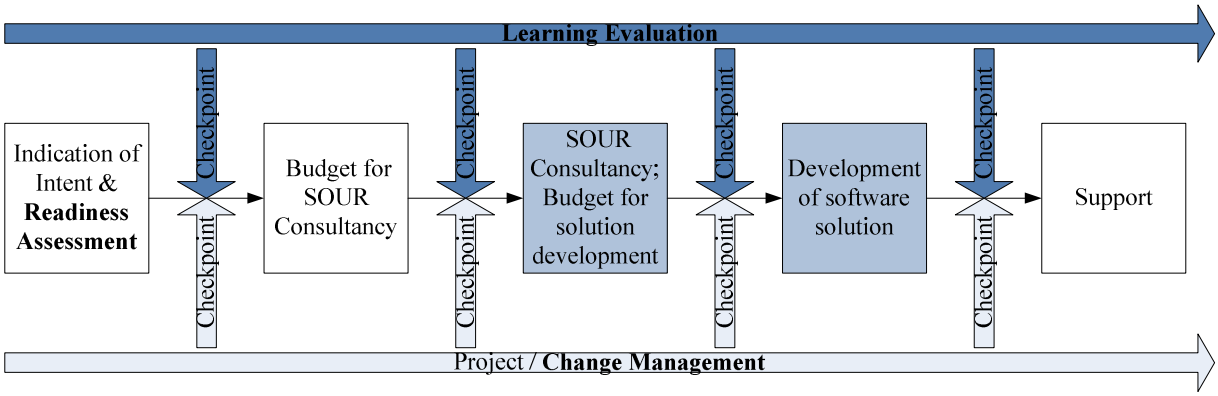

Figure 19: Learning Evaluation Checkpoints in the New ISD Process

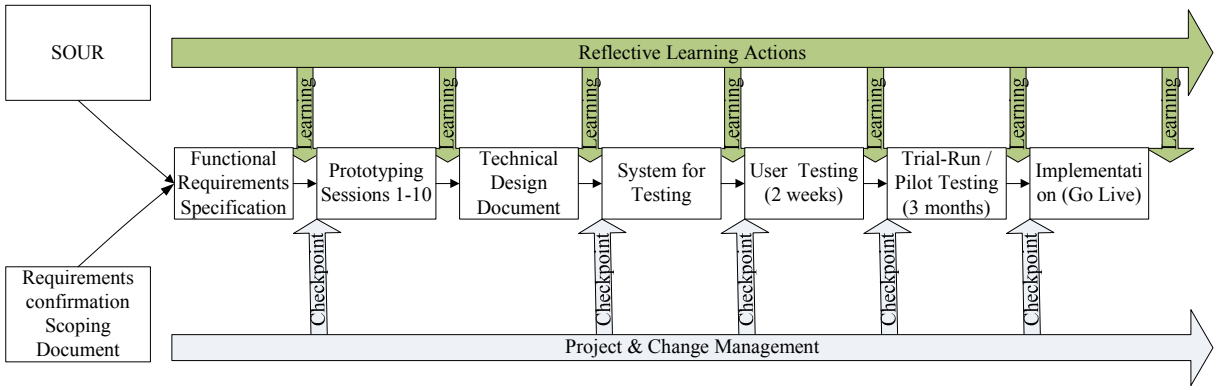

Figure 20: Learning Evaluation Checkpoints in the Design Process

I further suggested that the learning evaluation should involve the following (also as depicted at Figure 21):

- At the end of each action / stage social actors spend time reflecting on what has been done as well as on the learning (out-side of the process)
- A one day session is organised for this reflection
- Learning is analysed using Engeström's expansion learning theory (i.e. that is going through the four questions as articulated earlier in this report)
- Learning (improvement) actions where necessary are agreed and included in the next stage of the ISD process

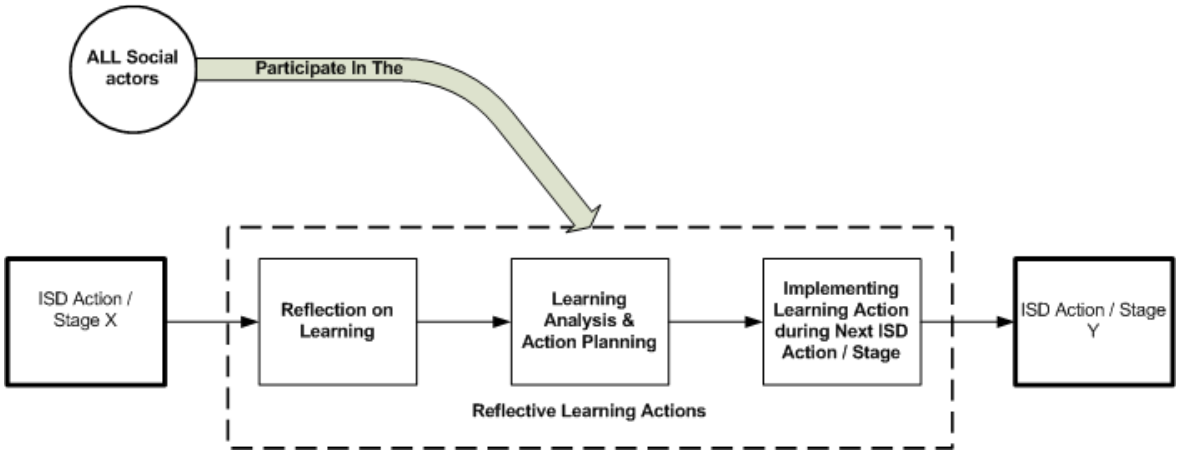

Figure 21: Reflecting on Learning

This new model was presented at the second change lab session as a stimulus to trigger discussions and focus thinking on learning and how to resolve current problems. I explained to the participants that joint collaboration in redesign of practice was crucial to the acceptance and implementation of the model. What follows next is presentation of the examination of this suggested model that took place at the second change lab, together with the learning that resulted from that.

The proposed model suggests that in activity theoretical terms, learning should be included together with work practice improvement as the object of the ISD activity. The suggested transition from the current to the new activity system is depicted at Figure 22. The suggested qualitative changes to the current activity system are as follows:

- Tools – in addition to the existing ISDMs that various developers use, they would have to also use the new ISD practice model that incorporates learning checkpoints;
- Subjects – Both users and developers would need to be active participants not just in the development process but also in the learning process;
- Rules – The current GIT framework would need to include the new rule of ensuring that all users adhere to and comply with the practice model;
- Community – All members of the community (i.e. the various government departments) and the IS / IT industry would need to have a clear understanding of the new model and also be active participants in its realisation;

- Division of Labour – there may be need to add more resources and teams on both sides to facilitate the learning evaluation process.

From a systemic point of view, these qualitative changes will affect mainly the subject and rule producing activity systems. The subjects produced in order to realise this model will need to be what Schön (1983, 1987) terms reflective practitioners. A study of whether current ISD practitioners are reflective along the lines described by Schön would be an interesting one to carry out. In terms of the rule producing activity, a process will need to be initiated to incorporate this new model into the GIT framework as well as to put the necessary measures in place to ensure adherence in line with government requirements.

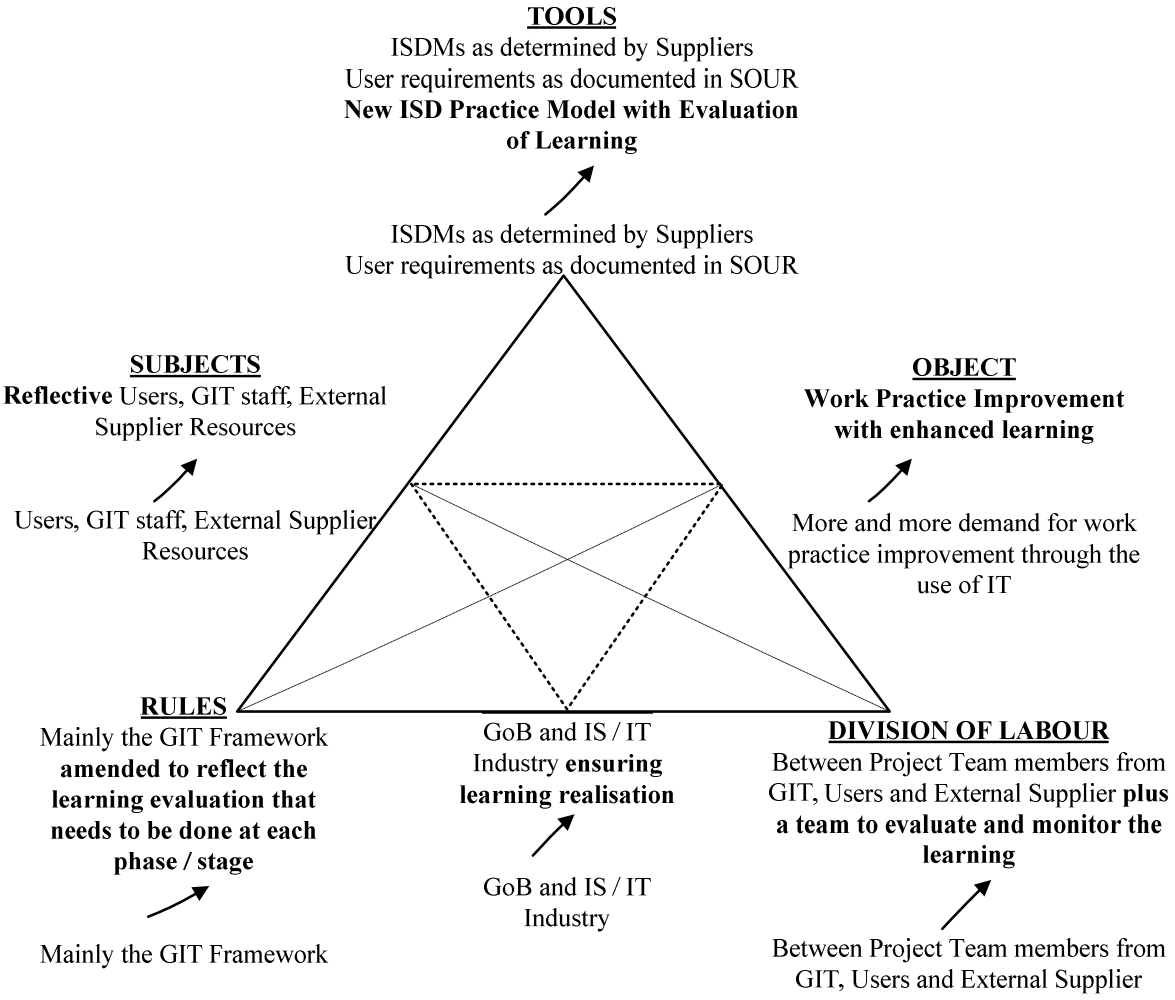

Figure 22: New ISD Activity System

6.5 Learning action 4 – Examining the new model

Examining the new model was done immediately after I had presented the model at the second change lab session. Again as the interventionist, at the end of presentation of the proposed model, I provided guideline questions to facilitate the expansive learning as the new model was being examined. The guideline questions were meant to assist in the analysis of expansion of the object in line with the four dimensions of expansion as suggested by Engeström (2000), Hasu (2000), and Engeström and Sannino (2010). The questions were open ended in structure to allow flexibility in examining all aspects of the model. Though the order of discussion did not necessarily follow the order of questions as I had provided them, we managed to have useful dialogue around each one as well as others that resulted from the discussions. The usefulness of the questions as a guide was not missed by the participants, whereon after about an hour of discussion one of the participants said '… *Go back to the last slide with the list of questions so we can have more organised contributions around those questions'.*

The questions and the analysis of learning along these dimensions follow in the order of the guideline questions, again just so that I can have an organised analysis rather than jumping from comment to comment.

i) So would this (i.e. the new model) suffice and will it address the current learning challenges?

This represents a systemic-developmental dimension of expansion where the questioning and learning is on "how does this shape the future of the activity". Through this question I wanted participants to dialogue on first of all whether the model would achieve the desired results in terms of learning and secondly how the future activity should be constituted based on this model.

On whether the model would suffice, there were those participants who offered their views specific to the model and the concepts that I had indicated informed the development of the model e.g. conscious and unconscious learning and reflection as demonstrated, for example by the following comments from the participants:

Excerpt 1:

'... I do agree with you when you said that sometimes we dwell more on task learning to an extent that even yourself you are not even aware of how much learning has actually taken place in yourself ... and then people go to an extent of learning to do things without appreciating the other side of the learning i.e. the knowledge that they have gained and it becomes in most cases evident when you ask someone to show somebody else what they have learnt and how it works and how it can improve their operations ... and they will give you a blank kind of face and they say ''Aa I don't know we went through that and we are supposed to do this and this and this" ... but I do agree that somewhere in the system we have to deliberately make an effort to build into the whole cycle an opportunity to help people realise that there has been learning ... to make them conscious of that which they are not conscious of ... it will add more value to all these initiatives that we are always doing and sometimes things do not catch up and get implemented as we anticipated because people are not aware of how much they have learnt ...'

Excerpt 2:

'In my opinion really when we are in unconscious level, we are in the ideal state which means learning has taken place and we are now in a pilot mode and for me to get to that stage will require a lot of repetitive type engagement in projects ... in other words the whole system, the whole user community, implementers as well needed to have been involved in a lot of that in order to get to that point ... so that will be my comment. And that is a very ideal stage because 20 years later when we evaluate Botswana as a whole in ICT implementations and whether they are achieving what they are supposed to achieve ... basically we will be able to say ... look a lot of learning has taken place and we are now at stage where we can unconsciously when given a system to implement we will all know what to do in the correct manner to achieve the project objectives.'

This comment seemed to suggest the desired levels of learning may require engagement in more than just one project but repetitive projects. But there are also those who without making reference to the concepts of conscious, unconscious learning and reflection

thought the model would achieve the desired results as gleaned from the following comments.

Excerpt 3:

'I totally agree with the learning and evaluation throughout. I am going to give you an example of the PEX project. I joined them at like completion of the whole thing, but then it had so many problems ... and the users themselves you'd ask why this thing is like that? "No, I don't understand, the supplier just said this it ok and I said it was ok". Then you would go on to another stage or four more stages, (but) for you to correct the first stage it's so expensive, it is linked to the 2nd, 3rd, and 4th and now it cost the government about 100,000 to correct. But if after learning that part it was evaluated and checked how it would influence the next one - maybe it would have cost government about 12,000 ... but now that it is way far it was attracting those costs ... so I think learning and evaluation can improve on the systems.'

Excerpt 4:

'... my concern is that from what you have come up with ... I did not get the part of linking the functional and management level because the level of understanding is not the same, there should be a model of how do you provide learning to Management throughout the process as against the functional users throughout the process...'

This last comment was suggesting improvement to the model, which I believe had already been taken care of since the evaluation sessions would involve all the social actors. This was pointed out during the discussions.

The Change Management aspect of the model was also discussed as being critical especially since one of the Subject-Object contradictions that had been identified in the current activity system had to do with the fact that in most cases Management were the initiators of most ISD projects, and their involvement during the development process was minimal as they left everything to the functional users who may or may not be willing or capable to carry out the work. About this one of the participants stated:

Excerpt 5:

'... Sometimes the project may be initiated from the top, and sometimes when it starts there may be issues of communication that an organisation has to deal with. The workers or junior staff may feel that the project has not been communicated well to them and may not want to own anything or do anything. But they will go along with the project because it is an instruction that from now onwards we will do this – they will not question it and if you ask them about the project they will tell you about a different thing about the process, they will deliberately give you wrong information because they are really not interested. And this really comes back to the issue of Change Management...'

There was emphasis on the fact that in order for the model to work, there would have to be a Readiness Assessment as well as someone (or party) taking responsibility for guiding the learning:

Except 6:

'... if we want to achieve that (i.e. system uptake and meaningful work transformation) then we must guide that whole learning process and that whole learning process for it to be guided needs somebody who must have the knowledge ... the blind need to be lead ... so that will be my contribution on that and obviously at each stage we will have identified what we believe is the readiness level, really what specific areas do we believe will contribute to learning, so that when we evaluate at least we have some guidelines of some sort which says at this stage this is really what we want to evaluate and hopefully see if there is a shift from what our initial assessment was...'

The comments on the need to lead the learning process shifted the discussion to a discussion on ownership. The discussion on ownership moved from a discussion on ownership of the learning process to ownership of the system that was being developed. This was even extended to a discussion on how ISD contracts should be framed in order to protect the rights of users from developers who were said to be taking advantage and selling systems developed using user information for their sole benefit. But after some

lengthy discussion on this we reverted back to the central question which had been posed by one of the participants as:

'Who should own and drive the learning?'

I like the fact that this was a question that had resulted from the discussion about the model and that it was not amongst the three guideline questions that I had provided. This, according to the four dimensions offered by Engeström (2000) and Hasu (2000) represents expansion in the moral-ideological dimension which is said to address the question "who is responsible and who decides?"

There was general agreement that Management, as the initiators of projects should drive the learning process. This, according to some, would also ensure their active involvement throughout the process. In addition to reflection, there was a strong feeling that the learning and knowledge from stage to stage needs to be captured. This would be made possible, if the model would also expand on the learning that is anticipated at each stage of the process.

The discussion on how the future activity should be constituted was addressed indirectly as part of the second and third questions in that even though the questions have been classified as representing the anticipatory-temporal dimension in the discussions that ensued the group touched on the systemic-developmental dimension because introducing a Learning Contract or amending the current GIT Framework will affect the activity system as a whole. The learning contract would constitute a new rule, and amending the GIT Framework would also mean changing existing rules as well as tools, since now social actors would need to follow a new model.

On other systemic issues one of the participants observed that delays to project implementation and inability to achieve project milestones due to lack of funding could contribute to failure in achieving the desired results with the use of the new model. This

delay may make it difficult to evaluate the learning since some '*... project input was missing from the beginning*.'

ii) How can we make it work in practice? Do we need to have a 'Learning Contract' in addition to the Memorandum of Agreement between clients (i.e. users) and suppliers (developers)?

This represents the anticipatory-temporal dimension where the questioning relates to "what previous and forthcoming steps should be considered". I wanted to trigger discussions here on what forthcoming steps should be considered for the new activity. This question also touches on the systemic-developmental dimension as mentioned above.

In terms of the next steps, there are those who felt that the Learning Contract should be introduced, but battled with how to frame a contract that includes what they termed 'active' learning (i.e. learning to use the system) and 'inactive' learning (i.e. as attained through participation in the project e.g. manager role).

Excerpt 7

'... (the learning contract will) assist with dealing with other issues that are not currently covered and allow people to think outside the box. The current (standard) MoA (Memorandum of Agreement) does not address what someone knows or doesn't know... How do you say you assisted someone with learning when it was not in the initial agreement ...?'

Excerpt 8

'I believe that should work (i.e. the learning contract). I think that is exactly what they need and it is possibly the best way of approaching it. That is the only way you can ensure that there is learning taking place and you are going to directly or indirectly get buy-in from these people because these people will now realise they need to be part of the process. ... It is probably something that has been missing. It is true that system uptake is

very low ... probably if you incorporate this you could increase the level of system uptake. You probably need to test it somewhere but I believe it can work. This is the way to go.'

Excerpt 9

'I am trying to think what does the learning contract entail because one aspect of learning a system is that users are going to be trained on it, so part of the learning contract already captures that i.e. the formalised way is already captured. The other learning which is not captured which is learning by observation e.g. the memory stick example, is the one that is not covered'

This discussion on whether to have a learning contract or not also took another focus shift as the group then began a discussion on informal learning and handholding.

Excerpt 10:

'... to me the more they talk about it the more I realise that probably there is more need for informal learning, maybe there is need for cognitive support as people are actually now implementing the system. So that when they reach challenges then there is ready support to say this is our problem and this is how you go about it. My problem with innovations is that people are trained initially and then not given continued support so that when they meet challenges they become discouraged...'

Excerpt 11:

'I would also want to suggest that if this process may be followed (i.e. the proposed model) you probably will be able to create more capacity so that the handholding (which is currently being provided as part of current practice) will be reduced to some extent, even aspects of problem solving will be reduced. But if they just come in at the end when the system has been developed there will be need for handholding and hugging (laughing). But if there is process learning you will increase capacity.'

After some lengthy discussion there was agreement that amending the GIT framework to include the use of the new ISD model may be the easiest and most appropriate route and

that provision would be made in the current contract that the new ISD model, incorporated in the GIT framework, would be used on all ISD projects.

iii) **How and when can we test and implement this model? What needs to be done in order for us to implement and test this new model (e.g. does the current government IT framework need to be amended?).**

This third question was also along the lines of anticipatory-temporal dimension of expansion. In addressing this participants were of the view that GIT should be consulted to assist with identifying a project that could be used. The difficulty that was noted with testing of the model was the length of time it would take, especially if the testing was to be done from the 'Intent' phase. The case project took ten years from intent to implementation, and most government projects, though they may not necessarily take ten years – are normally delayed for some reason or the other.

It does not appear as if the social spatial dimensions where the interest becomes "who else should be included?" was covered at all – not in the guideline questions or even during the change lab dialogues. This may have been so, because the activity system as represented and analysed included almost all the social actor's including at the community level. It will be interesting to find out if this dimension is not observed during the testing and implementation of the model.

6.6 *Conclusion*

In this chapter I have presented an analysis of collaborative ISD practice redesign following the expansive learning cycle or actions as proposed by Engeström. The analysis shows primary and secondary contradictions in current ISD practice which contribute towards ineffective learning by social actors. The analysis also shows the multi-voicedness of activity systems as participants during the co-design change labs expressed differed perspectives on first of all current challenges and then what they viewed as solutions to those challenges (Table 13 and Table 15). The analysis of learning actions during change lab dialogues that dealt with developing and examining the new model show possibility of expanding the object in three dimensions i.e. the anticipatory-temporal, moral-ideological and systemic-developmental. There was no clear demonstration of possible expansion in the social-spatial dimension.

The anticipatory-temporal dimension revealed possible expansion of the object through incorporation of the model into the GIT framework and adding the necessary contract provision in the MOA to ensure adherence by all parties. On the moral-ideological dimension, management was seen as the ideal candidates to drive and lead the learning process. Analysis on the systemic-developmental dimension further confirmed the need for considering the network of activities and the wider community (e.g. the Government Finance Department as mentioned here) in the eventual testing and implementation of the new model.

Learning actions 5 (Implementing the new model), 6 (Reflecting on new practice) and 7 (Consolidating Practice) have not been possible as part of this current research. I have initiated discussions with GIT on how this model can be tested and adopted within the government system. Though it was not possible to go through all the epistemic actions, learning was achieved as described by Daniels et al. (2007), Engeström and Sannino (2010). I was able to observe how the participants were able to expand the object of the activity and enrich it as they went through for example the focus shifts of discussing the moral-ideological dimension of who should drive the process. This had not been in my original guideline questions. We traversed the zone of proximal development together as we moved from the two key suggestions of Change Management and Readiness Assessment, to a model that incorporates learning checkpoints and requires reflection-on action at each phase / stage of the ISD process. This in itself constitutes the creation of new knowledge. At the beginning of the process we did not know what the final outcome would look like – the resulting model evolved as a result of the learning activity that we engaged in.

It was interesting to observe how participants reacted to the introduction of new intermediate concepts such as conscious and unconscious learning, and reflection. The conscious and unconscious learning concept was found to be an interesting way of looking at learning by others, but others saw it as a remote idea. This interpretation and reconstruction of the task at hand (i.e. in line with Vygotskian theory) using concepts that were new to some, opened up potential and emerging new psychological formations of the participants.

The new ISD model has the potential to have a meaningful impact on improving current ISD work practice in Botswana because the solution addresses mainly secondary as opposed to the primary contradictions identified in the current activity system. It will mainly address secondary

contradiction between Tools and Object, and between Rules and Object. And this, according to Engeström (1995) and Pihlaja (2005), is the best scenario since although solutions to primary contradictions may be necessary, they are much more hypothetical and therefore may achieve minimum benefit.

What now remains is for this model to be applied to a real life project and the results monitored over a period of time. In my final chapter, I will now evaluate contributions as well as report on the lessons learnt during my exploratory journey of learning by expansion.

7 CONCLUSION AND FINAL THOUGHTS

7.1 *Introduction*

This chapter presents an evaluation of contributions as well as my final thoughts on this learning journey. In Chapter 1, I laid out what I expected to be the contributions from this research. The questions that now need to be addressed by this chapter are: 1) what have been the actual contributions? and 2) what are the research limitations and therefore opportunities for future research? I address these two questions first before providing my conclusions and final thoughts.

But first I present a summary of the thesis by looking at the research questions and how they have been addressed through this research study.

7.2 *Thesis Summary*

1. Research Question 1: *What constitutes Botswana's ISD practice or how is ISD currently practiced in Botswana?*

   A description of current practice was provided through a review of secondary data (i.e. mainly the GIT Framework) as well as presentations that were made by the GITREP as well as the practitioners from both the government and the private sector during the change lab sessions. The analysis of current practice was carried out in the study through the use of the case project i.e. the PEX project, and this is what has been presented and described in Chapter 5 of the report. Furthermore, during learning action 1, an empirical analysis of current ISD practice was presented using the activity system model in terms of the object, subjects, tools, rules, community and division of labour (refer to Figure 15). The historical analysis of current ISD practice together with current contradictions was also carried out and has been presented at Sections 6.31.and 6.3.2 respectively.

2. Research Question 2: *What are the users and IS professionals learning and is the learning effective?*

   The findings from the post implementation review reported learning by users as dependent on whether users were new to computers or had prior knowledge of computers. Those that were new to computers reported learning on the use and value of IT and those with prior knowledge of computers reported learning on how systems could be developed through the ISD process and on business process improvement. But despite this reported learning there

was slow system uptake which was in contradiction to the reported learning. Developers on the other hand reported learning on the project environment as well as on how to manage clients in different settings.

The analysis of the effectiveness of learning on current ISD practice was done retrospectively using the heuristic model on two types of learning (i.e. conscious vs. unconscious learning) and the conclusion was that current learning was not effective since most of the learning actions / tasks tended to emphasise unconscious learning. The analysis and conclusion have been presented at Section 6.3.3 and more specifically Table 14.

3. Research Question 3: *How can current practice be improved in order to facilitate effective learning?*

   The answer to this research question has been provided through the redesigned ISD practice model that incorporates learning evaluation checkpoints. The co-design process which culminated in this model is described in detail at Sections 6.4 and 6.5.

4. Research Question 4: *What do users and IS professionals learn when collaborating in the review and redesign of ISD practice?*

   This sub-question is addressed through the extensive discussion which is presented at Chapter 6 which is mainly based on the two change lab sessions that were held with participants from government and the private sector, which also included users. A summary of what is learned is also included at Section 6.6 and 7.3.2

7.3 *Evaluation of Contribution*

7.3.1 **Contribution to (ISD) Practice**

The contribution to ISD practice is linked to the response to the third research question i.e. “How can current practice be improved in order to facilitate effective learning?” This has been achieved through the collaborative review and design of a new Botswana ISD practice model that includes learning evaluation checkpoints as well as readiness assessment and more focused change management activities. The collaborative redesign sessions offered an opportunity for participants from government and the private sector to actively engage in looking at possibilities for improving current practice. This is something that had not been done before.

The opportunity to reflect on the learning at each stage of the ISD process is viewed as critical to achieving effective learning. Reflection will make social actors aware or conscious that they are engaged in a learning activity as part of the ISD process. This awareness will contribute significantly towards achieving effective learning and this will manifest itself in higher levels of system uptake and significant work improvement.

The application of this model, because of its general nature, can be extended to global practice. In fact it would be interesting to test this model in research contexts outside Botswana.

7.3.2 Theoretical Contribution

This research has made theoretical contribution to IS research, learning and more specifically expansive learning studies.

Contribution to IS Research

There are very few IS research studies that have been carried out in Botswana that are of a practical nature, using a real-life case project with participation from government and the private sector, similar to what has been carried out in this research. This study is therefore a welcome addition to what little has been done in the past. Theoretically it provides an example of how IS research of a practical nature can be conducted using CHAT / expansive learning concepts similar to what has been achieved in Europe and other parts of the world.

Contribution to Learning / Expansive Learning

In terms of contribution to learning, it was possible to use Rogers (2003) and Malcolm et al.'s(2003) heuristic tool on two types of learning as a yard stick to retrospectively analyse the effectiveness of current learning in ISD. This I believe has provided an example of how this heuristic tool can actually be applied in practice. This tool was also useful in providing an additional theoretical tool to use to stimulate discussion and dialogue around improvements that needed to be made in order to facilitate effective learning. This is something that had never been attempted before.

On expansive learning, the research provides a further example of how CHAT and expansive learning concepts can be applied in real-life situations to analyse work practice and also to stimulate learning following the expansive learning cycle. The findings from analysing learning

by users and developers as they engaged in the review and redesign of ISD practice (i.e. in response to the fourth research question) was that of 1) learning as collective and distributed agency and 2) learning as expansion of the object in a number of dimensions.

Learning as Collective and Distributed Agency

The collective and distributed agency of the object was demonstrated during the collaborative redesign sessions. I initially triggered the questioning, but in the latter stages of the research – the object had moved from an individual object to a collective object as participants began to embark on a journey across the unchartered terrain of the zone of proximal development to find a solution to the current learning problem. This resulted in the formation of a new and expanded pattern of ISD activity which included learning evaluation checkpoints. The addition of learning checkpoints is new to ISD practice. The expansion of the object and the corresponding new pattern of activity brought about collective and distributed agency as demonstrated during the change lab sessions (Engeström & Sannino, 2010).

Learning as Expansion of the Object in multiple dimensions

During examination of the model it was interesting to observe expansion of the object in the systemic-developmental, moral-ideological, and anticipatory-temporal dimensions as identified by Hasu (2000) and Engeström (2000). This is interesting because examination of the model was being done in a change lab session and not during implementation and yet even then it was possible to observe these areas of expansion. This implies that there may be different levels of expansion of an object depending on the phase or stage of the expansive learning cycle. This represents a new insight with regards to expansive learning studies. It should therefore still be possible to trigger and observe similar object expansion dimensions during the testing and implementation of the model or even during the other subsequent phases of the expansive learning cycle. This could be done by using the same guideline questions that were used in the examination of the model to stimulate thinking, discussion and learning.

7.4 *Methodological Contribution*

In terms of the methodological contribution, this research has provided further insight into the application of DWR as a research method. One of the reasons that DWR was selected over action research was that it does not stipulate fixed actions or fixed starting and end points (Engeström and Sannino, 2010). In this research study it was only possible to carry out four out of the seven DWR epistemic learning actions shown at Figure 10. Despite this, the findings and contributions are deemed useful since there has been evidence of learning as outlined above.

Four other notable methodological contributions are that 1) a case project rather than an ethnography was used for the initial scoping, 2) examination of the model was done outside practice, 3) only two long change lab sessions were conducted instead of six or seven short sessions and 4) as the researcher / interventionist I was also one of the IS practitioners that was involved extensively in the PEX project.

Use of a Case Project as opposed to Ethnography

Most DWR studies start with an ethnography for the initial fieldwork. In this study an ethnography was not done instead a case analysis plus some interviews were used. This, in my view, provided adequate information from which the study frame or space could be defined and used to trigger the learning challenge of questioning current practice and remodelling it. This therefore means that one is not limited to ethnography in order to use DWR as a research methodology for studying learning activity. This was probably made easier by the fact that I had been following the problem for 21 years! What seems to matter is to have sufficient information, whether from ethnography or a case as demonstrated in this research project, to be able to lay out or outline the research problem space as well as to provide a basis for the subsequent activities of questioning, modelling and examining the new solution. The case data provided me the depth of information I required to define the problem space in terms of who the key social actors were and what some of the current issues and challenges were from the perspective of the users and developers. This therefore formed the basis for triggering the expansive learning cycle.

Examination of the model outside practice

Also in this study, I was able to use the four dimensions of learning as suggested by Hasu (2000) and Engeström (2000) during examination of the model and not at implementation as was the

case during their respective studies. Analysing learning at this stage revealed that a guideline question could have other dimensions embedded in it – or that the dimensions are not fixed dimensions. There is a constant movement throughout the zone of proximal development and therefore the dimensions of object expansion are in a flux. This further shows the variability and flexibility of application of expansive learning concepts.

Change Laboratory Sessions

The other methodological deviation was that two long change lab sessions were held, instead of six or seven two hour sessions because of concerns over the availability of participants. It would not have been possible to achieve the same level of interest and participation in the research activity had I opted for more sessions. Although the time between these sessions was long – it was still possible for participants to engage with the object and dialogue and think through how practice could be improved. This indicates that there can be flexibility in the CL design and approach which depends on the social context of the study and the practicalities on the ground.

Researcher / Interventionist and also IS Practitioner

Most of the DWR / expansive learning studies found in literature were conducted by researchers who were not themselves engaged in the specific work activity they were researching on. In this particular research I was a researcher / interventionist and practitioner engaged in the ISD activity daily (i.e. I assumed both an insider and outsider role). The question that arises then is how have I been able to deal with these two distinct roles and how has this influenced the research process and the findings. My role as both researcher and practitioner was articulated upfront and acknowledged in the research methodology (Section 4.4). I was therefore conscious throughout the research process that as an insider I did not bring my own individual biases into the analysis. I think that my dual role has enhanced the process rather than influence it since I was fully engaged with the rest of the participants in the learning challenge of redesigning new practice.

Throughout the process I tried to be '... open, authentic, honest, deeply interested in the experiences of one's research participants, and committed to accurately and adequately representing their experience' which is what is important in any qualitative research study and not so much that one is an insider or outsider (Dwyer & Buckler, 2009). In this study I have

clearly outlined my three roles. As insider I participated in the development of the PEX system as an analyst and later as a project manager. As an outsider and also interventionist I facilitated the change lab sessions as well as carried out the data analysis. Furthermore as an interventionist, I made suggestions during the CL sessions on the inclusion of the learning evaluation checkpoints. But, though it was difficult, I allowed the participants to openly discuss my suggestions without any interference from me – at that point during the change lab sessions I assumed the role of facilitator. My clear awareness of the complexity of assuming the dual role of insider-outsider made it possible to manage my dual role which has contributed to the validity of the findings.

7.5 *Research Limitations and Opportunities for Future Research*

Although there have been some notable contributions to practice and theory, there have also been a number of research challenges and limitations that I will discuss in this section i.e. 1) stakeholder participation and interest, 2) testing and implementing the model in real life 3) analysis of other interconnecting activity systems.

Stakeholder Participation and Interest

The biggest challenge for this research was to get all concerned stakeholders to participate fully – initially GIT was fully supportive, but once there were transfers and restructuring within that department, the momentum and the interest was lost. The management changed and as result of that the support and interest was lost. The impact of this is that it was not possible to identify a real-life project on which the new practice model could be applied and tested. Pihlaja (2005) also battles with similar questions with regards to the application of DWR and expansive learning:

> *'The developmental method applied in the Change Laboratory emphasises learning on the shop floor with the support of top managers. The empirical case highlighted the central role of the planners and designers, however, who resisted the new form of learning. The question thus remains of how to engage the designers in these kinds of projects. To what extent would it be possible to carry out the cycle of expansive learning in delivery work without changing the other related activities at the same time? If it is possible to produce the kinds of innovation and collaboration discussion above within the Change Lab, where in the larger organisation and by whom should the change be initiated, and how could the results be integrated into the established practices?'* (Pihlaja, 2005, p. 230)

Carrying out this research study was an ambitious task for me, because I was trying to influence changes to a process or practice that was perceived to be fully owned by government. I wanted to bring the private sector on board so they could also share some of the responsibility of IS failures and thereby collaborate in seeking a solution to the problem. But, as was anticipated, getting sustained interest from the private sector was also a challenge, especially because changing the process was not a priority for them.

Any future research that seeks to bring government and industry together in collaborative review and redesign of practice will need to find means and ways of ensuring sustained participation and interest from the two subject groups.

Testing and Implementation of the Model

Another limitation of the study is the fact that it was not possible to report on the testing and implementation of the model. It is expected that during the testing and implementation of the model longer CL sessions as well as more sessions will be held because at that stage the participants will be confined to a specific project with specific users and developers as opposed to representative users and developers as was the case in this current study. This, however, presents an opportunity for future research in terms of carrying out and analysing learning during the remaining three epistemic learning actions of implementation, reflection and consolidation.

Analysis of other activity systems

The research design did not provide for analysis of all the activity systems making up the network of activities (i.e. Finance activity, procurement activity, subject-producing activity, tool producing activity etc), as the focus was on the two interacting activities of users and developers. It will be interesting to study, for example, the subject producing activity system to see whether Botswana institutions are producing reflective practitioners and the impact of that on the ISD process. What would one describe as the attributes of reflective practitioners in the context of Botswana and how does that differ with the global context if at all? Would, for example reflective practitioners be more facilitative of the learning that is required in order to avoid IS failure?

7.6 *Final Thoughts*

This research study has been an interesting journey for me as I went through a process of dialectical thinking and expansive learning. The journey began when I, as an individual and practitioner within Botswana's ISD practice, began to question the current practice, especially with regard to issues of learning and system uptake. It moved from an individual quest to the collective as I designed this research study that would involve other practitioners from the government and private sector (as well as users) in the collaborative analysis and modelling of the zone of proximal development of ISD practice.

At the time when I started, I was not aware of activity theory and its utility as a framework that combines work and development. Activity theory was introduced to me through a paper that was given to me by my supervisor sometime in 2007. On reading the paper I felt that I had at last found something that could address my research objectives. I therefore began a journey of knowledge assimilation and learning as I conducted further research on CHAT and related concepts.

It has been an individual journey of questioning-analysing-modelling-examining and implementation as I questioned the suitability of CHAT and more specially DWR as a research methodology. I also questioned whether expansive learning concepts were on their own sufficient to analyse current learning challenges in ISD practice. This analysis led me to conclude that I would have to look at other learning theories. I therefore began to model an approach that also included concepts borrowed from other learning theorists. The modelled approach included the use of the two types of learning by Rogers (2003) and Malcolm et al., (2003) which interestingly are also encapsulated in Leontiev's hierarchy of activity i.e. activity comprising of conscious actions and unconscious operations. This discovery increased my horizon of the zone of proximal development.

During the write-up and the change labs I was constantly examining my own thinking process in terms of whether the research approach and concepts adopted were right for this type of study. The fact that I was able to bring IS professionals together to introspect and analyse current practice led me to conclude that the approach was indeed suitable. I now leave it to the rest of the academic world to test the applicability of my findings.

As a research work I have thoroughly enjoyed the journey through the zone of proximal development, as I together with other participants from government and industry explored and developed a solution to improve current ISD practice in Botswana!

References and Bibliography

Avison, D.E. and Fitzgerald, G., (1988). *Information Systems Development: Methodologies, Techniques and Tools,* Blackwell Scientific Publications, Oxford.

Avison, D.E., and Myers, M.D., (1995). Information Systems and Anthropology: an anthropological perspective on IT and organisational culture. *Information Technology & People* , Vol. 8, Iss. 3, pp. 43 - 107.

Avison, D.E. and Fitzgerald, G., (2003). Where Now for Information Systems Development Methodologies? *Communications of the ACM*, Vol. 46 No. 1, pp. 79 - 82.

Avgerou, C., (2005). Doing Critical Research in Information Systems: Some Further Thoughts. *Information Systems Journal*, Vol. 15, pp. 103 -109.

Bailey, J., (2004). Making Action Research relevant for practice - foreword. *MIS Quarterly*, Vol. 28 No. 3, pp. 329 - 335.

Barrett, M., and Walsham G., (2004). Making Contributions From Interpretive Case Studies: Examining Processes of Construction and Use, in: Information Systems Research: Relevant Theory and Informed Practice, Proceedings of the IFIP WG 8.2 Conference, Manchester. pp. 293 – 312.

Baskerville, R., and Myers, M.D., (2008). First steps in qualitative data analysis: transcribing. *Family Practice*, Vol. 25, pp. 127-131.

Baskerville, R., Pries-Heje J., and Ramesh B., (2007). The enduring contradictions of new software development approaches: a response to 'Persistent Problems and Practices in ISD'. *Information Systems Journal*, Vol. 17, pp. 241- 245.

Baskerville, R.L., and Wood-Harper, A.T., (2002). A critical perspective on Action Research as a Method for Information Systems Research in *(Qualitative Research in Information Systems – A Reader, Edited by Michael D. Myers and David Avison, SAGE Publications, London)*, pp. 129 - 145.

Baskerville, R., and Pries-Heje, J. (1999). Grounded Action Research: a method for understanding IT in practice. *Accounting, Management*, & Information Technologies, Vol. 9, pp. 1 - 23.

Baskerville, R., and Wood-Harper, A.T. (1998). Diversity in Information Systems Action Research Methods. *European Journal of Information Systems* , Vol. 7, pp. 90 - 107.

Baskerville, R., and Wood-Harper, A.T. (1996). A critical perspective on action research as a method for information systems research. *Journal of Information Technology* , Vol. 11, pp. 235-246.

Baskerville, R., (1993). Semantic Database Prototypes. *Journal of Information Systems*, Vol. 3 No. 2, pp. 119-144.

Benbasat, I., Goldstein, D.K., and Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. *MIS Quarterly*, September, pp. 369-386.

Beynon-Davies, P., Carne C., Mackay H., and Tudhope D., (1999). Rapid Application Development: an empirical review. *European Journal of Information Systems*, Vol. 8, pp. 211- 223.

Beynon-Davies, P., Carne C., Mackay H., and Tudhope D., (2000). Its lots of bits of paper and ticks and post-it notes and things...: a case study of a rapid application development project. *Information Systems Journal*, Vol. 8, pp. 211- 223.

Bødker, S., and Grönbeck, K., (1996). "Users and Designers in mutual activity: An analysis of cooperative activities in systems design". In Y. Engeström and D. Middleton (Eds), *Cognition and Communication at Work* (pp. 130-158). New York, USA: Cambridge University Press.

Bondarouk, T.V., (2006). Action-oriented group learning in the implementation of information technologies: results from three case studies. *European Journal of Information Systems*, Vol. 15, pp. 42-53.

Borland, R.J., and Hirschheim, R.A., (1987). Critical Issues in Information Systems Research, John Wiley & Sons, Chichester.

Borland, R.J., (2002). Information System Use as a Hermeneutic Process in *(Qualitative Research in Information Systems – A Reader, Edited by Michael D. Myers and David Avison, SAGE Publications, London)*, pp. 226 – 240.

Botswana , (1997). *Government IT Strategy.* Ministry of Finance and Development Planning. Gaborone, Botswana

Botswana, (2003). *National Development Plan 9.* Ministry of Finance and Development Planning, Gaborone, Botswana.

Botswana, (2004). *Project Initiation Document for PEX.* Gaborone, Botswana.

Botswana, (2004). *SOUR for PEX.* Gaborone, Botswana.

Botswana, (2004). *Post Implementation Review Findings for PEX.* Gaborone, Botswana.

Botswana, (2005). *National ICT Policy.* Ministry of Communications, Science and Technology, Gaborone, Botswana.

Botswana, (2007). *Design and Development Documentation for PEX.* Gaborone, Botswana.

Boud, D., Keogh R., and Walker D., (1985). *Reflection, Turning Experience into Learning*, Routledge.

Brown, R.B.K, Hyland P., and Piper I.C. *Eliciting and Specifying Requirements for Highly Interactive Systems using Activity Theory.* Centre for e-Business Applications Research (CeBAR), School of Information Technology and Computer Science, University of Wollongong, Australia.

Brown, J.S., Collins, A., and Duguid, P., (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, Vol. 18, No. 1, pp. 32-42.

Brown, J.S., and Duguid, P., (1991). Organisational Learning and Communities-of-Practice: Towards a Unified View of Working, Learning and Innovation. *Organisation Science*, Vol. No. 2 (1), pp. 40-57.

Brooke, C., (2002). What does it mean to be 'critical' in IS research. *Journal of Information Technology*, Vol. 17, pp. 49 - 57.

Cole, M., (2005). Cultural-Historical Activity Theory in the Family of Socio-Cultural Approaches. *International Society for the Study of Behavioural Development Newsletter.* No 1, Serial No. 47, pp 1-29.

Cole, M., (1996). *Cultural Psychology: A Once and a Future Discipline.* Harvard University Press, Cambridge.

Collins, K., (2006). Connecting work and learning: design engineers learning at work. *Journal of Workplace Learning*, Vol. 18 (7/8), pp. 404-413.

Bugelski B. R., (1956). *The Psychology of Learning,* Holt, Rinehart and Winston Inc, New York.

Daniels, H., and Warmington, P., (2007). Analysing third generation activity systems: labour-power, subject position and personal transformation. *Journal of Workplace Learning,* Vol. 19 No.6, pp. 377–391.

Daniels, H., Leadbetter, J., Warmington, P., Edwards, A., Martin, D., Popova, A., Apostolov, A., Middleton, D., Brown, S., (2007). Learning in and for multi-agency working. *Oxford Review of Education,* Vol. 33 (4), pp. 521–538.

Dayton, D. *Activity Theory: A Versatile Framework for Workplace Research.* ddayton@caribe.net, Project Web site: http://english.ttu.edu/dayton/, May 2006.

Davydov, V. V., (1999). *What is Real Learning Activity?* In Hedegarrd, M. & Lompscher, J. (Eds.) Learning Activity and Development. Aarhus: Aarhus University Press, pp. 123-138.

Dewey, J., (1933). *How We Think. A restatement of the relation of reflective thinking to the educative process* (Revised edition.), Boston: D. C. Heath.

Dube', L., and Pare', G. (2003). Rigor in Information Systems Positivist Case Research: Current Practices, Trends, and Recommendations. *MIS Quarterly*, Vol. 37 No. 4 December, pp. 597-635.

Dwyer, S.Y., and Buckle, J. L., (2003). On Being an Insider-Outsider in Qualitative Research (2009). *International Journal of Qualitative Methods*, Vol. 8 No. 1, pp. 54-63.

Engeström, Y., (1987). Learning by Expanding: An activity-theoretical approach to developmental research. Helsinki: Orienta-Konsultit.

Engeström, Y., (1990). "Developmental Work Research as Activity Theory in Practice: Analysing the Work of General Practitioners". In Y. Engeström, *Learning, Working and Imagining* (pp. 69-106). Helsinki: Orienta-Konsultit Oy.

Engeström, Y., (1990). "Constructing the Object in the Work Activity or Primary Care Physicians". In Y. Engeström, *Learning, Working and Imagining* (pp. 107-154). Helsinki: Orienta-Konsultit Oy.

Engeström, Y., (1990). "When is a Tool? Multiple Meanings of Artefacts in Human Activity". In Y. Engeström, *Learning, Working and Imagining* (pp. 171-195). Helsinki: Orienta-Konsultit Oy.

Engeström, Y., (1990). "Organisational Forgetting: An Activity Theoretical Perspective". In Y. Engeström, *Learning, Working and Imagining* (pp. 196-226). Helsinki: Orienta-Konsultit Oy.

Engeström, Y., and Miettinen, R., (1999). "Introduction". In Y. Engeström, R. Miettinen, and R. Punamaki (Eds.), *Perspectives on Activity Theory* (pp. 1-16). Cambridge, UK: Cambridge University Press.

Engeström, Y., (1999). "Activity Theory and the individual and individual and social transformation". In Y. Engeström, R. Miettinen, and R. Punamaki (Eds.), *Perspectives on Activity Theory* (pp. 19-38). Cambridge, UK: Cambridge University Press.

Engeström, Y., (1999). "Innovative learning in work teams: Analysing cycles of knowledge creation in practice". In Y. Engeström, R. Miettinen, and R. Punamaki (Eds.), *Perspectives on Activity Theory* (pp.377-404). Cambridge, UK: Cambridge University Press.

Engeström, Y., and Miettinen, R., (1999). *Activity Theory: A well kept secret in Perspectives on Activity Theory*, Engeström Y., Miettinen, R., and Punamki xx, (eds), pp.1 – 15.

Engeström,Y., (2001). Expansive Learning at work: toward an activity theoretical reconceptualisation. *Journal of Education and Work.* Vol. 14 (1), pp. 133-156.

Engeström,Y., (2004). New forms of learning in co-configuration work. *Journal of Workplace Learning.* Vol. 16 (1/2), pp. 11-12.

Engeström, Y., and Sannino, A., (2010). Studies of expansive learning: Foundations, findings and future challenges. Educational Research Review, Vol. 5, pp.1 – 24.

Fitzgerald, B., (1996). Formalised systems development methodologies: a critical perspective. Information Systems Journal, Vol. 6, pp. 3-23.

Fitzgerald, B., (1997). The use of systems development methodologies in practice: a field study. *Information Systems Journal*, Vol. 7, pp. 201 -212.

Fleck, J., (1994). Learning by trying: the implementation of configurational technology. *Research Policy*, Vol. 23, pp. 637-652.

Galliers, R.D., and Land, F.F., (2002). Choosing Appropriate Information Systems Research Methodologies in *(Qualitative Research in Information Systems – A Reader, Edited by Michael D. Myers and David Avison, SAGE Publications, London)*, pp. 13 - 17

Glass, R.L., (2004). Matching Methodology to Problem Domain: Soliciting advice on choosing and applying appropriate software development methodologies. *Communications of the ACM*, Vol. 47 No. 5, pp. 19 -21.

Goulielmos,M., (2004). Systems development approach: transcending methodology. *Information Systems Journal,* Vol. 14, pp. 363-386.

Hartely, J., (1998). *Learning and Studying: A Research Perspective.* London: Routledge.

Hasu, M., (2000). Blind Men and the Elephant: Implementation of a New Artefact as an Expansive Possibility. *Outlines*, Vol. 2, pp. 5-41.

Hasu, M., and Engeström, Y., (2000). Measurement in action: an activity-theoretical perspective on producer-user interaction. *International Journal of Human-Computer Studies*, Vol. 53, pp. 61-81.

Hasu, M., (2001). Critical Transition from Users to Developers: Activity-Theoretical Studies of Interaction and Learning in the Innovation Process. PhD thesis, University of Helsinki.

Hatch E., (1978). *Second Language Acquisition.* Rowley, MA: Newbury House.

Hergenhahn, B.R. and Olson, M.H., (1997). *An Introduction to Theories of Learning* (5th ed.). London: Routledge.

Hill, R., Capper, P., Wilson, K., Whatman, R., and Wong, K., (2007). Workplace learning in the New Zealand apple industry network: A new co-design method for government "practice making". *Journal of Workplace Learning*, Vol. 19 No. 6, pp. 359–376.

Hirschheim, R., and Newman, M., (2002). Symbolism and Information Systems Development: Myth, Metaphor and Magic in *(Qualitative Research in Information Systems – A Reader, Edited by Michael D. Myers and David Avison, SAGE Publications, London)*, pp. 241 - 274

Hirschheim, R., and Klein H.K., (1989). Four paradigms of information systems development. *Communications of the ACM*, Vol. 32 No. 10, pp. 1199 - 1217.

Hirschheim, R., Iivari J., and Klein H.K., (1997). A comparison of five alternative approaches to systems development. *Australian Journal of Information Systems*, Vol. 5 No. 1, pp. 3 - 29.

Hutchins, E., (1993). *Learning to navigate* in Understanding Practice: Perspectives on activity and context, Seth Chaiklin and Jean Lave eds. Cambridge University Press: Canada, pp. 35-63.

Hyysalo, S., (2009). Learning for learning economy and social learning. *Research Policy*, Vol. 38, pp. 726-735.

Hyysalo, S., (2006). The Role of Learning-by-Using in the Design of Health Care Technologies: A Case Study. *The Information Society*, Vol. 22, pp. 89-99.

Hyysalo, S., (2005). Objects and Motives in a Product Design Process. *Mind, Culture and Activity*, Vol. 12 (1), pp. 19-36.

Iivari, J., Hirschheim R., and Klein H.K., (2000). A Dynamic Framework for Classifying Information Systems Development Methodologies and Approaches. *Journal of Management Information Systems*, Vol. 17 No. 3, pp. 179 - 218.

Iversen, J.H., Mathiassen, L., and Neilson, P.A., (2004). Managing Risk in Software Process Improvement: An Action Research Approach. *MIS Quarterly*, Vol. 28 No. 3, pp. 435 - 472.

Jarvis,P., (2004). *Adult Education & Lifelong Learning: Theory and Practice,* Routledge Falmer, London, 3rd Edition.

Jonassen, D.H, and Rohrer-Murvey L., (1999). Activity Theory as a Framework for Designing Constructivist Environments. *ETR&D*, Vol. 47, No. 1, pp. 61-79 ISSN 1042-1629.

Joyce, B., Calhoun, E., and Hopkins, D., (2002). *Models of Learning – tools for teaching,* Open University Press, Buckingham, 2nd Edition.

Kautz, K., Madson, S., and Norbjerg J., (2007). Persist Problems and practices in information systems development. *Information Systems Journal*, Vol. 17, pp. 217-239.

Kautz, K., Madson, S., and Norbjerg J., (2007). Continuing the debate: a response to a response - persist problems and practices in Information Systems Development. *Information Systems Journal*, Vol. 17, pp. 247-249.

Keller, C., and Keller, J.D., (1993). *Thinking and acting with iron* in Understanding Practice: Perspectives on activity and context, Seth Chaiklin and Jean Lave eds. Cambridge University Press: Canada, pp. 125 – 134.

Kerosuo, H., and Engeström, Y., (2003). Boundary crossing and learning in creation of new work practice. *Journal of Workplace Learning*, Vol. 15 No. 7/8, pp. 345–351.

Kerosuo, H., (2006). Boundaries in Action: An activity-theoretical study of Development, Learning and Change in Health Care for Patients with Multiple and Chronic illnesses. PhD Thesis, University of Helsinki.

Klein, H. K. and Myers, M.D., (1999). A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems. *MIS Quarterly* Vol. 23 1, pp. 67-93.

Korpela, M., (1994). *Nigerian Practice in Computer Systems Development: A multidisciplinary Theoretical Framework, Applied to Health Informatics*. Dissertation. Helsinki University of Technology.

Korpela, M., Mursu, A., and Soriyan H.A., (2002). Information Systems Development as an Activity. *Computer Supported Cooperative Work*, Vol 11, pp. 111-128.

Korpela, M., Mursu, A., Soriyan A., Eerola A., Hakkinen H., and Toiviainen M., (2005?). *Information Systems Research and Development By Activity Analysis and Development: Dead Horse or Next Wave?*. Conference Paper, pp. 453 – 471.

Korpela, M., Soriyan H.A., and Olufokunbi (2000). Activity Analysis as a method for Information Systems Development: General Introduction and Experiments from Nigeria and Finland. *Scandinavian Journal of Information Systems*, Vol 12, pp. 191-210.

Krashen, S.D., (1982). *Principles and Practice in Second Language Acquisition.* New York: Prentice-Hall International.

Kuutti, K., (1999). "Activity Theory, transformation of work, and information systems design". In Y. Engeström, R. Miettinen and R. Punamaki (Eds), *Perpectives on activity theory* (pp. 360-376). New York, USA: Cambridge University Press.

Lave, J., (1996). Teaching, as Learning, in Practice. *Mind, Culture and Activity*, Vol. 3 No.3, pp. 33-50.

Lave, J., (1993). "The Practice of Learning". In S. Chaiklin and J. Lave (Eds), *Understanding Practice: Perspectives on activity and context* (pp.3-32). Canada: Cambridge University Press.

Lave, J., (1988). *Cognition in Practice*. Cambridge University Press: Cambridge, UK.

Lee, A. S., (1989). A Scientific Methodology for MIS Case Studies. *MIS Quarterly*, March, pp. 149-164.

Leontiev, A.N., (1981). *Problems of the Development of the Mind*. Moscow: Progress Publishers.

Lindgren, R., Henfridsson, O., and Schultze, U., (2004). Design Principles for Competence Management Systems: A Synthesis of an Action Research Study. *MIS Quarterly*, Vol. 28 No. 3, pp. 435 - 472.

Lyytinen, K., and Robey, D., (1999). Learning Failure in Information Systems Development. *Information System Journal*, Vol. 9, pp. 85-101.

Lyytinen, K., Rose, G., and Welke, R., (1998). The Brave New World of Development in the Inter-network Computing Architecture (InterNCA): Or how Distributed Computing Platforms Will Change Systems Development. *Information System Journal*, Vol 8, no.3, pp. 241-253.

Malcolm, J., Hodkinson, P., and Colley, H., (2003). The interrelationships between informal and formal learning. Journal of Workplace Learning, Vol. 15, No. 7/8, pp. 313-318.

Markus, M. L. (1983). Power, Politics and MIS Implementation. *Communications of the ACM*, Vol. 26 No.6, pp 430-444.

Martensson, P., and Lee, S., (2004). Dialogical Action Research at Omega Corporation. *MIS Quarterly*, Vol. 28 No. 3, pp. 435 - 472.

Mathiassen, L., and Purao S., (2002). Educating reflective systems developers. *Information Systems Journal*, Vol. 12, pp. 81-102.

Mathiassen, L., (2002). Collaborative Practice Research. *Scandinavian Information Systems Journal*, Vol. 14, pp. 57-73.

Mathiassen, L., (1998). Reflective Systems Development. *Scandinavian Information Systems Journal*, Vol. 10 (1&2), pp. 67-118.

McGrath, K., (2005). Doing Critical Research in Information Systems: A Case of Theory and Practice not informing each other. *Information Systems Journal*, Vol. 15, pp. 85-101.

Merriam, S.B., and Cafarella, R.S, (1991). *Learning in Adulthood: A Comprehensive Guide,* Jossey-Bass Publishers, San Francisco, California.

Miettinen, R., (1998). Object Construction and Networks in Research Work: The Case of Research on Cellulose-Degrading Enzymes. *Social Studies of Science*, Vol. 28(3), pp. 423-463.

Miettinen, R., Lehenkari, J., and Tuunainen, J., (2008). Learning and Network Collaboration in Product Development: How Things Work for Human Use. *Management Learning,* Vol. 39 (2), pp. 203–219.

Miettinen, R., (2005). Object of Activity and Individual Motivation. *Mind, Culture, and Activity*, Vol. 12(1), pp. 52–69.

Minick, N., (1997). "The early history of the Vygotskian school: the relationship between mind and activity". In M. Cole, Y. Engeström, and O. Vasquez (Eds.), *Mind, culture, and activity:*

Seminal papers from the Laboratory of Comparitive Human Cognition (pp. 117-127). Cambridge, UK: Cambridge University Press.

Mumford, E., (2001). Advice for an Action Researcher. *Information Technology and People*, Vol. 14 No. 1, pp. 12-27.

Mursu, A., (2002). *Information Systems Development in Developing Countries: Risk Management and Sustainability Analysis in Nigerian Software Companies*. Dissertation. University of Jyvaskyla.

Myers, M.D., and Avison, D.E., (2002). An Introduction to Qualitative Research in Information Systems in *(Qualitative Research in Information Systems – A Reader, Edited by Michael D. Myers and David Avison, SAGE Publications, London)*, pp. 3 – 12

Myers, M. D., (1999). Investigating Information Systems with Ethnographic Research. *Communications of the Association for Information Systems*, Vol. 2, pp. 2-20.

Myers, M.D.,(1997). *Qualitative Research in Information Systems*, http://www.qual.auckland.ac.nz , 28 March 2006.

Orlikowski, W.J., and Baroudi, J.J., (2002). Studying Information Technology in Organisations: Research Approaches and Assumptions in *(Qualitative Research in Information Systems – A Reader, Edited by Michael D. Myers and David Avison, SAGE Publications, London)*, pp. 52 - 77

Orlikowski, W.J., (1991). Integrated Information Environment or Matrix Control? The Contradictory Implications of Information Technology. *Accounting, Management and Information Technologies,* Vol 1. No. 1, pp. 9-42.

Palmius, J., (2007). Criteria for measuring and comparing information systems. *Proceedings of the 30th Information Systems Research Seminar in Scandinavia IRIS 2007.*

Pare', G., (2004). Investigating Information Systems with Positivist Case Study Research. *Communications of the Association for Information Systems*, Vol. 13, pp. 233-264.

Paviainen, P., Tihinen, M., Lormas, M., and van Solingen, R., (2004). Requirements Engineering: Dealing with the Complexity of Sociotechnical Systems Development. VTT Publications. Espoo.

Pihlaja, J., (2005). Learning in and for Production: An Activity-Theoretical Study of the Historical Development of Distributed Systems of Generalisation. PhD thesis, University of Helsinki.

Pozzebon, M., (2002). *Conducting and Evaluating Critical Interpretive Research: Examining Criteria as a Key Component in Building a Research Tradition.* HEC Montreal.

Rockart, J. F., "Chief executives define their own data needs", *Harvard Business Review* 1979 (2), pp. 81-93.

Rogers, A., (2003). *What is the Difference? A new critique of adult learning and teaching,* NIACE Publishers, Leicester, England.

Rogers, C.R., (1969). *Freedom to Learn,* Charles E. Merrill Publishing Company, Columbus, Ohio.

Rogoff, B., and Lave, J., (1984). *Everyday Cognition: It's Development in Social Context*. Harvard University Press: USA.

Roode, J.D., (1993). "Implications for Teaching of a Process-Based Research Framework for Information Systems". In Proceedings of the 8th Annual Conference of the International Academy for Information Management, Orlando, Florida, pp. 61 – 78.

Schulz, K., (2005). Learning in complex organisations as practicing and reflecting: A model development and application from a theory of practice perspective. *Journal of Workplace Learning*, Vol. 17 No. 8, pp. 493-507.

Roth, W., and Lee, Y., (2007). Vygotsky's Neglected Legacy: Cultural-Historical Activity Theory. *Review of Educational Research*, Vol 77 No. 2, pp. 186-232.

Schon, D., (1987). *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Profession*. Jossey-Boss Publishers: San Francisco.

Schulz, K., (2005). Learning in complex organisations as practicing and reflecting: A model development and application from a theory of practice perspective. *Journal of Workplace Learning*, Vol. 17 No. 8, pp. 493-507.

Sfrad, A., (1998). On Two Metaphors for Learning and the Dangers of Choosing Just One. *Educational Researcher*, Vol.27, No.2, pp. 4-13.

Smith, M. K., (1999) 'Learning theory', the encyclopaedia of informal education, www.infed.org/biblio/b-learn.htm, Last update: 03 September 2009

Smith, M. K., (1999) 'The social / situational orientation to learning', the *encyclopaedia of informal education*, www.infed.org/biblio/b-learn.htm, Last update: 03 September 2009

Stowell F., (1995). *Information Systems Provision: The contribution of Soft Systems Methodology (Soft Systems Methodology and its Relevance to the Development of Information Systems by Peter Checkland).* London: McGraw-Hill.

Suchman, L. A., and Trigg, R.H., (1993). *Artificial Intelligence as Craftwork* in Understanding Practice: Perspectives on activity and context, Seth Chaiklin and Jean Lave eds. Cambridge University Press: Canada.

Tilley, S.A., (2003). "Challenging" research practices: turning a critical lens on the work of transcription. *Qualitative Inquiry*, Vol. 9, pp. 750-773.

Toiviainen, H., (2003). Learning across levels: Challenges of Collaboration in a Small-Firm Network. PhD thesis, University of Helsinki.

Toiviainen, H., (2007). Inter-organisational learning across levels: an object-oriented approach. *Journal of Workplace and Learning*, Vol. 19 No.6, pp. 343-358.

Tuunainen, J., (2004). Hybrid Practices: The Dynamics of University Research and Emergence of a Biotechnology Company. PhD thesis, University of Helsinki.

Vickers, M.H., (1999). Information technology development methodologies: Towards a non-positivist, developmental paradigm. *The Journal of Management Development*, Vol. 18, No. 3, pp. 255 -272.

Victor, B., and Boynton, A.C., (1998). *Invented here: Maximising your organisation's internal growth and profitability.* Boston: Harvard Business School.

Vidgen, R., (1997). Stakeholders, soft systems and technology: separation and mediation in the analysis of information system requirements. *Information Systems Journal*, Vol. 7, pp. 21-46.

Virkkunen, J., and Kuutti, K., (2000). Understanding organisational learning by focusing on "activity systems". *Accounting Management and Information Technologies*, Vol. 10, p 291-319.

Vygotsky, L.S., (1962). *Thought and Language*. E. Hanfmann, and G. Vakar (Eds). Massachusetts, USA: The M.I.T. Press.

Vygotsky, L.S., (1978). *Mind in Society: The Development of Higher Psychological Processes*. M. Cole, V. John-Steiner, S. Scribner, and E. Souberman (Eds). Cambridge, UK: Harvard University Press.

Walsham, G., (2005). Learning about being critical. *Information Systems Journal*, Vol. 15, pp. 85-101.

Wastell, D.G., (1999). Learning Dysfunctions in Information Systems Development: Overcoming the Social Defences with Transitional Objectives. *MIS Quarterly*, Vol. 23, pp. 581- 600.

Wastell, D.G., (1996). The fetish of technique: methodology as a social defence. *Information Systems Journal*, Vol. 6, pp. 25 - 40.

Wenger, E.C., and Snyder W. M., (2000). Communities of Practice: The Organisational Frontier. *Harvard Business Review*, Jan-Feb, pp. 139 – 145.

Wertsch, J.V., (1985). *Vygotsky and the Social Formation of Mind*. Cambridge: Harvard University Press.

Westrup, C., (1999). Knowledge, legitimacy and progress? Requirements as inscriptions in information systems development. *Information Systems Journal*, Vol. 9, pp 35-54.

Wynekoop, J.L., and Russo, N.L. (1997). Studying system development methodologies: an examination of research methods. *Information Systems Journal*, Vol. 7, pp. 47 - 65.

Yamagata-Lynch, L.C., (2003). Using Activity Theory as an Analytical Lens for Examining Technology Professional Development in Schools. *Mind, Culture and Activity*, Vol. 10 (2), pp. 100 - 119.

Appendix A – PIR User Interview Guideline

1) NAME: DATE OF INTERVIEW:
2) POSITION:
3) NUMBER OF YEARS IN CURRENT POSITION:
4) EDUCATIONAL BACKGROUND:
5) INVOLVEMENT ON THE SMIMS PROJECT (i.e. Role and start date):
6) FUNCTIONALITY USED:
7) USEFULLNESS OF FUNCTIONALITY:
8) EASE OF USE:
9) EFFECTIVENESS
   - REPORTING
   - SUPPORTING BUSINESS PROCESSING)
   - TRAINING AND DOCUMENTATION EFFECTIVENESS
   - SUPPORT
10) IMPACT:
    (1) BUSINESS PROCESSING
    (2) INDIVIDUAL (WHAT HAS BEEN LEARNT)
11) REFLECTIONS ON THE PROJECT:

Appendix B – PIR COX Team Interview Guideline

1) NAME: DATE OF INTERVIEW:
2) POSITION:
3) NUMBER OF YEARS IN CURRENT POSITION:
4) EDUCATIONAL BACKGROUND:
5) INVOLVEMENT ON THE PEX PROJECT (i.e. Role and start date):

   (I) Role (e.g. Design Architect, Developer etc.)

   (II) Project phase / stage involvement started

   (III) User transition from SOUR phase to Design & Development

6) UNDERSTANDING OF GoB ISD PROCESS
   (I) Subject (s) / Social Actors
   (II) Object and Outcome
   (III) Methodologies and Tools used during design, development, implementation (state any changes to tools, methodology etc. during actual project execution, also state why specific methodologies / tools were used?)
   (IV) Rules governing ISD process (i.e. GoB or organisation specific)
   (V) Community
   (VI) Division of Labour (if any)
7) INDIVIDUAL CORPORATE MOTIVES FOR PROJECT ENGAGEMENT
8) EFFECTIVENESS
   - METHODOLOGY AND TOOLS (what have users learnt about the ISD process? Should they only learn about the use of the system?)
   - IMPLEMENTATION APPROACH (Does it contribute towards enhanced user learning?)
   - TRAINING AND DOCUMENTATION EFFECTIVENESS
   - SUPPORT
9) IMPACT:
   a. ORGANISATION
   b. INDIVIDUAL (WHAT HAS BEEN LEARNT)

10) REFLECTIONS ON THE PROJECT:

Appendix C – PIR COX – LEAD DEVELOPER Interview Guideline

NAME: DATE OF INTERVIEW:

ROLE ON THE SMIMS PROJECT:

POSITION IN THE COMPANY:

DATE COMPANY WAS ESTABLISHED:

NUMBER OF YEARS IN BUSINESS:

1) ONE OF THE REASONS YOU GAVE AT THE ISD PRACTICE CHANGE LAB FOR ADOPTING THE RAD / PROTOTYPING METHODOLOGY TO ISD WAS THAT IT ENCOURAGES LEARNING. IN YOUR VIEW DID THE PROTOTYPING SESSIONS FOR THE PEX PROJECT PROVIDE OPPORTUNITY FOR LEARNING? IF YES IN WHAT AREAS?
    - Users
    - For Developers
2) IN PLANNING FOR THE PROTOTYPING SESSIONS – DID YOU HAVE CLEAR OBJECTIVES AND EXPECTED OUTCOMES?
3) WERE YOU HAPPY WITH THE PLANNING AND THE OUTCOME OF THE SESSIONS AND WHAT ARE YOUR REASONS FOR THAT?
4) THERE WERE TEN (10) PROTOTYPING SESSIONS HELD AS OPPOSED TO THE THREE (3) ORIGINALLY PLANNED. WHAT BROUGHT THIS ABOUT?
5) THERE SEEMS TO HAVE BEEN A LOT OF TIME SPENT ON STATIC SCREEN DESIGNS WITH NO LOGIC BEHIND THE SCREENS - WHY DID YOU ADOPT THAT APPROACH? AND WERE YOU HAPPY WITH THE OUTCOME?
6) THE UAT WAS DELAYED. COULD THE FACT THAT MOST OF THE LOGIC WAS ONLY BUILT INTO THE SYSTEM AT THE END RATHER THAN DURING THE PROTOTYPING SESSIONS HAVE CONTRIBUTED TO THAT?
7) ON REFLECTION WOULD YOU STILL HAVE ADOPTED THE SAME APPROACH? IF NOT WHY NOT AND WHICH APPROACH WOULD YOU HAVE ADOPTED INSTEAD AND WHY?

8) USER LEARNING AND THEREFORE SLOW SYSTEM UPTAKE WAS A MAJOR PROBLEM ON THIS PROJECT – WHAT WOULD YOU SINGLE OUT AS HAVING BEEN THE MAJOR REASON FOR THAT? DID THE PROTOTYPING APPROACH ADOPTED CONTRIBUTE TO THAT?
9) DURING THE CHANGE LAB SESSION YOU RAISED THE ISSUE OF 'INSUFFICIENT JOB KNOWLEDGE AND PROCESSES – THE FACT THAT YOU ARE DOING A JOB DOES NOT MEAN YOU KNOW THE JOB – MAY NOT UNDERSTAND THE PROCESSES AND BUSINESS RULES BEHIND THE JOB' DID THIS AFFECT LEARNING AT ALL – ESPECIALLY FOR YOUR DEVELOPMENT TEAM? DID THIS ALSO AFFECT LEARNING BY USERS? WHAT NEEDS TO BE DONE TO ADDRESS THIS?
10) SHARE YOUR OTHER REFLECTIONS ON THE PROJECT?
11) WHAT DID YOU LEARN FROM THIS PROJECT WITH REGARDS TO THE CURRENT ISD PRACTICE?
12) AT THE CHANGE LAB YOU SUGGESTED A NUMBER OF THINGS TO IMPROVE CURRENT PRACTICE TWO OF WHICH WERE CHANGE MANAGEMENT AND DUE DILIGENCE ON THE REQUIREMENTS AND PROJECT APPROACH PRIOR TO STARTING A PROJECT. EXPAND ON THIS AND EXPLAIN HOW THEY WOULD ADDRESS THE MAJOR CHALLENGE OF LEARNING AND SYSTEM UPTAKE?