

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF INFORMATION SCIENCE

**THE POTENTIAL OF KNOWLEDGE-BASED SYSTEMS
IN ASSISTING THE JUSTICE SYSTEM: THE CASE OF
ETHIOPIAN LABOR LAW**

BY
YIHENEW DEMMELASH

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENT FOR THE DEGREE OF MASTERS OF SCIENCE IN
INFORMATION SCIENCE**

JUNE, 2010

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
DEPARTMENT OF INFORMATION SCIENCE

THE POTENTIAL OF KNOWLEDGE-BASED
SYSTEMS IN ASSISTING THE JUSTICE SYSTEM:
THE CASE OF ETHIOPIAN LABOR LAW

BY
YIHENEW DEMMELASH

Word to PDF - UnRegistered
<http://www.word-to-pdf.abdio.com/>

(Word to PDF - Unregistered) <http://www.word-to-pdf.abdio.com/>

DEDICATION

*To
Emewodesh: for whom, but for whom . . .*

ACKNOWLEDGMENT

First and foremost, I would like to acknowledge Almighty God for the love and courage I received during this research work and beyond.

This thesis would not have been possible without the people who supported me. My gratitude goes to my Advisor, Ato Tibebe Beshah, whose continuous assistance and convincing arguments helped me a lot throughout this research work.

I am indebted to Girma Hunduma, Meskerem Tariku, Kaleb Yetemgeta and Zerihun Teshale, the lawyers who devoted their valuable time in participating in the interviews and discussions I conducted in order to acquire the necessary legal knowledge which was important for developing the prototype knowledge based system.

I am also indebted to all the staffs of the record office of the Federal Supreme Court of Ethiopia for their kind cooperation in locating past judgment cases related with the topic of my work.

Further thanks go to members of the community of Department of Information Science, whose contribution is involved in this work in one way or the other. Special thanks goes to Dr. Dereje Teferi, Head of the Department, and Dr. Million Meshesha, for their invaluable help and encouragement, which I couldn't forget.

Finally, my heartfelt affection goes to all members of my family for their efforts to create conducive environment and a loving atmosphere which was a prerequisite for completing this work.

Word to PDF - UnRegistered
<http://www.word-to-pdf.abdio.com/>

(Word to PDF - Unregistered) <http://www.word-to-pdf.abdio.com/>

Yihenew Demmelash

Table of Contents

<u>CHAPTER ONE</u>	1
<u>INTRODUCTION</u>	1
<u>1.1 Background of the Study</u>	1
<u>1.1.1 Legal Knowledge-Based System</u>	1
<u>1.1.2 Types of Legal Systems</u>	3
<u>1.1.3 The Ethiopian Legal System</u>	4
<u>1.2 Statement of the Problem and Justification of the Study</u>	4
<u>1.3 Objectives of the Study</u>	7
<u>1.3.1 General Objective:</u>	7
<u>1.3.2 Specific Objectives:</u>	7
<u>1.4 Methodology</u>	8
<u>1.5 Significance of the Research</u>	8
<u>1.6 Scope and Limitations</u>	9
<u>1.7 Organization of the Thesis</u>	10
<u>CHAPTER TWO</u>	11
<u>KNOWLEDGE-BASED SYSTEMS</u>	11
<u>2.1 Overview</u>	11
<u>2.2 Knowledge-Based System Architecture</u>	13
<u>2.3 Knowledge-Based System Development Issues</u>	15
<u>2.3.1 Knowledge Acquisition</u>	15
<u>2.3.2 Knowledge Representation</u>	17
<u>2.3.3 Knowledge Models</u>	20
<u>2.3.4 Explanation Facility</u>	22
<u>2.4 Major Application Areas of Knowledge-Based Systems</u>	23
<u>2.5 Limitations of Knowledge-Based Systems</u>	27
<u>CHAPTER THREE</u>	30
<u>THE ETHIOPIAN LEGAL SYSTEM AND LABOR LAW</u>	30
<u>3.1 Overview of the Ethiopian Legal System</u>	30
<u>3.2 Judicial Institutions in the Legal Sector</u>	33

<u>3.3 Problems in Ethiopian Legal System</u>	36
<u>3.4 Efforts Made to Overcome the Problems of Ethiopian Legal System</u>	37
<u>3.5 Overview of the Labor Law</u>	39
<u>3.6 Basic Components of Labor Law</u>	41
<u>3.7 The Ethiopian Labor Law</u>	42
<u>CHAPTER 4</u>	45
<u>RESEARCH DESIGN AND METHODOLOGY</u>	45
<u>4.1 Introduction</u>	45
<u>4.2 Surveying Methods</u>	45
<u>4.2.1 General Approach</u>	45
<u>4.2.2 Method of the Study</u>	46
<u>4.2.3 Data Collection Procedure</u>	47
<u>4.2.4 Sampling Technique</u>	49
<u>4.2.5 Data Collection and Analysis</u>	50
<u>4.3 The Knowledge-Based System Development</u>	51
<u>4.3.1. Knowledge Acquisition</u>	51
<u>4.3.2. Knowledge Modeling</u>	53
<u>4.3.3. Knowledge Representation</u>	53
<u>4.3.4 Implementation (Programming Tool)</u>	56
<u>4.3.5 Prototype Testing and Evaluation</u>	57
<u>CHAPTER 5</u>	59
<u>DATA ANALYSIS AND THE KBS DEVELOPMENT</u>	59
<u>5.1 Report of the Preliminary Survey</u>	59
<u>5.1.1 Findings</u>	59
<u>5.1.2 Recommendations Made by Respondents</u>	62
<u>5.2 The KBS Development and Evaluation</u>	64
<u>5.2.1 Knowledge Acquisition</u>	64
<u>5.2.2 Knowledge Modeling</u>	65
<u>5.2.2.1 Extracted Concepts of the Ethiopian Labor Law</u>	65
<u>5.2.2.2 Conceptual Model Building</u>	73
<u>5.2.2.3. Goals</u>	76
<u>5.2.2.4. Conceptual Model for Validity of Termination of Contract of Employment</u>	77
<u>5.2.3 Knowledge Representation</u>	79

<u>5.2.3.1 The Rule-Based Module</u>	79
<u>5.2.3.2 The Case-Based Module</u>	85
<u>5.2.4 Testing and Evaluation</u>	96
<u>5.2.4.1 The Rule-Based Part</u>	97
<u>5.2.4.2 The Case-Based Part</u>	105
<u>CHAPTER SIX</u>	109
<u>CONCLUSIONS AND RECOMMENDATIONS</u>	109
<u>6.1 Conclusions</u>	109
<u>6.2 Recommendations</u>	110

List of Tables

Table 2.1: Table 2.1: Knowledge-Based System Application Areas	24
Table 5.1: Profile of Legal Experts Participated in Interviews and Discussion for the Purpose of Knowledge Acquisition.....	64
Table 5.2: Input and Output Parameters of Validity of Contract of Employment.....	74
Table 5.3: Input and Output Parameters of Validity of Suspension of Contract of Employment.	74
Table 5.4: Input and Output Parameters of Validity of Termination of Contract of Employment.	75
Table 5.5: Attributes Used for the Training of the Neural Network with their Value.....	87
Table 5.6: Confusion Matrix that Show the Result of the Experiment.....	103

List of Figures

Figure 2.1: Expert System Architecture.	15
Figure 5.1: A Model Used to Check the Validity of the CoE.....	66
Figure 5.2: A Model Used to Check the Validity of the Suspension of CoE.....	68
Figure 5.3: A Model Used to Check the Validity of Termination of Contract by Law.....	70
Figure 5.4: A Model Used to Check the Validity of Termination by Agreement.....	70
Figure 5.5: A Model Used to Check the Validity of Termination by the Request of Employer...72	
Figure 5.6: A Model Used to Check the Validity of Termination by the Request of Employee...72	
Figure 5.7: A Model Used to Check the Validity of Termination as per Collective Agreement..73	
Figure 5.8: A Conceptual Model for Validity of Termination of CoE Advisory System.....	78
Figure 5.9: The Welcoming Window of LaLA.....	85
Figure 5.10: The Dataset Used for Experimentation.....	93
Figure 5.11: View of the Network	95
Figure 5.12: The Performance Report.....	96

List of Acronyms

AI:	Artificial Intelligence
CBR:	Case Based Reasoning
CELU:	Confederation of Ethiopian Labor Unions
CoE:	Contract of Employment
FSCE:	Federal Supreme Court of Ethiopia
ICT:	Information and Communication Technology
ILO:	International Labor Organization
JSRP:	Justice Systems Reform Program
KBS:	Knowledge Based System
LaLA:	Labor Law Advisor
LHS:	Left Hand Side
LKBS:	Legal Knowledge Base System
NBE:	National Bank of Ethiopia

NCRP:	National Court Reform Program
RBR:	Rule Based Reasoning
RHS:	Right Hand Side
SVM:	Support Vector Machines

Abstract

Modern information and communication technology is revolutionizing how courts function, reducing backlogs by speeding up case resolutions and improving citizen access to trial proceedings and disposition. Ethiopia's system of justice has suffered from long delays that undermined public confidence in the rule of law and imperiled rights granted under the Constitution. Labor law, that governs the employer-employee relationship, is an area which can potentially benefit much from ICT.

This study examines the existing practice in the domain of Ethiopian labor law and identifies the most problematic parts of the law. A prototype legal knowledge based system, which is a combination of a rule-based and case-based reasoning mechanism is then developed with the objective of addressing the limitations of the current practice. The knowledge based system provides advice on the most prominent areas of the labor law. This will be very useful for meeting the increasing demands of court clients for speedy and quality decisions.

The prototype KBS developed combines a case-based legal reasoning with a rule-based one to address those parts of the law which requires different type of treatment. Areas of the law in which the law provide clear rules to handle cases will be treated using the rule-based module of the system, while the case-based module addresses those areas which are left to the discretion of the judge.

The system's output was tested against that of a set of decided cases. This allowed

the system's reasoning to be tested. Testing indicates that using a rule-based approach to reason with legislation and a case based reasoning to reason with cases is appropriate.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

1.1.1 Legal Knowledge-Based System

Beyond establishing an economic relationship between employer and employee, work provides a powerful structure for organizing social and cultural life. The employment relationship is more than the exchange of labor for money. In modern societies, self-worth, dignity, satisfaction, and accomplishment are often achieved by one's employment responsibilities, performance, and rewards. The development of employment law demonstrates the importance of work.

According to Deakin and Morris (2005), Labor Law is the normative framework for the existence and operation of all institutions of the labor market: the business enterprise, trade unions, employers' associations and, in its capacity as regulator and employer, the state.

The view that Labor Law is more than just the sum of its parts is derived initially from the writings of German jurists in the early decades of the twentieth century, who saw the subject as the embodiment of social policy in action.

According to Sommer (2004), the introduction of a formal Labor Law in Ethiopia (on collective labor relations) dates back to early 1960s with the name "Labor Relations Proclamation No. 210/1963". This proclamation recognized the rights of associations of workers and employers, as well as a system of collective bargaining, and it set up machinery for the settlement of trade disputes – the Labor Relation Board. During the Dergue period (1974-91), the imperial Labor Relations Proclamation was superseded by Labor Proclamation No. 64 of 1975, which contained almost all provisions of a socialist Labor Law. There were no employers' organizations, and no

contractual freedom between employer and employee.

The 1993 Labor Proclamation, Proclamation No. 42/1993, was developed in the post-socialist time, marking the overcoming of the centralized state-economy towards a market oriented, pluralistic society. In 2003 the House of People's Representatives adopted a new Labor Proclamation called Proclamation No. 377/2003. This text repealed Labor Proclamation No. 42/1993. It has become the principal source of Labor Law in Ethiopia.

Computers have long been utilized in the sphere of law. The main use of computers however, has merely been to automate office tasks. Recently, more sophisticated tools such as computerized legal research systems, document drafting packages, and practice management systems have become increasingly common. Most exciting however, has been the prospect of using artificial intelligence (AI) techniques to create 'automated legal reasoning systems', computer systems that reason with and apply the law in an effort to resolve legal disputes. Examples of such systems include Legal Knowledge-based systems.

A Legal knowledge-based system (LKBS) is a computer system which contains knowledge and implies the possible legal result of the application of law to certain cases and explains the reasoning process as well as the legal knowledge that is applied (Yoshino, n.d.). While computers have long been a fixture in the legal profession, they have mainly been relegated to back office tasks, such as billing, word processing, and other basic administrative duties (Raman and Palanissamy, 2008).

As Artificial Intelligence (AI) technology develops, the creation of computers that can autonomously reason with the law to determine legal solutions is slowly becoming a reality.

The possibility exists that AI will result in knowledge-based systems that could help judges produce an acceptable level of fairness without resorting to a strict model of fixed sentencing. The knowledge-based system would be normative rather than predictive, providing guidance based on complex modeling that considers the attributes of the crime, mitigating and aggravating circumstances, and the individual characteristics of the defendant.

Greenleaf, (1989) in his article discussing categories of possible knowledge-based applications to law, mentioned formal advisory systems, 'strategic' advisory systems, automatic document generators, 'intelligent' litigation/transaction support systems and 'intelligent' retrieval systems as the major ones.

1.1.2 Types of Legal Systems

Though other systems such as customary law, religious law and a mixture of two or more systems also exist, the two major legal systems in the world are Civil Law (Continental Law) and Common Law legal systems.

Duhaime, (nd) defined Civil Law as a body of law and ancillary legal system derived and evolved directly from Roman Law, the primary feature of which is that laws are struck in writing; codified, and not determined, as is Common Law, by the opinions of judges. Most Common Law jurisdictions have taken to codifying much of their law in subject-specific statutes.

As defined by Duhaime, (nd), Common Law is Judge-declared law, law which exists and applies to a group on the basis of customs and legal precedents developed over hundreds of years. Because it is not written by elected politicians, but rather, by judges, it is also referred to as

"unwritten" law.

1.1.3 The Ethiopian Legal System

Aberra quoted by Seifu (2005) described the Ethiopian Legal system as one which has its own features. Since the fifteenth century, the country accepted features of the Roman-Germanic law (Civil Law) through the Fetha Negest (The Law of The Kings). The Constitution, the Civil Code, the Labor Code, the Commercial Code and the Civil Procedure Code are all instances which show that the country's legal system is based on codified laws (Civil Law).

1.2 Statement of the Problem and Justification of the Study

As the number of cases to be handled by courts increases, the need for new mechanisms which can assist judges while giving decisions, and accordingly, to respond to the increasing needs of customers become more important. FSCE (2008) shows that the number of cases handled by the court exhibits a 40.3% increase in 1999 E.C. Due to the relatively large number of such cases, there is a separate bench which rules only labor cases in all federal courts.

Delayed delivery of justice on court cases is another problem which is faced by the legal system. The very core of a civil society and rule of law is the provision of justice, but the decision must be delivered within a reasonable time (Miglan, n.d.). Delayed delivery of justice has a negative impact in the morale and economic status of the parties involved. Marshall, (2008) described how the trust of the people on the justice system can be threatened due to delayed justice in the following words:

Justice, as delivered, is built little by little, piece by piece, detail by detail, each part affecting the whole. For the parent anxiously awaiting a judgment on custody or child

support, for the business that loses the use of funds while waiting for an award of monetary damages, or for the victim of crime who is denied some sense of closure because of endless continuances in a criminal trial, justice administratively delayed truly is justice denied. Public faith in our independent courts simply cannot be sustained if even the highest level of substantive justice is delivered in a manner that renders it practically useless.

The above mentioned report of the Federal Supreme Court of Ethiopia stated that 5.3% of the cases being handled by the Federal Supreme Court took more than a year. Note that the Federal Supreme Court examines cases which are already ruled by lower courts (First Instance and Higher) and came to it by appeal or cassation, and the cases took additional time while being ruled by the lower courts.

Judgment disparity is also another problem which is being exhibited in the current legal system. Judgment disparity, as defined by Cheathouse (nd) is that the judge does not hand out the same judgment, or the terms of the judgment, when handling almost the same cases. Presence of discrepancies in similar rulings is one of the main reasons which threaten the trust of the people on courts in particular and the legal system in general.

There are various efforts being made to solve the above mentioned and other related problems in the legal system. The major one is the National Court Reform Program (NCRP), which aims at reducing administrative inefficiencies and operational deficiencies at all levels of courts of the country (FSCE, 2009). The project aspires to address existing deficiencies in Case Record Keeping, Information Management, Training, Service Delivery, Recording and Transcribing of court proceedings. Though this effort is on process and it is not the right time to determine its

outcomes, one can propose the integration of other efforts made on the area with this court reform program can bring better improvement for the situation at hand.

Works done on the area of legal knowledge-based systems are reviewed with objective of understanding the level of development in the area and to make sure that the problem planned to be addressed by this work is not already addressed.

Ethiopia (2002) developed a legal precedent retrieval system using case-based approach and her focus area was the Ethiopian Labor Law. The objective of her work was building a knowledge base in which complete decided cases could be entered and then recalled when similar cases arose again. However, application of computer systems that reason with the law in an effort to resolve legal disputes in general, and labor disputes in particular is still an area that requires the contribution of many research works. One such area is using a combination of rule-bases and neural network approaches to determine the outcome of the case. The other area of research is incorporating features which provide an advisory service in the area of Labor Law so as users would develop confidence and get motivated to use it.

Seifu (2005) also developed a prototype combined legal knowledge-based system that forms legal arguments in criminal sentencing in the area of criminal cases, specifically that of sexual crimes. The area of the application of the researcher is the penal code of Ethiopia, which governs criminal acts of offenders. The potential of such combination of rule-bases and neural network approaches to determine the outcome of the case in civil cases is still an area that requires further contribution. The nature of the two categories of law are different since the aim of the penal code is primarily punishing wrong doers and giving warning to others, while the civil code is about protecting the social and economic interests of the individuals.

Labor rights have been integral to the social and economic development since the industrial revolution. Economic development results in increase in the number of contractual relationships to be governed by Labor Law, and hence the need of stakeholders for advisory system in the domain of Labor Law will also increase. The prototype knowledge-based system makes this service easily accessible to the public.

1.3 Objectives of the Study

The research work has the following general and specific objectives.

1.3.1 General Objective:

The general objective of this research is to investigate the potential application of a combination of rule-based and case-based knowledge-based system to the Ethiopian civil justice system, with particular emphasis to the Ethiopian Labor Law.

1.3.2 Specific Objectives:

With the aim of achieving the above mentioned general objective, the following specific objectives of the study were drawn.

- To review literature so as to explore the applicability of knowledge-based systems in the area of law.
- To assess the magnitude of the problem in the domain of Labor Law.
- To acquire expert knowledge from domain experts
- To represent the knowledge acquired from experts
- To build a prototype rule-based knowledge-based system that forms legal

arguments for judges and lawyers concerning labor cases.

- To train a neural network model that predicts the type of order to be given by the court in cases where invalid termination is proved (reinstatement or compensation).
- To conduct experiments with cases to test the performance of the prototype knowledge-based system.
- To make conclusions and recommendations based on the results of the experiment.

1.4 Methodology

With the aim of achieving the above mentioned objectives, different tools and techniques are used for data collection and analysis, implementation and testing and evaluation. The complete discussion on the research design and methodology is presented in chapter four of this document.

1.5 Significance of the Research

The Ethiopian legal system is predominantly Civil Law, in which the judges base their decisions on the written law. Therefore, judges are not obliged to be guided by past decisions. However, the planned legal knowledge-based system helps judges to consider the decisions of other courts on similar past cases and therefore allows them to pass similar decisions. This will have an effect of reducing discrepancies in similar rulings.

On the other hand, lawyers providing advisory service to their clients on employment relation cases will benefit much from the planned legal knowledge-based system. They can check the value of an attribute by playing “what if” with the knowledge-based system. If the decision is

changed when the value of one attribute is changed while the values of all other attributes remain the same, the lawyers can infer that the attribute is strong. This helps them to predict the decision to be given by the court and to act in response to this situation. In other words, the program will be useful as an attorney's assistant, spotting issues, strengths, weaknesses, and precedents that an attorney representing a client in the labor case would want to take into account.

Potential court clients considering opening labor files will also benefit from the system. Consider a client who seeks legal advice as to her/his legal options in some matter of the Labor Law. Good legal advice will filter out a case with almost no hope of winning. If the facts of the case are clear and the system suggests that the client will lose, he/she may refrain from opening a file or defending the case, and therefore will protect himself/herself from the cost of legal redress which might be prohibitively expensive. Further, the time delay involved may well be avoided by pre-determining the potential judgment.

1.6 Scope and Limitations

This work deals with the development of a prototype legal knowledge-based system which handles only Labor Law cases involving employment contract, suspension of employment contract and termination of employment contract. Issues to be handled by the Labor Law, other than those mentioned above, such as wages and salaries, overtime payment, annual leave, sick leave, collective agreement or trade unions and employers associations will not be covered by this research. Due to availability of information, the cases to be considered in this work will be those verdicts given by the Federal Supreme Court of Ethiopia in related domain.

The rule-based and case-based modules of the system are existed independently. Integration of the two modules so that the user can use both modules through a single interface is not done due

to time constraint.

1.7 Organization of the Thesis

This thesis is organized into six chapters. The first chapter presents basic introduction about core concepts, the statement of the problem, objective of the study, the methodology applied, the significance of the study and its scope and limitations.

The next two chapters contain reviews on related literatures focusing on knowledge-based systems and the Labor Law respectively. The earlier focuses on the various concepts related with knowledge-based systems in general and legal knowledge-based systems in particular. The focus of the latter is the Labor Law in general and the Ethiopian Labor Law in particular.

The fourth chapter deals with the research design and methodology employed for the development of the knowledge-based system in the area of Labor Law. This includes the data collection methodology, design and modeling of the knowledge acquired, the programming tool used, and the testing and evaluation techniques employed.

The fifth chapter focuses on the rule creation, the representation of the rule-base and the case-base, the development of the prototype KBS and its evaluation. A brief discussion on the strengths and weaknesses of the system based on the findings of the evaluation is also presented in this chapter.

Finally, concluding remarks and recommendations are highlighted in the fifth chapter.

CHAPTER TWO

KNOWLEDGE-BASED SYSTEMS

2.1 Overview

Perhaps the most intellectually stimulating issue to have arisen from the advent of computer technology concerns the idea of artificial intelligence. This topic has attracted comment from exponents of many diverse disciplines. Marvin Minsky, one of the founders of AI, defined AI as the science of making machines do things that would require intelligence if done by man (Minsky, 1968).

There are many tasks that computer scientists are currently endeavoring to program computers to perform which are deemed to result in artificially intelligent computer behavior: Natural Language Processing; Speech Recognition; Vision and Perception; Game Playing; Machine Learning; Automatic Programming; Intelligent Computer-aided Instruction or Tutors; Intelligent Knowledge-Based Systems or Expert Systems. Moreover, attempts to build intelligent robot systems (Robotics), and the study of the human mind using the computer as a means of testing hypotheses and modeling human behavior, that is, using what is commonly referred to as the Computational Metaphor, are also considered to be contributions to the study of AI (Rissland,1990)

The particular aspect of A.I. from which the research question at hand may well benefit is often regarded as the applied branch and is usually referred to as Knowledge-Based Systems (K.B.S.). These are systems that contain representations of knowledge which can be deployed in the solving of given problems. Expert Systems, despite the fact that this term is often considered to be synonymous with K.B.S., are, more precisely, a type of K.B.S. Expert systems are computer programs that have been constructed with the assistance of human experts in such a way that they are capable of functioning at the standard of experts in given fields. (Rissland,1990).

Successful applications of KBSs result in numerous benefits, including reduced decision-making time, improved service levels, and better use of an expert's time (Duchessi and O'Keefe, 1995). As Pomykalski et al (1999) discussed, the primary intent of expert system technology is to realize the integration of human expertise into computer processes. This integration not only helps to preserve the human expertise but also allows humans to be freed from performing the more routine activities that might be associated with interactions with a computer-based system.

According to Susskind, (1986), arguably the first sustained and successful work in this field was initiated in 1965. This was the DENDRAL project, carried out at Stanford University and inspired by one of the fathers of A.I., Edward A. Feigenbaum. By harnessing the formal and heuristic knowledge both of Joshua Lederberg (a professor of genetics), and of Carl Djerassi (a physical chemist), Feigenbaum wrote a program that can infer the molecular structure of an unknown molecule given the mass spectroscopic data that would normally be available to a physical chemist engaged in such a task. The system is used in university and industrial environments throughout the world.

Perhaps the most widely known expert systems are those that perform medical diagnoses. MYCIN, for instance, a system developed at the hands of a doctor as well as computer scientist, Edward H. Shortliffe, provides consultative advice on diagnosis and antibiotic therapy for infectious diseases such as blood infections and meningitis (Susskind, 1986).

2.2 Knowledge-Based System Architecture

According to Pomykalski et al (1999), discussion about the architecture of a KBS requires prior introduction to the concept of an KBS kernel. The kernel of a KBS contains those components

that are the basic and the required components for all expert systems. These components are identified as a knowledge base, an inference engine, and a user interface.

The knowledge base: It contains the system's factual knowledge as well as the heuristics of the expert(s). Mykytyn et al (1990), stated that the knowledge is often represented in the form of "if... then" rules. The knowledge engineer, an artificial intelligence professional, is skilled in the art of developing Expert Systems but may be unfamiliar with the specific domain of the system. A domain expert is an individual who is considered to have the expertise in the domain of the system being developed. He or she need not understand related technology because that is the function of the knowledge engineer. Knowledge acquisition, the process of obtaining the knowledge from human experts, is based upon a relationship between the knowledge engineer and experts, a relationship that is crucial for this process to be successful.

The user interface: It communicates with the user, translating input from the user into information understandable by the system. The communication is bidirectional: the intended user must be able to communicate with the system and understand the system's responses as well as the questions the system asks. The intended users are often computer novices. Thus, like any computer-based system, an expert system must be easy to use. A properly developed user interface will help ensure support for the needs, preferences, and individual differences of the users. (Mykytyn, 1990)

The inference engine: This element, using appropriate heuristic search techniques, defines how the rules in the knowledge base are to be applied to the problem. An inference engine, in essence, "runs" an expert system. It decides which rules are to be utilized, accesses the appropriate rules in the knowledge base, executes the rules, interacts with the user to gain additional information

about the problem, and makes a decision or recommendation when a satisfactory solution has been found. (Mykytyn, 1990)

Pomykalski et al (1999) discussed two ways or control strategies by which the inference engine manages rules to arrive at some conclusion or to arrive at a sequence of actions to be taken with respect to the environment. These are forward and backward chaining. Griffin N. et al (n.d.) defined them as follows.

- *Forward Chaining*: It is a top-down method which takes facts as they become available and attempts to draw conclusions (from satisfied conditions in rules) which lead to actions being executed. It supports what is called “data-driven” reasoning. It’s especially important for monitoring functions.
- *Backward Chaining*: It is a bottom-up procedure which starts with goals (or actions) and queries the user about information which may satisfy the conditions contained in the rules. It is a verification process rather than an exploration process. It supports goal-driven reasoning. It is especially important for diagnostic activities. (Griffin and Lewis, n.d.)

The following figure, taken from Pomykalski et al (1999), displays the architecture commonly associated with Knowledge-based systems.

2.3 Knowledge-Based System Development Issues

Though there are various issues related with the development of KBSs, the major ones are knowledge acquisition, knowledge representation, knowledge modeling, and explanation facility. A detailed review is made on each of these issues, and presented hereunder.

2.3.1 Knowledge Acquisition

Knowledge acquisition is the process of extracting knowledge from experts. Given the difficulty involved in having experts articulate their "intuition" in terms of a systematic process of reasoning; this aspect is regarded as the main "bottleneck" in KBSs development (Greinke, 1994). The knowledge base stores information about the subject domain. However, this goes further than a passive collection of records in a database. Rather it contains symbolic representations of experts' knowledge, including definitions of domain terms, interconnections of component entities, and cause-effect relationships between these components.

As Holder et al (2005) points out, there are three basic components of successful knowledge acquisition, namely, feature selection, learning rules relating the selected features to the categories of interest and acquiring knowledge incrementally and detect when knowledge is changing.

The first step in any knowledge acquisition task is the collection of data and selection of the features to represent the data. Numerous feature selection techniques have been proposed in different literatures. Their importance continues to be stressed, most recently with the advent of support vector machines (SVMs) and their efficient utilization of higher-dimensional features for simple, regression-like learning methods. SVMs represent one of the most advanced methods for learning, and feature selection is crucial to the success of this approach. (Holder L., 2006).

As with methods for computer intrusion detection, many knowledge acquisition methods are being motivated by the heightened attention to security tasks like counter-terrorism, emergency response and border monitoring. One of the common characteristics of security-related tasks is the dynamic nature of the data, which typically arrives via multiple data streams in real time, and the dynamic nature of the knowledge (e.g., patterns of behavior), which undergo constant change. The ability to handle this dynamic environment is a challenge to current knowledge acquisition methods. One approach in this issue is when the streaming data describes a changing network of nodes and links and the task is to learn patterns in the network and detect when these patterns change over time.

Similar to the challenge of acquiring knowledge from multiple data streams is the task of assimilating such knowledge from multiple sources. In many domains there are typically

multiple, possibly conflict sources of knowledge about some phenomena. An abstract approach to combing learned knowledge is represented by the recent advances in ensemble learning, After identifying the proper knowledge acquisition method, the next challenge is the design of integrated knowledge acquisition systems that draw from best practices and utilize appropriate methods where needed and motivated by the ultimate representation and use of the knowledge to support improved understanding of the domain and automated reasoning to infer new knowledge. Explicit feedback mechanisms should be in place to allow these targeted uses of the knowledge to inform and guide the acquisition of the knowledge and a more fully-automated approach to selecting appropriate knowledge acquisition methods (Holder et al, 2005).

2.3.2 Knowledge Representation

Knowledge representation and its use for reasoning and understanding complete the grand AI challenge initiated by the knowledge acquisition task. Like knowledge acquisition, knowledge representation and reasoning have a long history in AI research, and even well beyond that into the realm of philosophy and declarative thought. First-order logic has been and continues to be the substrate of most knowledge representations, and the treatment of the topic in this issue is no different.

Just as database research has developed multiple representations for specific facts, many techniques exist to represent the more general knowledge required for expert systems. Clifford et al (1983) briefly reviewed the following four major knowledge representation techniques and their related inference mechanisms.

Production Rules: Rules have been the most popular form of knowledge representation in

Knowledge-based systems. There are three interpretations of the function of rules in KBSs. First is the interpretation of rules as a programming language. A rule typically has the form:

If X then Y.

It can be used in computations in different ways. On one hand, in a data-driven or forward chaining approach, one can try to match a given situation to the condition X in order to infer a possible action Y. On the other hand, one can try to "prove" a hypothesis Y by establishing the preconditions X through further analysis (backward chaining). Combinations of both methods are also sometimes used.

Both approaches require a pattern matching process, perhaps combined with unification (substitute constants or other variables for variables in the pattern to be matched) to identify the applicable rules in a given problem situation. If there is more than one of those, one has to be selected for further processing first.

Secondly, rules can be used as description tools for problem-solving heuristics, replacing a more formal analysis of the problem. In this sense the rules are thought of as "rules of thumb," incomplete but very useful guides to make decisions that cut down the size of the problem space being explored. These rules are input to an expert system by the human expert, usually iteratively and perhaps by means of an interactive program that guides and prompts the expert to make this task easier, and perhaps does some limited consistency checking.

Finally, rules have been proposed as in some sense a simulation of the cognitive behavior of human experts. By this claim, rules are not just a neat formalism to represent expert knowledge in a computer but rather a model of actual human behavior.

Clifford et al (1983) mentioned the organization of the stored knowledge in a way that permits efficient yet transparent control over the search processes inside the knowledge base as a problem with rule-based techniques.

Logic-Based Knowledge Representation: Precise knowledge can be stated as assertions over objects that take the form of first-order predicates with functions and equality. Logic has the advantage of offering a sound and complete set of inference rules. It is also purely declarative and therefore allows multiple uses of the same piece of knowledge. For inference purposes, predicates are usually transformed in a quantifier-free normal form called clausal form. In order to prove a theorem in clausal form, its negation is added to the set of knowledge clauses or "axioms". If the thus augmented conjunction of clauses can be shown to be contradictory, the theorem has been proved.

Semantic Networks: Semantic networks seem to be more popular in other AI applications (e.g., natural language processing) than in KBSs. Nevertheless, a number of expert systems rely on network formalisms, among them very large systems such as INTERNIST (Pople, 1983) and Prospector (Hart et al, 1979). Networks are a natural and efficient way to organize knowledge. Nodes describe objects, concepts, or situations whereas arcs define the relevant relationships. Reasoning corresponds to network traversals along the arcs or to pattern matching of problem descriptions and subnets. A large number of exact and heuristic mechanisms exist for these tasks. The disadvantages of this approach stem from the lack of formal semantics making verification of the correctness of reasoning very difficult.

Frame-based Representation Languages: Much knowledge is based on experience and expectations adapted from previous situations and general concepts to a specific problem.

Frames provide a structure to such experiential knowledge by offering so-called slots which can be filled with type descriptions, default values, attached procedures, etc. Frames are a very general and powerful representation form. It may be difficult, however, to specify their meaning precisely as well as to implement them efficiently.

Multiple Knowledge Representations: Clifford et al (1983) suggested that no one of the knowledge representation methods discussed above is ideally suited for all tasks. In very complex systems using many sources of knowledge simultaneously (e.g. speech recognition), the goal of uniformity may have to be sacrificed in favor of exploiting the benefits of multiple knowledge representations each tailored to a different subtask. Similar to the interdisciplinary cooperation of several human experts, the necessity of translating among knowledge representations becomes a problem in such cases.

2.3.3 Knowledge Models

Knowledge engineers make use of a number of ways of representing knowledge when acquiring knowledge from experts. These are usually referred to as knowledge models. Knowledge models are the structural representation of knowledge by using symbols to represent pieces of knowledge and relationships between them. They are set of concept maps and associated resources about a particular domain of knowledge. (Canas, 2003).

The generation and modification of a knowledge model is an essential aspect of knowledge acquisition, as the model helps to clarify the language being used and quickly convey information for validation and modification where necessary. Thus, the use of knowledge models is of great benefit during knowledge elicitation and validation (from an expert), cross-validation (with

another expert), knowledge publication and maintenance and updating of the knowledge system or publication. Most forms of knowledge models are composed of primitive elements called knowledge objects.

As discussed by Milton, (2003), knowledge models include symbolic character-based languages, such as logic, diagrammatic representations, such as networks and ladders, tabular representations, such as matrices and structured text, such as hypertext. Of which, the three important types of knowledge models are:

- **Ladders:** Ladders are hierarchical (tree-like) diagrams. Some important types of ladders are concept ladder, composition ladder, decision ladder and attribute ladder.
- **Network Diagrams:** Network diagrams show nodes connected by arrows. Depending on the type of network diagram, the nodes might represent any type of concept, attribute, value or task, and the arrows between the nodes any type of relationship. Examples of network diagrams include concept maps, process maps and state transition networks.
- **Tables and Grids:** Tabular representations make use of tables or grids. Three important types are forms, frames, timelines and matrices/grids (Milton, 2003).

2.3.4 Explanation Facility

Within the context of using expert systems to solve problems, the term "explanation" has been used very loosely to cover almost any request for further information. For example, users might have a need for further operational instruction, more data, explication of terms, feedback, or justification of the reasoning methods used or advice given (Richard and Johnson, 1995).

The Explanation process is used by the expert system to provide to the user a reasoned history of its actions and/or recommendations. This explanation is usually generated by providing a textual commentary identifying the sequence of rules it has fired with associated canned or automated commentary generation on why the rule was fired. This type of explanation can be used by the user to verify that the reasoning mechanism being utilized by the expert system is correct. It also provides additional information to the user that can be used to establish a more complete context for understanding both the state of the environment in question and the rationale for any advice or opinion given by the Knowledge-based system.

Some KBSs aim at replacing their human counterparts. Usually they are intended to function as assistants or advisers to professional people with different technical background and problem-solving experience. To be useful and acceptable, a Knowledge-based system must not only perform at a level comparable to a human expert's, but also must be able to explain the reasoning processes it employs to solve problems and make recommendations. Richard and Johnson's article describes two unique characteristics of KBS applications. First, Knowledge-based systems are often developed to help make relatively unstructured decisions, and a time lag may exist between when such decisions must be made and when their quality can be assessed. As a result, the acceptance of KBS-generated advice is more likely to be determined by its reasonableness than by its correctness. Second, real-world decisions have practical-financial, legal, political, and social-consequences. If users are to remain responsible for the decisions made, they are unlikely to accept a system's recommendation if they do not understand its underlying reasoning processes. An explanation facility provides the potential to make a Knowledge-based system more useful and acceptable by increasing user understanding

of, and confidence in, its decisions and recommendations.

2.4 Major Application Areas of Knowledge-Based Systems

Pomykalski et al (1999) defined two different perspectives to look at the application areas for Knowledge-based systems. These are looking at the functional nature of the problem and the application domain. Reviewing both of these ways will enable us to get a better understanding for the application of Knowledge-based systems to real-world problems.

A KBS may have many differing functions. It may monitor, detect and isolate faults, control, give advice, document, assist, etc. The range of applications for Knowledge-based system technology ranges from highly embedded turnkey KBSs for controlling certain functions in a car or home to systems that provide financial, medical, or navigation advice to systems that control spacecraft.

The following table lists different types of problems generally solved by Knowledge-based systems.

Problem Type	Description
Control	Governing system behavior to meet specifications
Design	Configuring Objects under constraint
Diagnosis	Inferring System Malfunction from observables
Instruction	Diagnosing, debugging, and repairing student behavior

Interpretation	Inferring situation description from data
Monitoring	Comparing observations to expectations
Planning	Designing actions
Prediction	Inferring likely consequences of given situation
Prescription	Recommending solution to system malfunction
Selection	Identifying best choice from a list of possibilities

Table 2.1: Knowledge-Based System Application Areas, Pomykalski et al (1999)

KBSs also cover a number of different application areas, such as agriculture, education, environment, law, manufacturing, medicine power systems etc. Hereafter, application areas in which Knowledge-based systems are widely used among the practitioners due to the maturity of the field by revealing the acceptance of the technology by the commercial sectors are discussed.

Knowledge-Based Systems in Agriculture: Knowledge-based systems for Agriculture are the same as other KBSs, as they use the rule-based approach which the experience and knowledge of a human expert is captured in the form of IF-THEN rules and facts. These rules and facts are used to solve problems by answering questions on such diversified topics, such as pest control, the need to spray, selection of a chemical to spray, mixing and application, optimal machinery management practices, weather damage recovery such as freeze, frost or drought, etc (Siew et al, 2005).

Knowledge-Based Systems in Medicine: KBSs in medicine contain medical knowledge, usually about a very specifically defined task, and are able to reason with data from individual patients to come up with reasoned conclusions. Although there are many variations, the knowledge within

an expert system is typically represented in the form of a set of rules.

Siew et al. (2005) mentioned the various tasks of the medicine domain, in which KBSs can be applied. These are generating alerts and reminders, diagnostic assistance, therapy critiquing and planning, agents for information retrieval and image recognition and interpretation.

Knowledge-Based Systems in Education: In the education field, many of the KBS's applications are embedded inside the Intelligent Tutoring System (ITS) by using techniques from adaptive hypertext and hypermedia. Knowledge-based systems are important as a teaching tool, because they are equipped with the unique features which allow users to ask question on how, why and what format. When they are applied in the class environment, they will give many benefits to student as they prepare responses to their questions without a need of involving the teacher.

In term of technology used, Knowledge-based systems in the education field have expanded consistently from microcomputer to web based and agent-based KBSs. By using web-based technology, they can provide an excellent alternative to private tutoring anytime from anyplace, where Internet is provided. Agent based expert systems on the other hand will help users by finding materials from the web based on the user's profile. (Siew et al, 2005).

Knowledge-Based Systems in Law: These days, legal KBSs have attracted attention from legal theorists as well as computer scientists. For legal theory, Knowledge-based systems in law raise the hope of specific instruments for the immediate support of professional work in law. For AI and computer science, KBSs in law raise the hope of opening up new applications, not otherwise easy to access. From both viewpoints, the construction of legal KBSs has provided challenges which have sometimes stimulated joint efforts from the different communities of Law, AI, and Computer Science. However, the success of these efforts has so far been rather modest.

At present, in the field of law there seem to be two categories of KBSs (Fiedler, 1991). First, there are methodologically ambitious and sophisticated systems, which are not of practical use. Systems like these may be based on predicate logic and may include some advanced features, such as some natural language processing. However, they have remained in the state of concepts, model systems or research prototypes. Second, there are methodologically less ambitious systems, which have some potential to be used in practice. Systems like these may be based on propositional logic only, but have very simple and comfortable user interfaces. On the whole, limited progress has been made in AI-based systems that attempt to capture legal expertise and reasoning in a way that can be of real benefit to the profession (Fiedler, 1991).

Knowledge-Based Systems in Environmental Management: The application of KBS technology in the domain of environmental management is particularly appropriate in order to assist human beings in their attempt to preserve and disseminate valuable expertise efficiently and at reasonable costs. Nowadays, there have been a number of expert system applications on environmental management domain including those which are still in the development process.

One of the potential KBS applications in the domain of environmental management is the computer-aided system for environmental compliance auditing. The system was actually a cost effective integrated environmental monitoring system for Environmental Impact Assessment (EIA) project as well as environmental database management system (Siew et al, 2005).

2.5 Limitations of Knowledge-Based Systems

The future for knowledge-based systems development is bright; however, there remain many obstacles that must be overcome in order for KBSs to truly flourish into a common problem

solving methodology. The current generation of KBSs is plagued by various limitations such as information brittleness, isolation, static knowledge, absence of common sense and being expensive and time-consuming to develop (Kobori, n.d, Pomykalski et al, 1999). There are on-going efforts to extend the usefulness of KBSs and overcome the limitations.

In order to overcome the limitations inherent in the technology, Pomykalski et al, (1999) suggested methods of learning and the integration with other technologies to be incorporated in intelligent systems that solve critical problems in changing domains. These methods include the use of KBSs embedded within other technologies, the use of hybrid intelligent systems as problem solvers, and the current state-of-the-art in learning mechanisms that can be incorporated in KBSs.

Embedded Systems: Artificial Intelligence systems, including KBSs can be broadly categorized into two general classes based on their architecture: stand-alone and embedded. Typically, a KBS has been developed in a stand-alone architecture and exists either independently or as the main component of a system that relies on another system for data collection.

An embedded Knowledge-based system would be one that is designed and built to be an integral part of some larger system environment. The overall system environment provides a wide range of functions that support the system's mission and define its architecture. The embedded Knowledge-based systems can provide these functions directly, or support them indirectly as services. In either case, the use of a KBS should be invisible to the surrounding system and the user. The future of KBSs will be as part of larger systems in an embedded architecture. Both software systems and consumer products will have KBS functionality embedded within the product and that functionality will be invisible to the user (Pomykalski et al, 1999).

Hybrid Systems: One of the major reasons for the rise of Knowledge-based systems has been the failure of other traditional techniques to address problems of automating problem solving knowledge. Approaches from operations research have attempted to optimize where in many cases optimization is not possible. On the other hand, recent interest in neural networks has shown where Knowledge-based systems have failed to address important aspects of problem solving knowledge acquired through inductive learning.

Instead of relying entirely on a single technology, many complex domains require multiple technological solutions. When combined into a single system, these hybrids can sometimes outperform the solutions provided by their individual technological components (Pomykalski et al, 1999).

Learning: Developing machines that learn, in the sense of biological systems, remains one of the fundamental challenges in artificial intelligence. Nonetheless, a great deal has been accomplished over the last several decades of research in this area. Of course, learning represents a broad activity in its own right encompassing approaches as varied as direct changes in rules to improve performance and the automatic acquisition of knowledge. The former represents a relatively simple approach to automated learning, while the latter is a goal that has yet to be realized (Pomykalski et al, 1999).

Most learning, automated or not, operates with some form of feedback. When the feedback comes from a supervisor or teacher, it is called supervised learning. On the other hand, when the feedback derives from internally formulated criteria, it is called unsupervised learning.

CHAPTER THREE

THE ETHIOPIAN LEGAL SYSTEM AND LABOR LAW

3.1 Overview of the Ethiopian Legal System

Ethiopia has long depended on written laws. The first integrated legal code, the Fetha Nagast (Law of Kings), was translated from Arabic in the mid-fifteenth century (Library of Congress Country Studies, 2009). This law was inspired by the Pentateuch (the first five books of the Old Testament), the New Testament, canons of the Christians' early church councils, Roman Civil Law, and tenets of Quranic law. However, the Fetha Nagast was not the only applicable law of the time. Muslims continued to be judged in their own courts according to Sharia law. Also,

outside the ordinary judicial system, clan and tribal courts exercised unofficial but effective coercive powers, and people rarely appealed their decisions to regular courts.

The Fetha Nagast and customary laws remained the basis of criminal judicial procedure until 1930, when Haile Selassie I introduced a penal code, which strove for modernity in its articulation. In 1958 a Swiss legal expert drafted a revised penal code to meet the needs of a developing nation. A 1961 criminal procedures code, drafted by a British jurist, augmented the 1930 penal code. The former was based on the Swiss penal code and many secondary sources; the latter reflected the influence of English Common Law. For virtually every offense listed in the revised penal code, there were upper and lower limits of punishment. The effect was to stress acceptance of the concept of degrees of culpability, as well as the concept of extenuating and aggravating circumstances. Separate provisions existed for juveniles (Library of Congress Country Studies, 2009).

According to Brietzke, 1974, it was in 1960 that the Government made the first modern attempt at a comprehensive and formal statement of Ethiopian private law by promulgating Civil, Commercial and Maritime Codes. Emphasizing the relative modernity of these Codes, analyses have tended to follow uncritically the lead of Professor David, the Civil Code draftsman. The predominant flavor of these codes is French-in approach, style and, to a large extent, substance. The French draftsmen of the Civil and Commercial Codes (David, Jauffret and Escarra) claim to have used an eclectic approach based on comparative law methodologies, and to have consulted Western European, Middle Eastern, and North African Codes, as well as Anglo-American legal rules (Beckstrom, 1973)

Following the 1974 revolution, a normal legal process theoretically was in effect for dealing with

criminal offenses. Existing parallel to it was a "revolutionary" system of neighborhood justice. In practice, it was impossible to distinguish between criminal acts and political offenses according to the definitions adopted in post-1974 revisions of the penal code. A November 1974 decree introduced martial law, which set up a system of military tribunals empowered to impose the death penalty or long prison terms for a wide range of political offenses. Special three-member military tribunals sat in Addis Ababa and in each of the country's fourteen administrative regions (Library of Congress Country Studies, 2009).

In July 1976, the government amended the penal code. This revision empowered association tribunals to deal with criminal offenses but limited their jurisdiction to their urban neighborhood or rural area. Elected magistrates, without formal legal training, conducted criminal trials. Procedures, precedents, and punishments varied widely from tribunal to tribunal, depending on the imperatives of the association involved.

In 1981 the Amended Special Penal Code replaced the Special Penal Code. This amended code included offenses against the government and the head of state, such as crimes against the state's independence and territorial integrity, armed uprising, breach of trust by public officials and economic offenses, illegal currency transactions, and corruption and abuse of authority. The Amended Special Penal Code also abolished the Special Military Courts and created new Special Courts to try offenses under the Amended Special Penal Code. Special Courts consisted of three civilian judges applied the existing criminal and civil procedure codes. Defendants had the right to legal representation and to appeal to a Special Appeal Court (Library of Congress Country Studies, 2009).

In 1991 the former military government was overthrown and new transitional government came

to power. In 1995 new constitution was framed and a new government was elected. The constitution has enshrined commonly acceptable democratic and fundamental human right principles. The constitution has also recognized the importance of international laws to which Ethiopia is a signatory. Moreover, it has established ethnic federalism as a political system. It further empowered the constituent federations to form their independent legislative, executive and judicial bodies. To this end, states can enact and execute their laws based on their socio-economic and political backgrounds (Tesfaye, n.d.).

Prior to the advent of the federal system of government, court services were not accessible and affordable to citizens. Under the Derg regime, the Ethiopian judicial system was unitary and the country was divided into 14 areas in which the High Courts would sit (The World Bank, 2004). The Supreme Court was located only in Addis Ababa and Higher Courts in the capitals of the 14 administrative areas. By virtue of the power vested in them by law, the Supreme and High Courts had exclusive jurisdiction to hear and dispose cassation and appeal cases respectively. For this reason, citizens who needed to file such cases had to travel far from the district level to the capital. As the process of opening case files and receiving appointments required them to spend many days in the capital, this exposed them to grave economic and social sufferings. The situation is even worse considering the number of appointments they needed to attend from time to time until the trial is concluded (Tuominen and Lyabandi, 2009).

The government of Ethiopia is now putting into place a decentralized federal system of courts consisting of regional and district courts consistent with the 1994 constitution. The creation of a federal system of government, each region under a federal government empowered to maintain similar justice and judicial structures is helping to alleviate the above stated situation. Regions

were made to have justice bureaus with similar function to that of Federal Ministry of Justice and an identical court system, i.e., Supreme Court, High Court, Woreda Court and First Instance City Courts. Although the decentralized justice structure helped to bring justice institutions closer to citizens, the judicial system in the country was suffering from a range of problems related to human, institutional, administration, systemic and procedural deficiencies (Tuominen S. et al, 2009).

3.2 Judicial Institutions in the Legal Sector

Federal Courts

The 1995 Constitution declares the independence of the judicial branch and articulates the structure and powers of the courts. The federal courts were established by Proclamation 25/1996, and consist of the Federal Supreme Court, the Federal High Courts, and the Federal First Instance Courts. These courts have original and appellate jurisdiction over cases arising under federal law, and in other specified instances. The vast majority of federal court judges are located in Addis Ababa, with a small group in Dire Dawa. The federal courts are generally seen as central government courts (The World Bank, 2004).

The Federal Supreme Court includes a cassation bench with the power to review and overturn decisions issued by lower federal courts and State Supreme Courts containing fundamental errors of law. Judicial decisions in general do not create precedent and, in theory, are not binding on lower courts. However, in practice, superior courts tend to insist, de facto, on the binding nature of their precedents, often in the guise of challenging the competence of the lower courts (The World Bank, 2004).

Each court has a civil, criminal, and labor division with a presiding judge and two other judges in each division. The Federal Supreme Court has thirteen members and sits in Addis Ababa. The Federal High Courts and First Instance Courts sit in Addis Ababa and Dire Dawa (Tuominen and Lyabandi, 2009).

State Courts

The Constitution directs the creation of three levels of state courts: the State Supreme Court, High Courts (or the Zonal Courts), and First Instance Courts (or the Woreda Courts). State Supreme Courts sit in the capital cities and have final judicial authority over matters of state law and jurisdiction; they can also exercise the jurisdiction of the Federal High Court if none exists in that state. Similarly, State High Courts sit in the zonal regions and can assert the jurisdiction of Federal First Instance Courts in addition to state jurisdiction (The World Bank, 2004).

Municipal District Courts

The Addis Ababa City Charter creates two levels of City Courts exercising municipal jurisdiction, First Instance and Appellate Courts. Cassation review of Appellate Court decisions can be brought before the Federal Supreme Court, which also decides jurisdictional conflicts between the city and federal courts. The City Charter also confers judicial powers on the following entities: the Labor Relations Board, the Civil Service Tribunal, the Tax Appeals Commission, and the Urban Land Clearance Matters Appeals Commission. Dire Dawa does not yet have a formal municipal court system independent of the federal courts. Social Courts operate at the kebele level, but their legal authority is unclear and no appellate courts currently exist (The World Bank, 2004).

Other Courts

The Constitution of Ethiopia permits the adjudication of disputes relating to personal and family matters in accordance with religious or customary laws, but only with the consent of all parties. Official recognition can be granted to both religious and customary courts. Traditional systems currently have no jurisdictional or legal relationship with the official system (The World Bank, 2004).

To date, Sharia Courts, applying Islamic laws, are the only religious courts that have been officially established in states, districts, and municipal districts. Sharia Courts apply only Islamic laws and have their own appellate system. Parties must voluntarily submit to the jurisdiction of these courts, or the dispute should be redirected to ordinary justice.

Customary/Traditional Courts are not yet widely established by law, despite their constitutional recognition. Unlike social courts, customary courts are only recognized, not created, by law. The authority of these courts stems from tradition and local customs (The World Bank, 2004).

3.3 Problems in Ethiopian Legal System

Developing the Rule of Law is key to establish a sustainable system of democracy. The rule of law promotes economic growth and reduces poverty by providing opportunity, empowerment, and security through laws and legal institutions. On the other hand, problems in the legal system will have a negative impact in the social, political and economic wellbeing of the people (The World Bank, 2004).

Although the decentralized justice structure helped to bring justice institutions closer to citizens, the judicial system in the country was suffering from a range of problems related to human,

institutional, administration, systemic and procedural deficiencies. According to The World Bank (2004), these problems include lack of transparent and clear guidelines for the recruitment and deployment of judges, assignment of judges, prosecutors and support staff with inadequate qualifications and experience, lack of adequate on-the-job-training or skill upgrading opportunities for judges, prosecutors and court administrative personnel, lack of a system to hold judges and administrative personnel responsible for wrong doings, lack of transparency of courts and justice institutions and existence of little or no awareness among the public about court procedures and operations, inefficient file management systems and operational procedures has resulted in the huge pile up of backlogged case files, interpretation of law is more dependent on experience than following court procedures, hence characterized by arbitrariness, and inefficient court administration due to the wide gap between judicial knowledge and the management skill needed to plan, monitor and evaluate court activities.

The most basic problems in the Ethiopian legal system as emphasized by Tuominen and Lyabandi, (2009) are dismal conditions of service, staff shortages, a lack of adequate training, debilitating infrastructure and logistical problems.

3.4 Efforts Made to Overcome the Problems of Ethiopian Legal System

There is overall acknowledgement of the need for certain reforms within the Ethiopian legal and judicial system. The Government and other stakeholders are working together to support for reforms in the legal system and judiciary. Within the scope of the reform, The World Bank (2004) identified a number of priorities which has to be implemented on the medium to longer term. These include quality of justice, dissemination of legal information, legal education, access to justice, commercial justice and staging of reforms.

A Civil Service Reform Program was begun in 1996 to strengthen public sector systems and services, including elements of the judiciary. Projects addressed solely to judicial strengthening started in 1997. Miscellaneous training programs for lower level judges have also been provided by the Federal Supreme Court and various other entities or institutions.

In 1997 the Ethiopian Justice and Legal System Research Institute was established to provide a forum for the executive, legislative, and judicial branches to work together to reform legislation and modernize the justice sector, and at its inception was intended to be the primary actor researching, reforming, and modernizing the laws (The World Bank (2004).

The Justice Systems Reform Program (JSRP)

In 2002 the Ministry of Capacity Building produced a Justice System Reform Program (JSRP) announcing its plans to take forward its ongoing efforts in justice systems reform. The JSRP proposal encompassed all actors and institutions involved in the justice sector including the federal and state courts, the Ministry of Justice and Regional Bureaus of Justice and federal and state police (The World Bank, 2004).

The components outlined in the JSRP included inter alia strengthening of the Justice Systems Reform Program Office, judicial law revision and reform, court administration reform, law enforcement, strengthening of legislative organs, as well as legal education and training. Even as these efforts to further develop comprehensive Justice Systems Reform Program proceeded, the Government continued to pursue reform efforts over the 2001-2003 period including a nation-wide baseline assessment of the full range of justice systems institutions, law revision and law reform activities; a second phase of court administration reform including records and case

management; the establishment of a judicial in-service training institution; and the roll-out of training for judges (The World Bank (2004).

The various efforts made to reform the justice system of the country gave emphasis to the potential of Information and Communication Technology in the field. The website developed and maintained by Federal Supreme Court of Ethiopia has immensely facilitated the systematic organization and updating of court information and disseminating this information to researchers and the public at large. Efforts are also underway regarding the development of an information portal which would provide online access to the legal information and services of federal courts. As part of the implementation of JSRP, efforts are being exerted by different justice institutions to develop electronic information resources management tools. Other efforts to exploit ICT to support the justice system include: the development of a National Integrated Justice Information System Portal, which would serve as a clearing house for justice information (Tuominen and Lyabandi, 2009).

Though considerable achievements can be scored, the course of justice reform activities and proposals has become rather complicated and somewhat fragmented. Achievement of a successful reform program will require ample time and consideration to be devoted to the assessment of needs and development of tailored and realistic implementation mechanisms, strategies, priorities, and objectives. The current reform outline appears comprehensive and perhaps overly ambitious in certain aspects, but only narrowly addresses or ignores other complex problems that will not likely be resolved simply by increasing capacity (Tuominen and Lyabandi, 2009).

3.5 Overview of the Labor Law

Less than a century ago, there was little or no protection for employees. It was up to the Employers to determine how to treat their employees, often paying them wages as low as possible while working them as long hours as they could get out of them. Working conditions were often unhealthy or dangerous, and workers were offered no benefits such as health insurance or worker's compensation in the event of an accident on the job. Even children were subjected to this employment abuse (Swan, 2003).

As the Industrial Revolution swept America, Europe, and the rest of the industrialized world, more and more people left their rural lives to live in cities and work in factories. As the number of such employees rose and working conditions worsened, it became clear that the government would need to step in to protect the rights of the workers. These initial efforts eventually gave way to modern employment law (Swan, 2003).

Employment law protects employees from any mistreatment by their employers. Current employment laws incorporates provisions to establish fair wages, limit the number of hours worked in a week, and prevent children from being exploited were among the first components of employment law. Rules were also established to regulate the cleanliness of the workplace, and employers were required to take precautions to protect their employees and prevent dangerous accidents. These initial efforts are still an important part of employment law, although they have been improved and expanded as needed over the years. Employment law protects other rights of employees, too. Laws have been passed to establish standards that include protection against discrimination in the workplace based on race, gender, religion, disability, or veteran status (Davies et al, 2005).

Employment law is a vital part of government's efforts to protect citizen's rights as human

beings. Employment law ensures that employees cannot be overworked, placed in an unhealthy or dangerous environment, or rendered unable to work without appropriate compensation. Employment law also guarantees that workers can't be unfairly discriminated. Employment law is what stands between modern employees and such crimes as became widespread during the Industrial Revolution.

3.6 Basic Components of Labor Law

Though there might be a slight difference from country to country, Davies et al, (2005) discussed the following items as major components a typical Labor Law is expected to cover.

Contract of employment: Contract of employment is a legally enforceable agreement, either oral or written, between an employer and an employee that defines terms and conditions of employment to which both parties must adhere. Express terms of the contract are agreed between the two parties and include the organization's normal terms and conditions in addition to those that relate specifically to the individual. These terms can only be changed by employee agreement, if the contract itself allows for variation, or by terminating the contract (Davies et al, 2005).

The rights and obligations of the worker and the employer between one another are mediated through the contract of employment between the two. This is the core reality of modern economic relations. Many terms and conditions of the contract are however implied by

legislation or Common Law, in such a way as to restrict the freedom of people to agree to certain things in order to protect employees, and facilitate a fluid labor market.

Working time: Before the Industrial Revolution, the workday varied between 11 and 14 hours. With the growth of industrialism and the introduction of machinery, longer hours became far more common. The eight-hour movement's struggle finally led to the first law on the length of a working day, passed in 1833 in England, limiting miners to 12 hours, and children to 8 hours. The 10-hour day was established in 1848, and shorter hours with the same pay was gradually accepted thereafter (Davies et al, 2005).

Health and safety: Many Labor Laws involve safety concerning workers. Occupational health and safety is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goal of all occupational health and safety programs is to foster a safe work environment. As a secondary effect, it may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment (Davies et al, 2005).

Unfair dismissal: Wrongful dismissal, also is a legal phrase describing a situation in which an employee's contract of employment has been terminated by the employer in circumstances where the termination breaches one or more terms of the contract of employment, or a statute provision in employment law. It follows that the scope for wrongful dismissal varies according to the terms of the employment contract, and varies by jurisdiction (Davies et al, 2005).

3.7 The Ethiopian Labor Law

The introduction of labor related regulations in Ethiopia dates back to the last 40-50 years.

Present-day Labor Law only came into existence as a result of the modern industrial development and with the rise of the status of the employee as wage earner. Ethiopia's process of modernization and industrialization – in contrast with other African countries with a history of colonization - continued slowly but surely since the times of Menelik II (Emperor of Ethiopia from 1889–1913) , and was only interrupted by the Italian invasion in 1935. Nevertheless, only the postwar years allowed the further development of individual and social rights in line with the attempt to economical development (Sommer, 2004).

At the very beginning, the workers' movement in Ethiopia was rather corporative, taking the form of the traditional Ethiopian organizations, such as “ekub” and “edir”, local self-help societies that provide services and mutual aid and protection of the interest of their members. One of the first workers' organization with the pattern of a modern trade union was the “Franco-Ethiopian Railway Company Workers' Association”, founded in 1947. But it was not before 1961 that the first union was registered under the Civil Code (Civil Code Proclamation, No. 165/1960).

In 1963 the first formal Labor Law was established with the “Labor Relations Proclamation No. 210/1963”. This proclamation recognized the rights of associations of employers and workers, as well as a system of collective bargaining, and it set up machinery for the settlement of trade disputes – the Labor Relation Board. Consecutively, in 1963 the “Federation of Employers of Ethiopia”, and in 1964 the Confederation of Ethiopian Labor Unions – CELU, were founded. However, individual labor relations were treated exclusively like any other service contract according to the regulations of the Civil Code (Sommer, 2004).

During the Dergue period (1974-91) as part of the socialist order of state and society, Labor Law was based on the public ownership of the means of production and was subject to central

planning and central management. The Labor Proclamation No. 64 of 1975 superseded the imperial Labor Relations Proclamation, and contained almost all provisions of a socialist Labor Law. There was no autonomy with regard to the conclusion of collective agreements as a form of independent control over working life exercised by freely constituted trade unions. There were no employers' organizations, and no contractual freedom between employer and employee. Until recently, the main source of Labor Law, the Labor Proclamation, Proclamation No. 42/1993, was developed in the post-socialist time, marking the overcoming of the centralized state-economy towards a market oriented, pluralistic society (Sommer, 2004).

In 2003, the House of People's Representatives adopted Labor Proclamation No. 377/2003, effective since 26 February 2004. This text repealed Labor Proclamation No. 42/1993 (as amended by Proclamation 88/1994). It has become the principal source of Labor Law in Ethiopia (Sommer, 2004). The new statute represents an important tool for unions and employers to participate in all labor matters. The innovation concerns the right of workers, without distinction whatsoever, to form organizations of their own choosing and the right of these organizations to organize their activities without interference by the public authorities and not to be dissolved by administrative authority (Article 114 (1), (2) and (7)).

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

In this part of the research document, the research design and methodology employed for the assessment and exploration of the current situation of the labor justice system and the development of the knowledge-based system in the area of Labor Law will be discussed. This includes the data collection methodology, design and modeling of the knowledge acquired, the programming tool to be used, and the testing and evaluation techniques to be employed will be discussed.

4.2 Surveying Methods

4.2.1 General Approach

Before proposing a solution in any area of study, the researcher would need to investigate the existing system, find the limitations present, and finally evaluate whether the proposed mechanism would help the stakeholders. In the same manner, it will be helpful to conduct a preliminary survey on the problems of the Ethiopian legal system with special emphasis on the cases related with the Ethiopian Labor Law, before going through the knowledge-based system

development process. The purposes of making such a survey are:

- To show the magnitude of the problems defined in this research work based on the facts to be collected from concerning parties (employees, employers and judges)
- To identify further holes which are present in the existing system which require intervention

To fulfill the above stated objectives, a preliminary survey was conducted. Qualitative data collection mechanism, typically interview, was employed to collect information concerning the existing legal system as a whole, and the Ethiopian Labor Law in particular. The respondents were selected using convenience sampling, taking only two, out of ten federal first instance courts residing in Addis Ababa. Survey subjects approached for data collection included: judges, attorneys and court clients who are stakeholders of the justice system. From each of the two courts, 6 respondents were randomly selected from court clients and two respondents from judges working on labor benches. The 6 respondents from the court clients were randomly selected applying quota sampling technique to make them equally representative of both the employee and employer sides. The findings of the survey were used as an input to the development of knowledge-based system with the purpose of addressing core problems.

4.2.2 Method of the Study

Prior to developing a knowledge-based system which will make an attempt to address the existing problems in the Ethiopian legal system with special emphasis on the Ethiopian Labor Law, one has to have precise and adequate knowledge about the domain. For this purpose, descriptive survey approach was used. Descriptive research design is a scientific method which

involves observing and describing the behavior of a subject without influencing it in any way.

This approach applies surveys and fact-finding enquiries in order to acquire state of affairs as it exists. As the researcher's objective at this level is getting a complete and dependable understanding about the Ethiopian Labor Law, descriptive research design will be a valid method for researching this specific domain. Besides enabling to obtain a general overview of the subject, it will be suitable to investigate the way how to manage and to assess the cases associated with Labor Law.

4.2.3 Data Collection Procedure

Both primary and secondary sources were used to collect the data required for the development of the knowledge-based system in the area of Labor Law. The primary sources of data for the development of the legal knowledge-based system include various legal experts which have adequate knowledge and experience in the area of Labor Law. These are judges and attorneys working and handling cases at federal and regional courts. In view of increasing the quality of data collected and in order to collect diverse and complimentary inputs, group discussions were conducted among judges and attorneys. This strategy was found to be effective in soliciting good inputs on issues of common concern in other related researches. The selection criterion for the legal experts is the adequate experience the experts have in the area of Labor Law in addition to their specialization in the field of law.

The second category of primary source of information is the Labor Proclamation No. 377/2003, which is currently in effect to handle employment related cases. As it was discussed in Chapter I of this document, there are two major legal systems in the world, namely Common Law and Civil

Law (Continental Law) legal systems. The law in Common Law countries is derived from legislation and from case law. Legislation, or statute law, consists of statutes and delegated legislation. Statutes are usually made by legislative organ of the government (the Parliament). Delegated legislation (rules, regulations, ordinances, by-laws, etc.) is made by a person or body to whom legislative power has been delegated by statute. Case law, or the Common Law, is judge-made law: judicial resolutions of specific disputes. The sources of case law are the published reports of the cases as heard before various courts. Legislation takes precedence over case law; parliaments can override judge-made law by legislative enactment. However, judges have the task of determining the meaning of legislation. Any legal expert system which seeks to deal with the law in a Common Law country must account for both statute law and case law (Popple, 1996).

On the other hand, the law in Civil Law countries exclusively comes from the legislation. Judges do not have to hear similar cases previously heard by various courts before making decisions. Therefore, any legal expert system which seeks to deal with the law in a Civil Law country must account only statute law. As discussed in chapter one of this document, the Ethiopian legal system is predominantly Civil Law, and therefore considering only the legislation for the rule-base of the expert system is proper.

Additionally, review of legal cases was made to gather information on the content and structure of legal proceedings for the purpose of training the neural network. Taking the amount of time available for the research work, adequate number of concluded legal cases available at Federal Supreme Court of Ethiopia was reviewed.

As secondary sources of information, various documents, books and journals which focus on the

Ethiopian Labor Law were assessed.

4.2.4 Sampling Technique

Four legal experts were used to acquire the necessary information for the rule-base of the legal knowledge-based system. The sampling technique used in order to select these legal experts is purposive sampling, which takes the limited accessibility of such type of experts into consideration. As one of these four legal professionals work in Oromiya Regional State Higher Court and the remaining three work at the Federal level, the system can accommodate slight interpretation differences which may exist between federal and regional courts. The fact that two of the professionals are attorneys while the remaining two are judges will give room to incorporate potential interpretation differences which may emerge from the role of the participants.

The source for legal proceedings which will be reviewed for the purpose of training the neural network will be the Federal Supreme Court of Ethiopia. Though the judicial structure which is currently in effect forms federal and regional Supreme Courts, High Courts, Woreda Courts and First Instance City Courts, the Federal Supreme Court is selected for the following reasons.

- Due to the implementation of electronic file and record management system at the Federal Supreme Court of Ethiopia, the time and effort required to access relevant cases is considerably reduced.
- The Federal judiciary functions in a three-tier structure. Among them, the Federal

Supreme Court of Ethiopia includes a cassation bench with the power to review and overturn decisions issued by lower federal courts and State Supreme Courts containing fundamental errors of law. This will make the court the highest ranked court in the state's judicial system, and its decision will be the final.

- Due to the centralized location of the court, there is easy access of relevant legal proceedings.

4.2.5 Data Collection and Analysis

The data required for both the rule-based and case-based modules is collected by manual means. The data required for the rule-based part is collected from the domain experts through interviews and discussions while registration of relevant facts from decided cases were done from files for the case-based part. The results of the unstructured interviews and discussions made are recorded manually on forms customized to collect specific information. The data collected for the purpose of training the neural network is then input into an Excel spreadsheet for easy management.

To begin the data analysis process, results were measured by category. In the case-based part, there were twelve categories, representing the twelve dependent variables. Findings from the decided cases were coded from 0 to 5 depending on the number of categories available for each input. The output for each process was coded from 0 to 1, as there are only two items of output in each process. Item analysis was conducted to determine the internal consistency and reliability of each individual item as well as each category.

The preliminary survey was administered in May 2010 across 2 branches of the Federal First Instance Court of Ethiopia, residing in Addis Ababa. These branches are Yeka Branch and Kera

Branch. The intended target group for this survey was the clients and judges, including lawyers representing employees or employers in the labor cases. Respondents were invited to participate in the survey in person. The invitation included a brief description of the KBS development research, its aims, and the fact that the response will be used only for academic purpose.

The total number of respondents across the branches of the Federal First Instance Court consists of 16 respondents, of which 12 of them from court clients and attorneys which handle labor cases, and 4 respondents from judges working on labor benches in each of the two branches. The respondents and branches were selected using convenient sampling technique.

4.3 The Knowledge-Based System Development

Regardless of the methodology chosen to develop a knowledge-based system, the key activities to be performed within the development life cycle of a knowledge-based system following the problem selection activity are knowledge acquisition, knowledge representation, implementation, testing and evaluation, and maintenance (Pomykalski et al, 1999).

4.3.1. Knowledge Acquisition

The knowledge acquisition process is used by the KBS to acquire new facts and rules associated with its specific domain. It is through this process that capabilities can be added to or subtracted from the expert system. Associated with this process is the concept of knowledge engineering. This is the process whereby knowledge from an expert or group of experts or other sources such as books, procedure manuals, training guides, etc. are gathered, formatted, verified and validated, and input into the knowledge base of the expert system. (Pomykalski et al, 1999)

To get knowledge into a computer program, it must be acquired from some source. Coffey et al

(2003), describe three categories of general techniques that include analysis of the tasks experts perform as they engage in problem solving or decision-making, the use of unstructured or structured interview techniques, and the employment of contrived techniques. The following brief discussion describes these general categories.

The analysis of familiar tasks encompasses a range of activities that involve observation of the expert actually performing work. In this approach, the expert typically verbalizes while performing a task. This procedure can lead to the enumeration of a protocol for the performance of the task. This method utilizes test cases that may be typical of the sort of problems the expert faces, or that may be anomalous in the sense that they occur infrequently, or because they are difficult to solve.

Unstructured interviews are informal conversations geared toward a broad goal. They can be useful early in the process when basic, groundwork-laying information is sought. However, some degree of structure is typically best for all but initial interviews. Interviews may have varying degrees of structure along at least two dimensions: i.e., the type of question asked and adherence to a pre-defined set of questions. Types of questions can include Open-ended, fill-in-the-blank, binary and scaled-response (Coffey et al, 2003).

Contrived techniques such as decision analysis, rating and sorting tasks, graph construction, and constrained processing/limited information problems require the expert to perform other activities than their familiar tasks. In decision analysis, the expert generates lists that include the elements of a problem, relationships among the elements, the types of problems encountered, etc. From such an analysis, the approach to decision making can be determined and represented in a reasoning model. Rating and sorting tasks involve making judgments regarding attributes of a

problem domain (Coffey et al, 2003).

Graph construction involves the creation of conceptual graphs or concept maps that are structured, non-textual representations of knowledge. Concept maps are graphs that are comprised of concepts on the nodes and linking phrases that elaborate the relationships among concepts on the arcs. The elicitation of concept maps has proven to be an effective means of externalizing an expert's key concepts of a knowledge domain and providing a framework for the structuring of knowledge (Coffey et al, 2003).

For the purpose of this research, unstructured interviews will be conducted with judges and attorneys at Federal First Instance Court and Oromiya Higher Court. The reason for selecting unstructured interview as the principal knowledge acquisition technique is that it will allow to forward additional questions in cases where the responses are not clear or complete.

4.3.2. Knowledge Modeling

Knowledge Modeling is a cross disciplinary approach to capturing and modeling knowledge. Knowledge models are structured representations of knowledge using symbols to represent pieces of knowledge and relationships between them. Knowledge models view the knowledge base using diagram and other structured representations, such as trees, maps and matrices (Robert and Edward, 1993). The advantage of using structured knowledge is its easiness to the user and the software to understand and maintain, manage and reuse. Diagrammatic representation of knowledge is used as a knowledge modeling approach in this thesis.

4.3.3. Knowledge Representation

There are several accepted methods of knowledge representation that have been devised for AI

type applications. Some of these are also suitable for use and interpretation by humans and can form a bridge between human knowledge and machine knowledge. This is important if organizational knowledge is to be archived in such a way that it can be effectively used in automated systems and also understood and updated by humans. Gordon (2000) discussed the following representational methods and their merit as knowledge management tools.

i. Rule-Based Reasoning

One of the earliest steps toward a model of legal reasoning was the use of expert systems to model certain rule-based aspects of law. Rule-based expert systems were the first type of AI system to become widely available and employed beyond the AI research community. Furthermore, their underlying computational mechanisms are conceptually clear and they have much computational strength. While from the legal standpoint there is a variety of opinions as to the validity, usefulness, and status of rules, and there are acknowledged difficulties in representing them, it is still quite natural to take some body of legal rules and embed them in a standard rule-based computational framework. In the rule-based approach, a rule is encoded in a simple, stylized if-then format: If certain conditions are known to hold, then take the stated action or draw the stated conclusion. Rule-based systems work by chaining these rules together. The rule-based approach is particularly useful because in many domains much of an expert's knowledge is amenable to expression in if-then rules, many of which are heuristic. Heuristics are typically an expert's individual synthesis of past problem solving, and they capture methods for making educated hunches. Expert systems provide a straightforward way to harness heuristic expertise, expressed as rules (Rissland,1990).

In this research work, rule-based reasoning method is used to represent part of the legal

knowledge regarding a specific domain of Labor Law acquired from the domain experts. The reason for making such a choice is that rule-based reasoning method is the most common one and it can be satisfyingly powerful from the perspective of building useful applications. Moreover, it has been proved that it can function well to represent legal knowledge in the development of a number of well-known legal expert systems. Rissland (1990) mentioned Legal Decision-making System (LDS) and the Logic Programming Group projects as examples of successful knowledge-based systems which applied rule-based reasoning method. One limitation of rule-based reasoning is that its inability to deal with open-texture.

ii. Case-Based Reasoning (Neural Networks)

Case-based reasoning is a form of knowledge representation based on analogical reasoning. Cases are used to capture the previous experiences of expert in solving problems in a domain. When presented with a new situation, the system attempts to match previous cases with the given situation. The previous cases are reformulated in order to provide a solution for the given situation (Pomykalski et al, 1999).

Open-textures are prevalent in any legislation. These are cases where a term or concept will be open to interpretation. Instead of putting rules for certain circumstances which may happen in cases, the law will give the discretion to determine the outcome for the judge. In Ethiopian Labor Law for example, the law will give the discretion to decide the outcome (reinstatement or compensation) to the judge, provided that unlawful termination of employment contract by the employer is proved. Rule-based systems can't deal with open texture; therefore, looking for another mechanism is required. In such cases neural networks have advantages over rule-based systems because a neural network generalizes from the examples it is provided with, though they

concede that a neural network cannot explain its decision by referring to explicit rules since its knowledge is not symbolic.

Neural networks represent one of the first approaches to machine intelligence and induction. While genetic algorithms use an analogy with evolution, neural networks use an analogy to the physical structure of the brain. Instead of a single complex processing unit, neural networks attempt to employ many simpler processors working together cooperatively in a network (Pomykalski et al, 1999).

For the purpose of this research work, a neural network model will be trained that predicts the type of outcome (reinstatement or compensation) in cases where unlawful termination of contract of employment is proved.

Taking the above requirements into consideration, a combination of rule-based and case-based approaches of designing legal expert systems will be used in this work as no single approach can design a system which can handle the two different tasks to be performed.

4.3.4 Implementation (Programming Tool)

In this research work, Prolog language is used to demonstrate the potential of knowledge-based systems in the area of Labor Law. The programming language PROLOG (PROgramming in LOGic) is an implementation of predicate logic for computing and is therefore a natural environment for using predicate logic to represent knowledge in a domain; many successful applications have been developed in PROLOG (Bramer, 2005). Prolog language is chosen because of its built-in pattern matching, rule-based programming and backtracking execution.

MATLAB language is used to train the neural network which will be used in the case-based part of the knowledge-based system. MATLAB is a high-level language and interactive environment that enables users to perform computationally intensive tasks faster than with traditional programming languages such as C, C++, and FORTRAN. MATLAB has a suite of programs designed to build neural networks (the Neural Networks Toolbox). Additionally, there are demonstrations available through MATLAB's help feature. MATLAB is chosen because of its interactive environment which makes it faster.

4.3.5 Prototype Testing and Evaluation

An important component of any software development effort is the testing and evaluation of the software system (solution) to ensure correctness of the outputs and user satisfaction with the product in solving the given problem. Since knowledge-based systems are software solutions to problems then the importance of testing and evaluation cannot be minimized (Pomykalski et al, 1999).

Typically, the performance of a knowledge-based system has been validated by running a number of test cases through the system, and comparing the result (i.e. the classification, final certainty factors, the advice given, or whatever) from the system against either known results or expert opinion. A percentage is calculated for the success rate of the system, and subjective judgment is used to both analyze this and explain the failure of the ES where its result was in contradiction to the known result or expert opinion. There are a number of well-known knowledge-based systems which used this approach of validation, including MYCIN and chest pain diagnosis system called EMERGE (O'Keefe et al, 1986).

In the same manner, 30 randomly selected test cases were given to the knowledge-based system in order to validate the knowledge-based system against known results (decisions made on the cases by the judges). All the cases to be used for the purpose of testing were selected from the archives of the Federal Supreme court of Ethiopia. The accuracy of the knowledge-based system in comparison with previously concluded cases were computed. Finally, the match and mismatch of the performance of the knowledge-based system and the previously concluded cases were compared using a Confusion Matrix.

In this research work, both the preliminary and the final results will be tested. The evaluation function will enable us to answer questions related with the system's potential to provide right answers, the consistency of the acquired knowledge with that of the domain experts and the available facilities and capabilities of the system.

CHAPTER 5

DATA ANALYSIS AND THE KBS DEVELOPMENT

5.1 Report of the Preliminary Survey

This preliminary report provides a summary of the outcomes of the survey for all participating individuals, including employers, employees, judges and attorneys, which are stakeholders in labor related court cases. The survey is a key component of this thesis work.

The preliminary survey included closed and open ended interview questions regarding respondent's beliefs about the performance of the existing labor justice system, the presence/absence of discrepancies on the decisions being made in the courts and stakeholder's views about the most effective approaches to enhance the performance of the existing legal system.

The Labor Law attributes listed in the survey were selected following a review of the relevant literature.

5.1.1 Findings

A total of 16 respondents, i.e. 8 court clients, 4 attorneys and 4 judges responded in the survey. For almost all of the respondents who are court clients, it was their first Labor Law case they faced in their life time. On the other hand, the attorneys averaged a total of 6 years in representing clients in labor related cases with more than 10 years practice in the legal field. The judges working in the labor benches of the two branches of the Federal First Instance Court averaged a total of 4 years in working in the labor benches of the courts with more than 5 years practice in the legal field.

i. Problems of the Existing Labor Justice System

Among the respondents interviewed who have been involved in labor cases which are being handled by courts, most reported varying degrees of dissatisfaction in the performance of the existing labor justice system. In fact, nearly all of the judges and attorneys interviewed, acknowledged that the existing labor justice system may not be satisfactory to court clients because of various reasons.

Interviews conducted with court clients, both employees and employers; reveal a number of different factors that are impacting the effectiveness of the labor legal system. The two main reasons discussed by the clients as determinant factors are the extended time which labor cases took before final decisions are made and the disparity of decisions made on almost similar cases. The later factor is shared by attorneys who represent clients in labor cases as well. In view of judges participated in the survey, the strongest barriers to satisfying court clients appear to relate to lack of adequate number of judges and the required court infrastructures. Other key obstacles relate to the availability and accessibility of court services geared specifically for clients involving in labor cases. They believe that the number of judges and benches which handle labor cases is much lower than the ever increasing number of such cases. Moreover, judges working in labor cases often handle other non-labor cases due to lack of enough number of judges.

Overall, the preliminary assessment of the case reveals that the major deterrents to satisfaction of court clients involved in labor cases include:

- The relative delay of labor cases before it got final decision
- Presence of inconsistency on decisions made on similar cases

- Lack of enough number of judges and labor benches in courts to handle increasing number of employment cases
- Inadequate supply of court infrastructure which hinders the provision of speedy decisions.

Among the court clients interviewed who have labor cases in courts not yet concluded, half of them reported that their case already took more than 9 months. From those whose case is concluded, 66% of them spend 1 ½ years or more before their case is concluded. Only 15% of the respondents evaluated the length of time required to reach on decision on labor cases as “fair”. With very few exceptions, the judges participated in the survey shared the fact that the labor cases being seen in courts actually took more time than they are expected to take. They attributed this fact to the increasing number of labor cases, failure of court clients to submit relevant evidences on time, lack of proper court infrastructure, inadequate legal knowledge of court clients etc.

On the other hand, most of these respondents, including those who complained that the time required concluding labor cases before courts is too long, are inclined to believe that the decision made on their case is similar with other identical cases. Only few of them feel the presence of inconsistency on decisions made on similar cases. This belief of the court clients is shared by almost all of the legal professionals. The judges participated in the survey believe that there is a possibility for the existence of inconsistency on decisions made on similar cases.

ii. Professional Perspectives

The legal professionals (Attorneys and judges) highlighted important issues for the research.

Although these professionals agreed that various efforts are being made in order to improve the performance of the existing labor justice system, they frequently commented that the current performance is much lower than the expectation of the court clients. One professional insisted that “there is an effort being made to improve the quality of the service being given to court clients, but it didn’t reach the level which we all want yet” and another noted that the problems are not unique to the labor justice system, but to the general legal system as a whole.

Almost all of the professionals felt that the number of labor cases is increasing day-to-day, and the capacity of the legal system is not increasing in a proportionate rate with that of the number of labor cases. The professionals attributed this increase in the number of labor cases appearing in courts to the growth observed in the economy, natural increase of the population and the improvement scored in the awareness of people about their rights.

5.1.2 Recommendations Made by Respondents

Nearly all of the judges and attorneys interviewed acknowledged that the existing labor justice system is not fully satisfactory to court clients. With very few exceptions, however, these lawyers and judges were generally convinced that implementing the ongoing Justice System Reform Program can only address the existed problems in the labor justice system partially.

Most of the respondents are inclined to believe that the performance of the legal system in connection with their employment case is unsatisfactory. Few of them believe that the legal system is satisfactory, though they expressed that it needs interventions which can enhance its performance.

Throughout these interviews and in a variety of contexts, respondents revealed both directly and

indirectly the factors, environment and measures that they regard as contributing to labor justice system that they perceive, or would be more likely to perceive, as “satisfactory”

- **Reasonable number of appointments-** Minimally, court clients expect to get decisions within reasonable number of appointments. Frequent appointments to see the cases will result extra expenses and wastage of working time which will affect both their economy and relationship with their employers.
- **Proper Court Environment-** Respondents fully expect that courts will be transparent and well-organized, with an air of legal professionalism that reassures them that they are not receiving less than high-quality service.
- **Rapid Decision-** Although “rapid decision” was not something respondents in this study talked about or directly expressed as a need for, it is believed that access to “rapid decision” would have a motivating impact on the respondents decisions to handle their case in courts.

All in all, a consensus is observed among the judges, attorneys and court clients on the fact that the existing labor justice system is not in a status of securing full satisfaction of clients, and therefore it is in need of intervention which can enhance its performance. One possible intervention is the use of ICT for expediting and enhancing court activities.

5.2 The KBS Development and Evaluation

5.2.1 Knowledge Acquisition

The major technique used to acquire knowledge in the area of Labor Law is the unstructured interview conducted with legal experts to the rule-based module of the system, and review of related concluded cases for the case-based module. Unstructured interview is selected as the principal knowledge acquisition technique because it will allow to forward additional questions in cases where the responses are not clear or complete.

The legal experts who were used for acquiring the domain knowledge are judges and attorneys at Federal First Instance Court and Oromiya Higher Court. Both the judges and attorneys have extensive experience in the field of Labor Law, as the judges are working in labor benches of the courts they are working in, while the attorneys frequently represent clients having labor cases. The experts are selected due to their experience and in-depth knowledge in the area of Labor Law.

In addition to the legal experts, the Labor Proclamation No. 377/2003 is used as a source of knowledge. This proclamation is the labor law that is currently in effect in Ethiopia.

No.	Occupation	Field of Study	Educational Qualification	Experience in the field (in years)
1	Judge at Federal First Instance Court (Yeka Branch)	Law	L.L.B.	8
2	Judge at Regional (Oromiya) Higher Court	Law	L.L.B.	5
3	Attorney (Private)	Law	L.L.M.	11
4	Attorney (Private)	Law	L.L.B.	6

Table 5.1: Profile of Legal Experts Participated in Interviews and Discussion for the Purpose of

Knowledge Acquisition

5.2.2 Knowledge Modeling

5.2.2.1 Extracted Concepts of the Ethiopian Labor Law

Labor Law is a broad area encompassing all areas of the employer-employee relationship. There are various concepts which are directly or indirectly linked with Labor Law. Labor Law addresses different concerns of the society, such as equality of treatment and opportunity, freedom of association and collective bargaining, abolition of forced and child labor, employment promotion and vocational training, social security etc.

Though the above stated concepts appear in Labor Laws of different countries in different forms, the focus area of this research work is limited to that of the Ethiopian Labor Law. The following discussion is based on the findings of the intensive interviews conducted with the domain experts, the results of the preliminary survey conducted, and the reading materials used to gather additional information on the research topic at hand.

Even though there are more issues which the Ethiopian Labor Law addresses, the knowledge elicitation activity conducted for this research work mainly concentrate on: employment contract, suspension of employment contract and termination of employment of contract. The reason behind choosing these three issues is that, the finding of the preliminary survey and interview conducted revealed the fact that these three components of the Labor Law are issues in majority of the cases which are being handled by courts.

Conceptual models are built for all the three components, while the knowledge representation and prototype design which is done in the following units of the research also covers all the three

components.

The Ethiopian Labor Law declared that employment contract shall be deemed formed where a person (employee) agrees directly or indirectly to perform work for an employer in return for wage. The law states that the agreement can be for definite or indefinite period or for piece of work. Though the law did not force contracting parties to make their employment contract in written form, the respective rights and obligations of the contracting parties has to be clearly stated on employment contracts made on written form.

The law requires all the following conditions to be fulfilled in order to make the employment contract valid before the law.

- The CoE shall not be concluded for the performance of unlawful or immoral activities.
- The employee has to work in return for wage.
- The CoE can be made in any form (oral or written).
- The work has to be done under the authority of the employer.

Suspension of contract of employment is also another issue handled by the Labor Law. The law states that rights and obligations arising out of a contract of employment may be temporarily suspended. Though suspension shall not imply termination of contract, it has an effect of interrupting the obligation of the employee to perform the work and the employer to pay wages, benefits and allowances.

The law requires the fulfillment of at least one of the following conditions in order to make the suspension of employment contract valid before the law.

- Leave without pay is granted to the employee.
- Leave of absence for the purpose of trade union activities is given.
- Leave of absence for the purpose of social services is given.
- Detention of the employee for 30 days or less and the employer is notified about the detention within 10 days, or it is supposed to know about it.
- Employee receives national call.
- Full or partial suspension of the employer's activities due to force majeure (a natural and unavoidable catastrophe that interrupts the expected course of events) which lasts for 10 or more days.

Termination of Employment relation is another very important issue being addressed by the Labor Law. It has an effect of permanently interrupting the rights and obligations arising out of a contract of employment, including the employee's obligation to perform the work and the employer's duty to pay wages, benefits and allowances. Contract of employment may be

terminated in one of the five ways established in the law, namely: in accordance with the provisions of the law, by the agreement of the contracting parties, upon initiation by the employer, upon initiation by the employee, or in accordance with the collective agreement.

Termination of CoE by law is the case where the rights and obligations arising out of a contract of employment will be interrupted by the provisions of the law. The law requires the fulfillment of at least one of the following conditions in order to make the termination by law valid before the law.

- Expiry of the period for a definite time CoE: A temporary appointment is for a fixed term, and at the end of the specified period the contract will be terminated unless it is renewed.
- Completion of the work for a piece of work CoE: Such type of contract is for a fixed work, and at the completion of the work the contract will be terminated unless it is renewed.
- Death of the employee
- Retirement of the employee in accordance with the relevant law
- Permanent cease of the operation of the employer
- Inability of the employee to work due to partial or total permanent incapacity

The second category of valid termination of contract of employment law is termination by agreement. The contracting parties may terminate their contract by agreement provided that waiver by the worker of any of his/her rights under the law shall have no legal effect. Such type of termination will be valid on the worker only where it is made in written form.

Termination by the request of the employer is another ground stated by the Labor Law to terminate the contract of employment. This is one of the two cases in which the employment contract can be terminated at the request of one of the contracting parties. This is the most

disputing area of the law in which majority of the cases which is being handled by courts deals with.

The law requires the fulfillment of at least one of the following conditions in order to make the termination by the request of the employer valid before the law.

- Repeated and unjustified tardiness of the employee despite warning to that effect
- Absence from work without good cause for five or more consecutive working days
- Absence from work without good cause for ten or more working days in a month
- Absence from work without good cause for thirty or more working days in a year
- Deceitful or fraudulent conduct of the employee in carrying out duties
- Misappropriation of the property or fund of the employer for undue enrichment
- Returning persistently low qualities and quantities of output despite the potential of the employee
- Imprisonment sentenced against the employee for more than 30 days
- Causing brawls or quarrels at the work place

The fourth type of ground to terminate the contract of employment is termination by the request of the employee. The employee can terminate the employment contract for any reason he/she like, but is obliged to give thirty days prior notice to the employer with exception of few cases in which not obliged to do so.

The last category of valid termination of contract of employment law is termination as per collective agreement. In cases where there is an effective collective agreement in the organization, the employer and the labor union are free to include other grounds of termination of contract provided that these grounds do not violate legal provisions.

5.2.2.2 Conceptual Model Building

After making a detailed analysis on the knowledge acquired so far, knowledge models were built so that it will be easily understood. Being one of the well known techniques of data modeling, conceptual modeling captures ideas in a problem domain, while a conceptual model represents concepts (entities) and relationships between them. The aim of conceptual model is to find the correct relationships between different concepts. Once the domain concepts have been modeled, the model becomes a stable basis for subsequent development of applications in the domain. The following input and output parameters (attributes) were identified during the knowledge acquisition process of the Labor Law legal knowledge expert system.

Input Parameters	Output Parameters
<ul style="list-style-type: none">• Form of the CoE• Legality and morality of activity• Presence of wage	<ul style="list-style-type: none">• Valid contract of employment• Invalid contract of employment

<ul style="list-style-type: none"> • Authority of the employer 	
---	--

Table 5.2: Input and Output Parameters of Validity of Contract of Employment

In conceptual model building the various concepts to be incorporated are diverse and there is an interrelation among the parameters. Each of the input and output mentioned in the tables can have a relation with one or more of the other. It is this fact that makes building a conceptual model a complex task, though the idea of a conceptual model is that it should be easily understood.

Input Parameters	Output Parameters
<ul style="list-style-type: none"> • Leave without pay granted • Leave of absence for trade union activities granted • Leave of absence for social services • Detention of the employee for < 30 days while employer is notified or supposed to know within 10 days. • National call • Suspension of employer’s activities due to force majeure or financial problem 	<ul style="list-style-type: none"> • Valid suspension of contract of employment • Invalid suspension contract of employment

Table 5.3: Input and Output Parameters of Validity of Suspension of Contract of Employment

Since all the five categories of reasons for valid termination of employment contract, namely in accordance with the provisions of the law, by the agreement of the contracting parties, upon

initiation by the employer, upon initiation by the employee and in accordance with the collective agreement produce the same output, they are categorized together to simplify complexity.

Input Parameters	Output Parameters
<ul style="list-style-type: none"> • Expiry of the CoE • Completion of the work • Death of the employee • Retirement of the employee • Permanent cease of operation • Inability of the employee • Agreement to terminate the CoE • Tardiness of the employee • Absence for five or more consecutive working days • Absence for ten or more working days in a month • Absence for thirty or more working days in a year • Deceitful or fraudulent conduct • Misappropriation of property or fund • Returning persistently low qualities and 	<ul style="list-style-type: none"> • Valid termination of contract of employment • Invalid termination contract of employment

<p style="text-align: center;">quantities of output</p> <ul style="list-style-type: none"> • Imprisonment for more than 30 days • Causing brawls or quarrels at the work place • Employee request for terminate of CoE • Reason for termination in the collective agreement 	
---	--

Table 5.4: Input and Output Parameters of Validity of Termination of Contract of Employment

5.2.2.3. Goals

The analysis of the extracted and captured knowledge through the extensive interviews, group discussions and preliminary survey conducted revealed the fact that the concepts validity of contract of employment, validity of suspension of contract of employment and validity of termination of contract of employment are to target one of the following goals.

Goal 1: Valid contract of employment- this goal tells that the contractual relationship existed between the employee and the employer is valid before the law. It will constitute the rights and obligations arising out of a contract of employment, including the employee’s obligation to perform the work and the employer’s duty to pay wages, benefits and allowances.

Goal 2: Invalid contract of employment- this is the goal that tells the non-existence of a contractual relationship between the employee and the employer before the law. This will have an effect of making the contract void from its beginning and will not have any effect on the contracting parties.

Goal 3: Valid suspension - this goal tells that the suspension of the contract of employment is

valid before the law. Valid suspension will have an effect of interrupting the obligation of the employee to perform the work and the employer to pay wages, benefits and allowances. But, this does not imply termination or interruption of the contract of employment.

Goal 4: Invalid suspension - this is the goal that tells the non-existence of a valid suspension of contract of employment before the law. In this case all the rights and obligations of the contracting parties will continue to exist as usual. The court will order the resumption of the work and payment for the days on which the worker was suspended.

Goal 5: Valid termination - this is a goal which tells the permanent termination of all the rights and obligations of the contracting parties, including the employee's obligation to perform the work and the employer to pay wages, benefits and allowances. The difference between this goal and goal to above is that, in case of termination the employment contract was in existence till the date of termination, while in case of invalid contract of employment, the contract was void from its beginning.

Goal 6: Invalid termination - this goal tells that the termination of the employment contract is unlawful because the employer or the worker failed to comply with the requirements laid down in the law regarding termination. In this case, the court can order either reinstatement (returning back to his/her job) or termination of the contract with compensation of a worker. Though the law puts few points to be considered before deciding among the two alternatives, it gives the discretion to the court. Absence of definite rules which enable to decide either reinstatement or termination of the contract with compensation of a worker will make this area non-addressable by rule-based knowledge-based system. Therefore, a neural network trained based on previous concluded cases were used to make this decision.

5.2.2.4. Conceptual Model for Validity of Termination of Contract of Employment

Figure 5 shows the conceptual model for validity of termination of contract of employment. It integrates the five models for the different grounds of termination of employment contract illustrated above. This is because all the five categories produce the same output, and therefore categorizing them together will simplify complexity.

5.2.3 Knowledge Representation

Although case-based reasoning (CBR) was introduced as an alternative rule to rule-based reasoning (RBR), there is a growing interest in integrating it with other reasoning paradigms, including RBR. New hybrid approaches are being piloted to achieve new synergies and improve problem-solving capabilities.

Taking this trend into consideration, a combination of rule-based and case-based approaches of designing legal expert systems is used in this work as no single approach can be used to design a system which can handle the two different tasks to be performed.

In this approach to integration, RBR is used to determine the validity of contract of employment, suspension of contract of employment and termination of contract of employment, and CBR allows the predicting the type of outcome (reinstatement or compensation) in cases where unlawful termination of contract of employment is proved.

5.2.3.1 The Rule-Based Module

The development of the Labor Law advisory knowledge-based system, which is referred to as Labor Law Advisor (LaLA) hereafter, is based on a thorough investigation of the existing manual labor justice system. As it is discussed in the introduction chapter of this research work, the proposed knowledge-based system is not meant to replace the existing manual labor justice system. Rather, its objective is to support the existed system so as to tackle its limitations. LaLA is implemented in a windows environment.

In this research work, rule-based reasoning method was applied for representing the basic legal relations, especially those connected with the cases expressly regulated by law. It is primarily because rule-based reasoning method is the most common one and it can be satisfyingly powerful from the perspective of building useful applications. Additionally, rule-based representation is convenient to translate from the knowledge acquired and modeled using hierarchical tree.

The rules used for the knowledge-based systems are written in the form:

```
IF
    First_premise, and
    Second_premise, and ...
THEN
    conclusion
```

This is semantically the same as a Prolog rule:

```
conclusion :-
```

first_premise,

second_premise,

The rules used in this study are created through the transformation of the hierarchical tree modeled in the previous chapter to the IF-THEN rules. The source of these rules is the knowledge acquired through the knowledge elicitation techniques used in the previous chapter.

Before using the rules which are created from the hierarchical tree of the previous chapter, an evaluation is conducted in consultation with the domain experts involved in the knowledge acquisition phase. After the evaluation is made, 23 rules which were believed to be important for further steps were selected.

Sample Rules

Rules are the major carrier of conditional legal norms in the system. These rules have to mirror legal principles and avoid free interpretation of the act, as much as it is possible. Interpretation principles and reasoning should be separated from general knowledge base. Example of few rules is presented below:

Rule 1: IF the CoE is made in oral or written form

AND the CoE is made for the performance of lawful or morally accepted
activities

AND the employee is working in return for wage

AND work is to be done under the authority of the employer

THEN the CoE is valid before the law.

Rule 2: IF leave without pay is granted to the employee
THEN the suspension of the CoE is valid before the law.

Rule 3: IF the employee receives national call,
THEN suspension of the CoE is valid before the law.

Rule 4: IF the CoE is made for a definite time
AND the contract period expires
THEN termination of the CoE is valid before the law.

Rule 5: IF the CoE is made for a piece of work
AND the work completed,
THEN the termination of the CoE is valid before the law.

Reasoning Mechanism

There are basically two ways or control strategies by which the inference engine manages rules to arrive at some conclusion or to arrive at a sequence of actions to be taken with respect to the environment. These are forward and backward chaining.

Forward chaining supports what is called “data-driven” reasoning. It’s especially important for monitoring functions. Forward chaining works from LHS to RHS of rules.

The activation of the RHS of the selected rule(s) will result in new facts and data being instantiated in the fact base. These new data and facts can again be used to identify rules whose LHS are satisfied and the forward chaining process can proceed.

On the other hand, backward chaining supports goal-driven reasoning. It is especially important

for diagnostic activities. In this type of control strategy for managing rules the initial focus is on the RHS of some selected rule from a set of rules whose RHSs satisfy some selected goal. The idea is to identify the conditions of the environment that would be necessary to achieve a selected goal.

Using the identified facts as new goals and going through the identified process can continue this backward reasoning process until a goal is proven true.

As the goals are already predetermined in the previous section, the correct strategy is starting with this list of goals and works backwards from the consequent to the antecedent to see if there is data available that will support any of these consequents. Therefore, the reasoning mechanism used in this research work is the backward chaining.

Backward-chaining by an architecture means that no rules are fired upon assertion of new knowledge. When an unknown predicate about a known piece of knowledge is detected in an operator's condition list, all rules relevant to the knowledge in question are fired until the question is answered or until quiescence. Thus, backward chaining systems normally work from a goal state back to the original state.

The User Interface

Many technological innovations rely upon user interface design to elevate their technical complexity to a usable product. Technology alone may not win user acceptance. The User Experience, or how the user experiences the end product, is the key to acceptance. And that is where User Interface Design enters the design process. A well-designed user interface will keep repetitive tasks to a minimum, give as much information as possible to the user, and do it easily and quickly.

In the rule-based part of this research work, the interface of the SWI Prolog window is directly customized to serve as the user interface for the system. The user interface is designed in such a way that users can input their selections from the various alternatives available on the menu in written form. They can input their responses to the fact requests using “yes/y” or “no/n”.

The initial page of the user interface is designed in such a format which will enable to perform three major tasks. First, it welcomes the user to the system by displaying “WELCOME TO LABOR LAW ADVISORY KNOWLEDGE-BASED SYSTEM”. Then, the interface invite the user to write “start.”. The user is then requested to insert the term which represents its need on the system by writing the right option from the menu. Among the various concepts covered by the Labor Law, it is stated that three of them can be handled by the system. Therefore, the user is asked to write "contract." if his/her case is related with Employment Contract, "suspension.” for cases related with suspension of Employment Contract and "termination." For cases related with termination of Employment Contract.

There are also other invitations of the user interface. The user will be invited to write "how." for explanation of how and why part of the advisory system and "Aboutlabor." to know more about the Labor Law.

The system also invites the user if he/she wants to perform general activities like "help." to go into Prolog help, "quit." to stop the advice and "halt." to stop the Prolog shell.

determine the type of decision have to be converted in numeric format. Moreover, the two possible decisions expected to be generated by the system were represented by 0 or 1, due to the fact that the output values of a perceptron can take on only one of the two values. The data dictionary is attached on Appendix IV.

5.2.3.2 The Case-Based Module

In this system, RBR facilitates decision making on problems related with the validity of a CoE, suspension of CoE and termination of CoE, and CBR enables solving problems which are related with the type of decision to be made, that is, reinstatement or compensation, once an invalid termination of contract of employment is proved.

It is customarily done to leave deciding on some aspects of the law to the judge, in cases where the law maker believes that giving the discretion of choosing the type of decision by considering the facts at hand to the judge is preferable. The Ethiopian Labor Law also has some provisions in which the law give the discretion to the judge. One of these areas is the part of the law in which decision is made from reinstatement and compensation, where invalid termination of the employment contract is proved. The law provided that either of the two outcomes can be ruled, but did not mention where to apply each type of decision. Here, it is the judge who is responsible to consider the case and pass the ideal decision. Rule-based reasoning is of no help in these cases, as there are no definite rules which guide to the proper outcome. Therefore, a CBR will be applied to learn from previously concluded similar cases and pass a uniform decision.

Description of the Data Set

The data set used to train the neural network is composed of the attributes which are necessary to select the type of decision. Through the unstructured interviews conducted with the legal experts and the analysis of relevant documents made, the attributes which are being considered to determine the type of decision where invalid termination of the employment contract is proved are identified. Two of these attributes, namely the employee's will to reinstatement and the risk for potential rise of serious difficulties if employee reinstated are acquired from the labor proclamation, while the remaining attributes are acquired from the knowledge of the legal experts which was in tacit form.

No.	Attribute	possible value
1	Employee's will to re-instatement	Yes, no
2	Risk for potential rise of serious	High, medium, low, undetermined

	difficulties	
3	Pregnancy	Yes, no
4	Workers' representativeness	Yes, no
5	Disability	Yes, no
6	Sex	Male, female
7	Number of dependants	0-20
8	Number of years of service	½-50
9	Age	15-90
10	Salary	50-20,000
11	Education	Grade 0-PHD
12	Type of job	Professional, semi-professional, clerical and accounting, guard and laborer

Table 5.5: Attributes Used for the Training of the Neural Network with their Respective Values

The major principle behind these attributes is to enable the judge to make the right decision from reinstatement and compensation, which best matches the specific case. Here the judge has to consider the potential problems which may arise if the employment contract continues, the possibility of the employee to get another job, and his/her financial capacity to cover its costs till he/she get a new job. In other words, deciding from reinstatement and compensation is a result of due consideration of the law maker's intention of maintaining the stability of the industry and safeguarding the financial security of the employee. A brief explanation of these attributes is

presented below.

Employee's will to re-instatement: The employee's will to re-instatement refers to the state where the employee, whose termination of employment contract is proved invalid, demands to return back to his/her previous position. This attribute is one of the two attributes which the law explicitly urges the judge to consider before making decision.

Risk for potential rise of serious difficulties: The judge is required to check whether or not the continuation of the particular worker employer relations, by its nature is likely to give rise to serious difficulties. This is the second attribute which the law explicitly declared for consideration. The motive of this attribute is to avoid potential rise of a dispute between the two parties and to maintain the peace of the industry.

Pregnancy: Pregnancy refers to the status of a female employee in respect to being an expectant mother. In normal cases, reinstatement is recommended if employee is pregnant.

Workers' representativeness: Workers' representativeness refers to the status of the employee in respect to workers' association. The law gives better protection to representatives, as their condition will have an impact on the remaining employees. In normal cases, reinstatement is recommended if employee is workers' representatives.

Disability: Disability refers to the physical condition of the employee. In normal cases, reinstatement is recommended if employee is disabled.

Sex: Sex refers to the gender of the employee. In normal cases, reinstatement is recommended if employee is female.

Number of dependants: Number of dependants refers to the responsibility of the employee to

directly support other people, which are dependant in his/her, earnings. In normal cases, reinstatement is recommended if employee has many dependants.

Number of years of service: This refers to the length of service the employee gave to the employer. It is believed that, the more the number of years the employee served, the stronger the tie he/she will have with the employer. In normal cases, employees with longer service are recommended to reinstate.

Age: Age refers to the age of the employer. In normal cases, the older the age of the employee, it is recommended to reinstate.

Salary: Salary refers to the periodic earnings of the employee. It is possible to categorize employees based on their salary. Employees with lower salary are recommended to reinstate in normal cases.

Education: Education refers to the academic qualifications of the employee. Though this attribute is equally important with other attributes, it is rarely available in employment cases. In normal cases, employees with lower educational status are recommended to reinstate, as it might be difficult for them to get a new job.

Type of job: Type of job refers to the category of the position the employee is working on. Based on the type of job the employee assigned on, employees can be categorized into various clusters. Employees engaged on non-professional jobs are recommended to reinstate in normal cases.

The values for the above mentioned attributes are collected from concluded cases which are available in Federal Supreme Court of Ethiopia. The challenging task here in the identification of the important attribute was the incompleteness of the cases in regard to these attributes. The

majority of the cases which are available in the record office of Federal Supreme Court of Ethiopia lack one or few of the attributes which are identified as important to make a decision. To overcome this limitation, categories named unknown or undetermined are introduced. For example, for the attribute “Education”, a category “unknown” is used as the educational background of the employees involved in the case is not available. Additionally, the extraction of important features and the analysis was a time consuming task.

Building the Model

Building the model includes preprocessing the dataset, tagging the data and creating and training the neural network.

Dataset Preprocessing

The Neural Networks package offers several algorithms to build models using data. Before applying any of the built-in functions for training, it is important to check the quality of the data. Naturally, one cannot expect to obtain good models from poor or insufficient data.

The data captured from the cases available in Federal Supreme Court of Ethiopia had been preprocessed before being used for the building of the neural network model. Toward this end, the following tasks were carried out on the raw dataset before using it for the training of the model.

Data cleaning: this involves filling the missing values, identifying outliers and smoothing out noisy data, and correcting inconsistent data. In most of the cases, there were missing values of attributes, due to the fact that a judge may use few of the attributes which he/she think relevant for making decision. To address the problem of missing values, the most probable value of the

attribute is filled unless a specific value is expressed in the case. For example, for cases in which the disability of the employee is not clearly mentioned, it will be assigned a value as “not-disable”. In some cases, a new category called “unknown/undetermined” is introduced and used for attributes such as Risk for potential rise of serious difficulties, age, number of dependants, and educational background.

Discretization: This refers to splitting the whole range of numbers into manageable number of intervals. In this regard, attributes such as number of dependants, number of years of service, age, salary and educational background were categorized taking into consideration that the neural network can handle only definite number of columns of data while training.

Data reduction: This refers to reducing the number of attributes and attribute values. Attributes which were rarely available in the analyzed cases and those which are considered as less important by the domain experts to make decision were omitted.

Translating symbolic columns: Since the SWI-Prolog system which is used to develop the rule-based module accepts only numeric values as input; those datasets which are in the form of textual values were transformed into numeric values.

Partitioning the Training Dataset

To facilitate easy handling of the training data, it is stored in an Excel spreadsheet, in the form of rows and columns. Each row represents a single attribute, while each column represents a unique labor case. The last row represents the decision made on the cases.

A total of 40 labor cases were selected for the purpose of training the neural network. The legal experts involved in the knowledge engineering process are also involved in the evaluation

process, by selecting cases in which they believe that consistent decisions are given. In order to avoid the risk of the reflection of decision disparity in the case-based module of the neural network, the legal experts made a selection of 40 cases which they believe that there is a sort of consistency in the decision. The cases selected by the legal experts are partitioned into three sets of training data. These are:

Training data: used when training the network,

Validation data: used to periodically test network as it trains, to prevent overfitting. Overfitting is a case in which the error on the training set is driven to a very small value, but when new data is presented to the network, the error is large (Demuth and Beale, 2002).

Test data: used when training has finished to test the generalization ability of network to data it has never seen before.

Initial Data -3.xlsx - Microsoft Excel

		Case Number																																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40			
3	Employee's will to re-instatement	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
4	Risk for difficulty	0	3	2	1	2	3	3	1	3	3	3	3	3	2	3	3	3	2	1	3	3	3	3	0	1	1	1	0	3	3	3	3	3	3	3	3	3	1	3	3	3		
5	Pregnancy	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
6	Representative	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	
7	Disability	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Sex	0	1	1	0	0	1	0	0	0	1	1	0	0	0	0	1	0	1	1	1	0	1	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	1	0	1	1	
9	No. of Dependents	1	1	1	0	1	1	1	0	0	1	1	0	1	1	0	0	1	2	1	1	1	1	0	1	1	1	1	0	1	1	1	1	2	1	1	1	0	0	1	1	1		
10	No. of years of service	0	2	0	0	0	2	3	1	0	2	3	3	2	0	3	2	0	0	1	0	0	1	1	1	2	1	0	2	4	0	0	1	0	2	0	2	0	2	0	1	1	1	
11	Age	1	2	1	0	1	2	2	1	4	2	2	3	1	0	2	4	4	1	2	1	1	1	4	2	1	1	4	2	4	0	1	2	1	1	1	2	1	1	4	2			
12	Salary	3	2	1	2	0	0	1	4	1	4	2	1	2	1	2	1	2	0	1	2	2	3	2	1	1	3	3	1	1	0	3	1	1	2	1	4	0	1	0	2			
13	Education	3	5	1	2	1	0	1	4	2	4	3	5	1	1	2	1	3	0	1	2	3	2	2	1	0	3	4	1	5	5	2	1	2	1	5	3	0	0	5	2			
14	Type of job	0	0	2	0	2	2	2	0	2	0	0	1	3	2	2	3	0	3	2	1	0	1	1	3	3	0	0	2	3	2	2	3	2	2	3	0	3	3	3	1			
15	Decision	0	1	1	0	0	1	1	0	1	1	1	1	1	0	1	1	0	0	1	0	1	1	1	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0		

Raw Data | Processed Full | Input 24 | Test 8 | Check 8 | Decisson

Ready | 100% | 3:12 PM

Figure 5.10: The Dataset Used for Experimentation

The case-base in the case-based reasoning system is presented as a table composed of 40 columns representing individual cases (C1, C2, C3, ..., C40), and 12 rows representing case attributes (A1, A2, A3, ..., A12). Additionally, there is one more row at the end representing the decision made (D). In the meantime, each attribute has a sequence of possible values associated with it: (V1, V2, V3, ..., VK).

Creating the Neural Network

After preparing the data which will be used for the training of the neural network, the next step will be determining the type of neural network to be used to map the data. A multilayer perceptron that maps sets of attribute used to examine the type of decision to be made onto a set of decision (reinstatement or compensation) is created. A multilayer perceptron is a feedforward artificial neural network model that maps sets of input data onto a set of appropriate output. It is a modification of the standard linear perceptron in that it uses three or more layers of neurons (nodes) with nonlinear activation functions, and is more powerful than the perceptron in that it can distinguish data that is not linearly separable. Moreover, the perceptron rule is proven to converge on a solution in a finite number of iterations if a solution exists.

The neural network created uses a feedforward backpropagation algorithm for the purpose of training with the data and building a model. While creating the neural network, the input, target and validation data were stored in Microsoft Excel spreadsheet and saved in the text (.txt) format,

just for simplicity purpose. The input and target data were given to the MATLAB creator using the graphical User interface (GUI) of the neural network toolbox. The input range [0 1;0 3;0 1;0 1;0 1;0 2;0 3;0 4;0 4;0 5;0 3] was automatically accessed from the input, and the default number of neurons, i.e. 1, is used. The transfer function is set as HARDLIM (hard-limit transfer function), because it is the commonly used function in perceptrons. LEARNP is set to the learning function, as the perceptron has a better chance of producing the correct outputs each time LEARNP is executed.

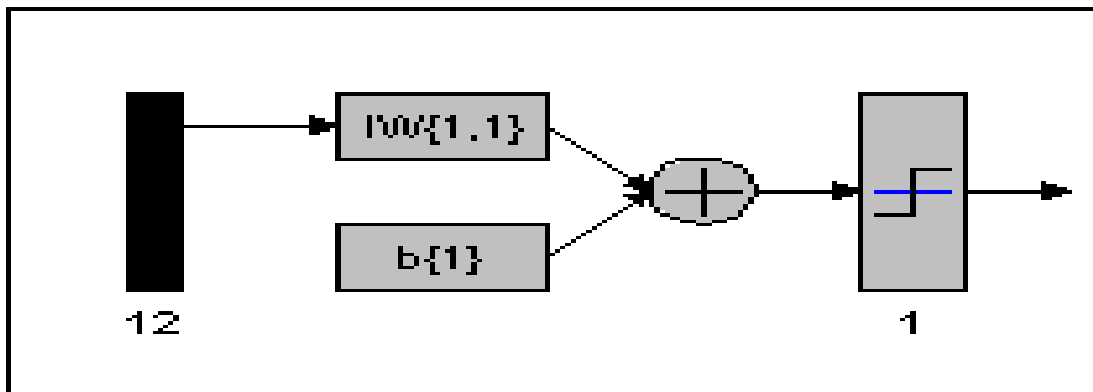


Figure 5.11: View of the Network

Training the Neural Network

While training the neural network, the dataset was classified into a first group of 24 records (60% of the total number of records) for training purpose, a second group of 8 records (20%) for

validation purpose and last group of 8 records (20%) for testing purpose.

Initially, the default set up of the neural network toolbox was used to train the multi Layer perceptron. The default set up has got 12 processing elements in its input layer and 1 processing element on its output layer. The transfer function and the learning functions used were HARDLIM and LEARNP respectively, which are defaults in perceptron. The network was trained to zero error in 100 epochs (pass through the input vectors). The perceptron network presented the inputs to the network in batches, and made corrections to the network based on the sum of all the individual corrections.

The following figure shows the learning curves for both the training and cross validation data sets.

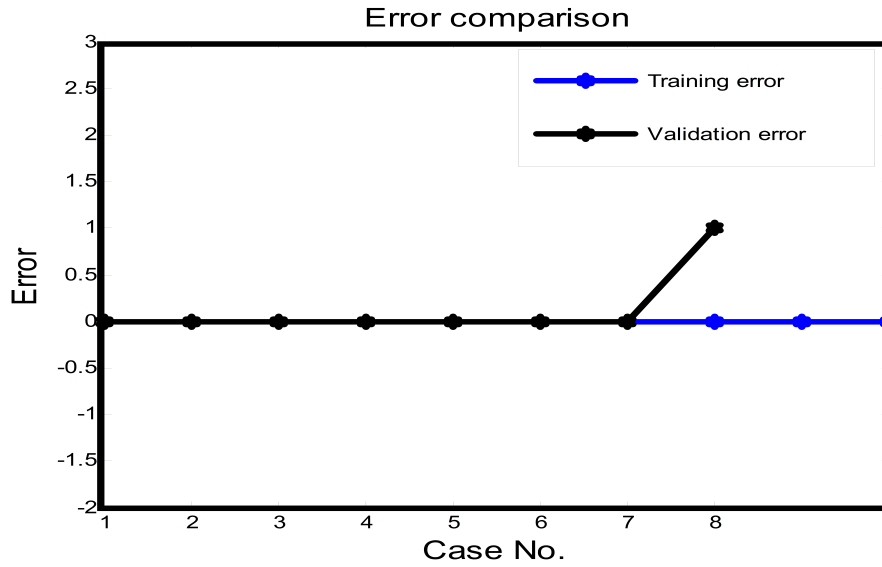


Figure 5.12: The Performance Report

As it can be easily observed from the figure, there is only one difference occurred between the system and the actual judge decision, out of the 8 cases processed.

5.2.4 Testing and Evaluation

Once the system has been programmed using the experts logic, development continues with the evaluation and testing of the system. Evaluation is an iterative process that takes place

throughout the development of the system, and the evaluations become more formal as the system matures. Evaluation in the early stages consists of a demonstration that the prototype can be used on simple cases. Then, once the knowledge base is expanded, the evaluation process continues to include more complex cases and feedback from experts and potential users.

Running a set of representative test cases through the proposed system and comparing the system's output with known results is one of the widely used techniques to evaluate the performance of a knowledge-based system. Using this approach, a group of concluded cases were used which are different from the cases used in the development process. A comparison is made between the decisions reached through the knowledge-based system and the human judges, providing the attributes available in the selected court cases to the KBS system. Additionally, the accuracy criterion is used to evaluate the successes of the KBS system.

5.2.4.1 The Rule-Based Part

The set of cases used to test the performance of the rule-based part of the system is composed of 30 labor cases which were concluded in Federal Supreme Court of Ethiopia. The cases are categorized into three groups based on their theme in which their major issue revolves around. Though the cases have similarity on the themes they contain with those which are in the same category, an attempt is made to select those with various differences in time, judge handled the case, and other features in order to avoid, or at least reduce the risk of having biases. Here follows is a brief description of three sample cases, one from each category

Case 1 (Case related with validity of contract of employment):

Case profile: In this case employee X agreed to work under the direct supervision of employer

Y¹ as of September 1996 E.C. The contract is made orally in front of a private employment broker. The work place was in Addis Ababa, and the two parties agreed upon the salary to be paid as Birr 450 a month. Though the work was being done in a liquor grocery, the real job of the employee was changing foreign currency to Ethiopian Birr and the vice versa in black market. The employer fired the employee in June 2000 E.C. without giving him a good reason. Employee X took the case to the court and demanded to be compensated due to invalid termination of contract as he had a valid employment contract with employer Y. Employer Y defended as he had no contract of employment with employee X.

Decision made: After asking the user the following questions, the rule-based part of the system concluded that the employment contract is invalid. The questions asked by the system, with their respective answers are presented below.

is_the_employment_contract_made_in_either_written_or_oral_form? *Yes*

is_the_employment_contract_made_to_perform_legal_and_non-immoral_work? *No*

The output of the system is “*The employment contract is invalid*”, which is identical with the one made by the human judges. The Judges in the court also concluded that the contract of employment between the two parties is invalid, on the ground that providing currency exchange service is strictly limited to financial institutions which got license from National Bank of Ethiopia (NBE), based on Banking Business Proclamation No. 592/2008. Any activity of currency exchange without license is illegal act.

The system decided 6 out of the total number of 8 cases given in a manner which matches the decision of the judges. This makes the accuracy of the system to determine the decision concerning the validity of contract of employment 75%. This verified that the rule-based module

of the system provided greater advising accuracy (that is, greater agreement with the human judges) concerning the validity of employment contracts.

Case 2 (Case related with validity of suspension of contract of employment):

Case profile: In this case 5 employees had a valid employment contract with employer Y for 2-11 years. They all were working in the automotive workshop of the employer as Mechanics of different levels. In February 1994 E.C. the employer suspended the five employees. All the employees did not request for leave without pay. The employer defended that its reason is the reduction of the company's revenue in the previous five months. On the other hand, the company did not cease its work while the five employees were suspended, and other employees of the workshop were performing their regular activities and earning their salary.

Decision made: After asking the user the following questions, the rule-based part of the system concluded that the suspension of the employment contract is invalid. The questions asked by the system, with their respective answers are presented below.

leave_without_pay_granted? *No*

leave_of_absence_for_trade_union_activities_granted? *No*

leave_of_absence_for_social_services_granted? *No*

employee_detained_for_<30_days_while_employer_is_notified_or_supposed_to_know_within_10_days? *No*

employee_recieve_National_call? *No*

employer's_activities_suspended_due_to_force_majeure_or_financial_problem? *No*

The output of the system is “*The suspension of the employment contract is invalid*”, which is also identical with the one made by the human judges. The Judges in the court reached on this conclusion on stating that the employer does not have any legal ground to suspend the employees.

The system decided 7 out of the total number of 8 cases given in a manner which matches the decision of the judges. This makes the accuracy of the system to determine the decision concerning the validity of suspension of contract of employment 87.5%. This verified that the rule-based module of the system provided greater agreement with the human judges concerning the validity of suspension of employment contracts. The domain experts commented that such a large accuracy value is achieved because the legal provisions which declare the terms for suspension of employment contract are written in a clear language which significantly reduces the possibility of reaching a different conclusion.

Case 3 (Case related with validity of termination of contract of employment):

Case profile: This case involved a termination of employment contract of Employee X by employer Y without the will of the employee on March 1999 E.C. The two parties were having a valid contract of employment in which the employer hired the employee for a position of security guard for its spare parts store located at Akaki-Kaliti sub-city. The employer defended his action as legal, stating the involvement of the employee in deceitful practice.

Decision made: After asking the user the following questions, the rule-based part of the system concluded that the termination of the employment contract is valid. The questions asked by the system, with their respective answers are presented below.

contract_expired? *No*

completion_of_the_work? *No*

employee_dead? *No*

employee_retired? *No*

permanent_cess_of_operation_of_the_employer? *No*

inability_of_the_employee? *No*

agreement_to_terminate_the_contract? *No*

tardiness_of_the_employee? *No*

absence_for_five_or_more_consecutive_working_days? *No*

absence_for_ten_or_more_working_days_in_a_month? *No*

absence_for_thirty_or_more_working_days_in_a_year? *No*

deceitful_or_fraudulent_conduct? *Yes*

The output of the system is “*The termination of the employment contract is valid*”, which is identical with the one made by the human judges. The reason for the Judges to their decision about the validity of the termination was, the employee’s participation in a deceitful action is a legal ground for termination of employment contract.

The system decided 10 out of the total number of 14 cases given in a manner which matches the decision of the judges. This makes the accuracy of the system to determine the decision concerning the validity of termination of contract of employment 71%. This again verified that the system provided greater agreement with the human judges concerning the validity of termination of employment contracts. The domain experts commented that such a relatively lower accuracy value is achieved because there are other procedural factors which may affect the type of decision and not included in the Labor Law. A good example can be the time of limitation in which the two parties have to submit their cases within a given time frame. An

employer which has a good reason to terminate the employment contract (say a fraudulent act of the employee) cannot fire the employee after the date on which he/she knows about the fraudulent act passed by 30 days.

All in all, the rule-based part of the system made a decision which matches that of the human judges in 23 out of the total number of 30 arbitrary tested cases. The brief details of the test cases are available on appendix V.

A slight modification of the evaluation technique used above is also available. This technique proposes that the same cases have to be given to both the system and to human experts, and comparing the conclusions of the system with that of the human experts, instead of comparing with historic cases. However, this technique is not applied in this research due to the risk of encountering bias while using the same legal experts for both the development and testing phases. Participating new legal experts for the evaluation phase is not taken as convenient option.

The Confusion Matrix

In the field of AI, a confusion matrix is a visualization tool typically used in supervised learning. A confusion matrix contains information about actual and predicted classifications done by a classification system. Performance of such systems is commonly evaluated using the data in the matrix.

Confusion Matrix provides an easy and complete way to describe the knowledge about a classification result. The confusion matrix structure depends on the classifier performance (therefore from the adopted working point) and on consistence of utilized test set. So, by using

confusion matrix as parameter of a function all this information is being taken into account. The confusion matrix is defined as follows:

$$\text{Confusion Matrix} = \begin{matrix} tn & fp \\ fn & tp \end{matrix} = \begin{matrix} C_{00} & C_{01} \\ C_{10} & C_{11} \end{matrix}$$

Where C= actual/predicted value

tn = C₀₀ is the number of correct predictions that an instance is negative

fp = C₀₁ is the number of incorrect predictions that an instance is positive

fn = C₁₀ is the number of incorrect of predictions that an instance negative

tp = C₁₁ is the number of correct predictions that an instance is positive

		Decision by human judges						Sum
		A	B	C	D	E	F	
Decision (Output) by the rule-base d part	A	3	1	0	0	0	0	4
	B	1	3	0	0	0	0	4
	C	0	0	3	1	0	0	4
	D	0	0	0	4	0	0	4
	E	0	0	0	0	6	2	8
	F	0	0	0	0	2	4	6
	Sum	4	4	3	5	8	6	30

Table 5.6: Confusion Matrix that Show the Result of the Experiment

Key: A = Valid contract of employment, B = Invalid contract of employment, C = Valid suspension of contract of employment, D = Invalid suspension of contract of employment, E = Valid termination of contract of employment, F = Invalid termination of contract of employment

Based on the figures of table 5.6, the accuracy of the system, which tells the degree of closeness

of measurements of the system's decisions to its actual value (decision of the judges) can be computed as follows.

$$\begin{aligned} \text{Accuracy} &= \frac{(tp+tn)}{(tp+tn+fp+fn)} = \frac{\text{No. of correct values}}{\text{Total no. of values}} \\ &= \frac{3+3+3+4+6+4}{30} \\ &= \frac{23}{30} \\ &= \mathbf{76.7\%} \end{aligned}$$

In the test cases for the rule-based part of the knowledge-based system specification described above, 76.7% of its decisions cases are good. However, the remaining decisions exhibiting a 23.3% difference means that the system has difficulty of reaching the correct decision. This may indicate a deficiency in the specification, or it may be indicative of a feature of the area of law.

Out of the nine cases which contributed to the 23.7% of the inaccuracy of the system, four of them came from the validation of termination of employment contract part of the system. In fact, this part of the law is the most disputing part as someone can easily observe from courts. Cases related with termination of employment contract are common in courts than cases containing issues related with suspension, wage and salary, employee's association etc. Moreover, there are other procedural factors which may influence the decision, contrary to the conclusions of the attributes discussed above.

The number of cases used to test the performance of the rule-based part of the system, that is 30, is believed enough to make conclusions. Ethiopia (2002) and Seifu (2005) used 14 and 4 test cases to evaluate the performance of their respective systems.

5.2.4.2 The Case-Based Part

The set of cases used to test the performance of the case-based part of the system is composed of 8 labor cases which were concluded in Federal Supreme Court of Ethiopia. The selection of these cases is again made by the legal professionals in order to ensure incorporating only those cases in which consistent decisions are made. The description of two of these cases one from each possible decision (reinstatement or compensation) is presented below.

Case 1 (Case related with the type of decision to be made, once invalid termination of contract of employment is proved):

Case profile: This case involved a termination of employment contract of Employee X, which is decided as invalid by the court. The employee was serving as a security personnel in the employer's plant earning a monthly salary of birr 760. He was 35 at the time the case was handled, with a total of 7 years of service. The employee is illiterate, and supports his mother with his salary. The employee explicitly expressed his will to be reinstated than being compensated.

Facts derived: The following facts which are important to the decision were derived from the above description of the case.

- The employee would like to be reinstated than being compensated.
- The risk of potential difficulty if the employee returns to his job is undetermined (a presumed fact since the contrary is not expressed)
- The employee is male.

- The employee is not pregnant. (a presumed fact due to the fact that he is male)
- The employee is not a worker's representative. (a presumed fact since the contrary is not expressed)
- The employee is not disabled. (a presumed fact since the contrary is not expressed)
- The employee has one dependant.
- The employee is in the age range of 20-35 years.
- The employee has a service of 5-10 years.
- The employee's salary is between the range Birr 501-1000.
- The employee's educational level is illiterate.
- The type of job the employee was performing is in guard and laborer.

Decision made: Based on the facts presented above, the case-based part of the system concluded that the employee has to be re-instated, which is identical with the one made by the human judges. The reason for the Judges to their decision about the reinstatement of the employee was that, the employee's may not easily get a another job which may fit the current one.

Case 2 (Case related with the type of decision to be made, once invalid termination of contract of employment is proved):

Case profile: This case involved a termination of employment contract of Employee X, who was serving as a finance clerk with educational background of Diploma and monthly salary of Birr 1405. by employer Y without the will of the employee on May 1998 E.C. The court did not accept that the reason stated by the employer as a ground to terminate the employment contract

legal, and therefore concluded that the termination is invalid. The employee explicitly expressed her will to be compensated than returning to her job, due to a risk of entering into a worsen difficulty with the employer, while the court assessed the potential of rising serious difficulty if the employee returned as medium. The employee was a 48 years old woman, with 5 years of experience in her field. She was a single mother of one child.

Facts derived: The following facts which are important to the decision were derived from the above description of the case.

- The employee would like to be compensated than re-instatement.
- There is a medium risk of potential difficulty if the employee returns to her job.
- The employee is female.
- The employee is not pregnant. (a presumed fact since the contrary is not expressed)
- The employee is not a worker's representative. (a presumed fact since the contrary is not expressed)
- The employee is not disabled. (a presumed fact since the contrary is not expressed)
- The employee has one dependant.
- The employee is in the age range of 36-55 years.
- The employee has a service of 5-10 years.
- The employee's salary is between the range Birr 1001-2000.
- The employee's educational level is diploma.
- The type of job the employee was performing is in semi-professional category.

Decision made: Based on the facts presented above, the case-based part of the system concluded that the employee has to be re-instated. This is different with the one made by the human judges.

The system decided 5 out of the total number of 8 cases given in a manner which matches the decision of the judges. This makes the accuracy of the system to determine the conclusion concerning the type of decision to be made, in cases where invalid termination of employment contract is proved 62.5%. Possible reasons for such a relatively lower accuracy value might be the fact that all except two of the 12 attributes incorporated in the case-based system to determine the type of decision are not explicitly expressed in the law. Therefore, the judges which made the decisions might not consistently use this attributes, and may give different weights to these values.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

This study has verified the potential of knowledge-based systems, consists of both rule-based and case-based reasoning, to contribute to effectiveness and efficiency of the legal system. In this chapter a concluding remarks on the problems addressed along with recommendations for further advancements are described.

6.1 Conclusions

When rule of law is coupled with an efficiently and effectively operating judicial system, it helps citizens build trust and confidence in the law of the state and encourages them to voluntarily participate in state-building efforts. Though computers could be used only for general auxiliary functions at first, the use of computers for more professional legal work such as legal information retrieval and legal reasoning became common after a while. Successful applications of expert systems in the area of law result in numerous benefits including reduced decision-making time, improved service levels, and better use of a legal expert's time.

Employment law is a vital part of government's efforts to protect citizen's rights as human beings. To insure this goal, the labor justice system must have the common characteristics which every part of has to have, such as reduced processing time and predictability. As it is possible to see from the results of the experiments made, LaLA combined system provides a framework for deciding various labor related cases with better performance scores.

The researcher believe that his approach of combining rule-based and case-based reasoning's will prove useful in the domain of law in which clearly declared rules are partially available along with the discretion of judges to pass decisions on few selected issues in which clear guidelines were not available. Testing of the combined system indicates that the approach taken to constructing the system, i.e. using rule-based reasoning to deal with the legislation and

case-based reasoning to deal with cases is found appropriate.

As discussed in the introductory part of this research document, the principal aim of this study is to exploit the potential of knowledge-based systems to address the limitations of the existing labor justice system. The research is concerned with building systems which simulate the decision which a court might give on a dispute before it or the advice that a lawyer might give concerning a client's legal rights. Some of the applications simulate the type of argument which a lawyer might put to a court.

Decision disparity is a characteristic of many legal systems, which threatens the people's trust in the system. People having similar cases and get different decisions will naturally lose their confidence on the courts, and this in turn has an effect of threatening the advancement of rule of law. The study has defined the existence of this problem in the Ethiopian legal system through the preliminary survey it incorporated. It further suggested possible solutions which will assist to reduce the magnitude of the problem.

6.2 Recommendations

Computerization of the legal office is an ongoing process. The ranges of non-legal applications now in common use include word processing, accounting, time costing, communication and administration systems. More recently it has been demonstrated that computers can be used as research tools, particularly in the retrieval of primary legal materials and equally importantly, legal reasoning.

Despite the promising results of this study, further work is needed to be done in order to upgrade the prototype system to a real system so as to insure the complete utilization of the system by the

targeted groups. Time and again, it is proved that KBS fostered a renewed interest in AI, especially for legal expert system. Further works to be performed in the area might consider the following areas, which may insure addressing the limitations with improved performance.

- As the rule-based and case-based modules of the system exist independently requiring to pass the output of the one as an input of the other, a further work to integrate the modules will enable to easily interact with the system. Moreover, the system will be more user friendly, if the case-based part of the system can receive its input data as it is, despite the fact that the existing system require the user to present the data in a different format using the attached data dictionary.
- The Labor Law is a legislation which incorporated a large number of issues and principles. The proposed system is designed to entertain only those issues which the domain experts considered the as core areas of the law, namely, validity of employment contract, suspension of employment contract and termination of employment contract and deciding compensation or reinstatement, in cases where invalid termination of employment contract is proved.
- The results of the case-based module of the system provide the type of decision to be made, once invalid termination of employment contract is proved. If the decision is compensation, the system will not further perform the task of computing the amount of compensation. In practice, the judge is expected to compute the amount of compensation as the integral part of the decision. A possible further work in the field might incorporate this functionality.

- The research work considered the important attributes which are direct grounds of a possible decision, and provided in the Labor Law. In reality, there are other procedural factors which may influence the decision, and available in different laws, such as the Civil Procedure law. Incorporating such procedural factors, such as time of limitation, will definitely enhance the performance of the system, and hence a concern of possible further works.

REFERENCE

- Beckstrom, J. H. (1973). *Transplantation of Legal Systems: An Early Report on the Reception of Western Laws in Ethiopia*. The American Journal of Comparative Law, Vol. 21, No. 3 (Summer, 1973), pp. 557-583, American Society of Comparative Law. Retrieved May 2010, from <http://www.jstor.org/stable/839298>
- Bramer, M. (2005). *Logic Programming with Prolog*. Department of Computer Science and Software Engineering, University of Portsmouth, United Kingdom.
- Brietzke, P. (1974). *Private Law in Ethiopia*. Journal of African Law, Vol. 18, No. 2 (Autumn, 1974), pp. 149-167, Cambridge University Press on behalf of the School of Oriental and African Studies. Retrieved April 2010, from <http://www.jstor.org/stable/745065>
- Canas, A.J., Hill, G. and Lott, J. (2003). *Support for Constructing Knowledge Models in CmapTools*. Institute for Human and Machine Cognition, Retrieved April 2010, from <http://cmap.ihmc.us/Publications/WhitePapers/Support%20for%20Constructing%20Knowledge%20Models%20in%20CmapTools.pdf>
- Chandrasekaran, B., Tanner, M.C. and Josephson, J.R. (1988). *Explanation: The Role of Control Strategies and Deep Models in Expert Systems: The User Interface*, J.A. Hendler (ed.), Ablex, Norwood.
- Cheathouse. (nd). *Grada Networks*. Retrieved April 2010, from http://www.cheathouse.com/essay/essayview.php?p_essay_id=21057.
- Civil Code of Ethiopia. (1960). Addis Ababa, Ethiopia.
- Clifford, J., Jarke, M. and Vassiliou, Y. (1983). *A Short Introduction to Expert Systems*, Center for Research on Information Systems. New York University.
- Coffey, J. W., Cañas, A. J., Reichherzer, T., Hill, G., Suri, N., Carff, R., Mitrovich T. & Eberle D. (2003). *Knowledge Modeling and the Creation of El-Tech: A Performance Support and Training System for Electronic Technicians*, Expert Systems with Applications, 25(4).
- Davies, P., Ewing, K. and Freedland, M. (2005). *The Law of the Labor Market-Industrialization, Employment and Legal Evolution*, Oxford University Press.
- Deakin, S. and Morris, G. (2005). *Labour Law*. Hart Publishing.
- Demuth, H. and Beale, M. (2002). *Neural Network Toolbox: For Use with MATLAB*. Retrieved April 2010, from www.mathworks.es/access/helpdesk/help/pdf_doc/nnet/nnet.pdf
- Duchessi, P. and O'Keefe, R. M. (1995). *Evolutionary Steps in Expert Systems Projects*. Interfaces, Vol. 25, No. 5 (Sep. - Oct., 1995), pp. 194-208. Informs. Retrieved April 2010, from <http://www.jstor.org/stable/25062059>
- Duhaime, L. (nd). *Civil Law*. Retrieved April 2010, from <http://www.jstor.org/stable/757784?seq=2>.
- Ethiopia Tadesse. (2002). *Application of Case Based Reasoning for Amharic Legal Precedent Retrieval: A Case Study with the Ethiopian Labor Law*, Department of Information Science, A.A.U.
- Fiedler, H. (1991). *Computers and Legal Reasoning: Developments in Germany*. Computers and the

- Humanities, Vol. 25, No. 2/3, Springer Retrieved April 2010, from <http://www.jstor.org/stable/30200258>
- FSCE. (2008). የኢትዮጵያ ጠቅላይ ፍርድ ቤት፣ በመታየት ላይ ያሉ ፋይሎች እድሜ. Retrieved April 2010, from <http://www.federalsupremecourt.gov.et/StatisticalReports/index.html>
- FSCE. (2009). *Project purpose*. Retrieved April 2010, from <http://www.fsc.gov.et/CourtReform/index.html>
- Gordon, J. (2000). *Creating Knowledge Maps by Exploiting Dependent Relationships*. Knowledge Based Systems, Vol 13 pages 71 - 79, Elsevier Science.
- Greenleaf, G. (1989). *Legal Expert Systems -- Robot Lawyers? An introduction to knowledge-based applications to law*. Darling Harbour, Australia.
- Greinke, A. (1994). *Legal Expert Systems - A Humanistic Critique of Mechanical Legal Inference*. Murdoch University Electronic Journal of Law, Volume 1, Number 4 (December 1994).
- Griffin, N. L. and Lewis, F. D. (n.d). *A Rule-Based Inference Engine which is Optimal and VLSI Implementable*. University of Kentucky Lexington, Kentucky, Retrieved April 2010, from <http://www.cs.uky.edu/~lewis/papers/inf-engine.pdf>
- Hart, P. E., Duda, R.O. and Einaudi. (1979). *A Computer-Based Consultation System for Mineral Exploration*. Tech. Report. SRI International.
- Holder, L. B., Markov, Z. and Russell, I. (2005). *Advances in Knowledge Acquisition and Representation*. International Journal on Artificial Intelligence Tools Vol. XX, No. X (2006) 1–8, World Scientific Publishing Company.
- Kobori, S. (n.d.). *Limitations of Expert Systems*, Faculty of Science and Technology, Ryukoku University, Retrieved April 2010, from <http://milan.elec.ryukoku.ac.jp/~kobori/resume/cog/Report08-4.pdf>
- Labor Proclamation No. 377/2003, (2003). Addis Ababa, Ethiopia.
- Library of Congress Country Studies. (2009). *Ethiopia, The legal system*. Retrieved May 2010, from [http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field\(DOCID+et0190\)](http://memory.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+et0190))
- Marshall, M. H. (2008). *Justice “Promptly, and Without Delay”:* Court Reform and Judicial Independence. Massachusetts Supreme Judicial Court.
- Miglani, D. (n.d.), *Justice Delayed is Justice Denied*, Retrieved April 2010, from <http://www.legalserviceindia.com/articles/jdjd.htm>
- Milton, N. (2003). Knowledge Modeling. Epistemics. Retrieved April 2010, from <http://www.epistemics.co.uk/notes/77-0-0.htm>
- Minsky, M. (1968). *Semantic Information Processing*, M. Minsky ed.
- Mykytyn, K, Mykytyn, P. P. Jr. and Slinkman, C.W. (1990). *Expert Systems: A Question of Liability?* MIS Quarterly, Vol. 14, No. 1 (Mar., 1990), pp. 27-42, Management Information Systems Research Center, University of Minnesota.
- O’Keefe, R., Balchi, O. and Smith, E.P. (1986). *Validation of Expert System Performance*. Virginia

Tech.

- Pomykalski, J. J, Truszkowski, W. F. and Brown D. E. (1999). *Expert Systems*, Wiley Encyclopedia for Electrical and Electronics Engineering. Retrieved May 2010, from <http://www.csc.liv.ac.uk/research/techreports/tr2003/ulcs-03-013.pdf>
- Pople, H. (1983). *Knowledge Based Expert Systems: The Buy or Build Decision*. Artificial Intelligence Applications for Business. W-Reitman, ed. Ablex .
- Popple, J. (1996), *A Pragmatic Legal Expert System*, Dartmouth Publishing Company Limited, USA, Retrieved April 2010, from <http://dictionary.bnet.com/definition/contract+of+employment.html>
- Raman, V. and Palanissamy, A. (2008). COMPUTER AIDED LEGAL SUPPORT SYSTEM: An Initial Framework for Retrieving Legal Cases by Case Base Reasoning Approach. Pages: 317 – 321. IEEE. 2008.
- Richard, L. and Johnson, P. E. (1995). *The Impact of Explanation Facilities on User Acceptance of Expert Systems Advice*. MIS Quarterly, Vol. 19, No. 2 (Jun., 1995), pp. 157-172, Management Information Systems Research Center, University of Minnesota Retrieved April 2010, from <http://www.jstor.org/stable/249686>.
- Rissland, E. L. (1990) *Artificial Intelligence and Law: Stepping Stones to a Model of Legal Reasoning*. The Yale Law Journal, Vol. 99, No. 8 (Jun., 1990), pp. 1957-1981. The Yale Law Journal Company, Inc.
- Robert, S.E. and Edward, F. (1993). *Expert Systems and Artificial Intelligence*. WTEC hyper Librarian, Japan.
- Seifu Tatek. (2005). *A Rule Based/Neural Network Hybrid Legal Expert System: A Prototype For Providing Legal Advice on Criminal Cases Under Ethiopian Law*, Retrieved April 2010, Department of Information Science, AAU.
- Siew, K., Latif, A., Fairuz M. and Abd, A. (2005). *System in Real World Applications*. Available at <http://www.generation5.org:80/articles.asp?Action=List&Topic=General>
- Sommer, M. (2004). *National Labour Law Profile: Federal Democratic Republic of Ethiopia*. International Labour Organization (ILO). Retrieved April 2010, from <http://www.ilo.org:80/public/english/dialogue/ifpdial/info/national/index.htm>
- Susskind, R. E. (1986). *Expert Systems in Law: A Jurisprudential Approach to Artificial Intelligence and Legal Reasoning*. The Modern Law Review, Vol. 49, No. 2 (Mar., 1986), pp. 168-194, Blackwell Publishing Retrieved April 2010, from <http://www.jstor.org/stable/1096291>
- Swan, K. (2003). *What is Employment Law?* Conjecture Corporation. Retrieved April 2010, from www.wisegeek.com/what-is-employment-law.htm
- Tesfay Kumenit. (n.d.). *An Overview on the Most Important Features of Ethiopian Legal System*. IALS Conference. Retrieved June 2010, from <http://www.ialsnet.org/meetings/enriching/kumenit.pdf>
- The World Bank. (2004). *Ethiopia Legal and Judicial Sector, Assessment*. Retrieved June 2010, from <http://siteresources.worldbank.org/INTLAWJUSTINST/Resources/EthiopiaSA.pdf>
- Tuominen, S. and Lyabandi, S. (2009). *Governance Out of a Box– African Experiences and*

Opportunities. Crisis Management Initiative, Helsinki.

Yoshino, H. (n.d.). *Legal Knowledge Based System and Legal Education, Focusing on understanding Change of Legal Relation*. Retrieved April 2010, from www.meijigakuin.ac.jp/~yoshino/documents/thesis/2006e_1.pdf

Appendix I

List of Interview Questions That Were Used to Collect Information About the Problems of the Labor Justice System from Employees, Employers and Attorneys

1. What is your role in the case?
2. When did the employment case you are involving opened on the court?
3. What is the theme of the case you are involving?
4. In which level/s is your case being seen? (First instance, Higher or Supreme courts)
5. Is your case seen by any level of appeal hearing court?
6. Is your case concluded?

Question no. 7-10 were forwarded only to those respondents whose response for question no. 6 is YES.

7. How long your case took to be concluded?
8. How do you evaluate the length of time your case took?
9. Do you get the decision made on your case similar with other identical cases? If you got it different, where does the difference exists?
10. How do you generally evaluate the performance of the legal system in connection with your employment case?

Appendix II

**List of Interview Questions That Were Used to Collect Information About the
Problems of the Labor Justice System from Judges**

1. In average, how long does it take **in principle** to conclude an employment case?
2. In average, how long does it take **in practice** to conclude an employment case?
3. What is the level of court you are working for? (First instance, Higher or Supreme courts)
4. Which theme of the employment case do you think is the most common in the labor bench of the court you are working?
5. How do you evaluate the length of time employment cases took?
6. Do you make any effort to make the decision made by your bench similar with identical cases decided by other courts? If yes, would you mind to mention the mechanisms you are using to ensure uniformity?
7. How do you generally evaluate the performance of the legal system in connection with employment cases?
8. What do you propose to improve the performance of the existing labor justice system?

/* Advice identification rules */

Appendix IV

Data Dictionary for the Case-Based Part

Input, Validation and Target Data

No.	Attribute	Value	Representation
1	Employee's will to re-instatement	Yes	1
		no	0
2	Risk for difficulty	Low	0
		Medium	1
		High	2
		Undetermined	3
3	Pregnancy	Yes	1
		No	0
4	Representativeness	Yes	0
		No	1
5	Disability	Yes	0
		no	1
6	Sex	Male	0
		Female	1
7	No. of Dependants	0	0
		1-5	1
		6 - 10	2

		>10	3
		Unknown	4
8	No. of years of service	<5	0
		5-10	1
		11-20	2
		21-35	3
		>35	4
9	Age	<20	0
		20-35	1
		36-55	2
		>55	3
		Unknown	4
10	Salary	<500	0
		501-1000	1
		1001-2000	2
		2001-3500	3
		>3500	4
No.	Attribute	Value	Representatio n
11	Education	Illiterate	0
		Grade 1-TVET	1
		Diploma	2
		BA/B.Sc.	3
		Above 1st Degree	4
		Unknown	5
12	Type of job	Professional	0
		Semi-professional	1
		Clerical & Accounting	2
		Guard & Laborer	3

Output

Type of decision	Value	Representation
	Compensation	0
	Reinstatement	1

Appendix V

Details of the Test Case Used in the Evaluation of the System

Case No.	Case category	Case finally decided by	System output	Judge's decision	Match
1	Validity of contract of employment	FSCE	Invalid	Invalid	✓
2		FSCE	Invalid	Valid	X
3		FSCE	Valid	Valid	✓
4		FSCE	Valid	Valid	✓
5		FSCE	Valid	Invalid	X
6		FSCE	Invalid	Invalid	✓
7					

8		FSCE	Invalid	Invalid	√
		FSCE	Valid	Valid	√
9	Validity of suspension of contract of employment	FSCE	Valid	Valid	√
10		FSCE	Invalid	Invalid	√
11		FSCE	Invalid	Invalid	√
12		FSCE	Invalid	Invalid	√
13		FSCE	Valid	Valid	√
14		FSCE	Valid	Valid	√
15		FSCE	Valid	Invalid	X
16		FSCE	Invalid	Invalid	√
17	Validity of termination of contract of employment	FSCE	Valid	Valid	√
18		FSCE	Invalid	Valid	X
19		FSCE	Valid	Valid	√
20		FSCE	Valid	Valid	√
21		FSCE	Invalid	Invalid	√
22		FSCE	Invalid	Invalid	√
23		FSCE	Invalid	Valid	X
24		FSCE	Valid	Invalid	X
25		FSCE	Invalid	Invalid	√
26		FSCE	Valid	Valid	√
27		FSCE	Invalid	Invalid	√
28		FSCE	Valid	Invalid	X
29		FSCE	Valid	Valid	√
30		FSCE	Valid	Valid	√

Key: √- Match

X- Mismatch

DECLARATION

THIS THESIS IS MY ORIGINAL WORK AND HAS NOT BEEN SUBMITTED AS A PARTIAL REQUIREMENT FOR A DEGREE IN ANY UNIVERSITY, THAT ALL SOURCES OF MATERIAL USED FOR THE THESIS HAVE BEEN DULY ACKNOWLEDGED.

YIHENEW DEMMELASH ALEMU

JUNE, 2010

THE THESIS HAS BEEN SUBMITTED FOR EXAMINATION WITH MY APPROVAL AS UNIVERSITY ADVISOR.

ATO TIBEBE BESHAN

Submitted by

Student

Signature

Date

Approved by

1. _____
Advisor

Signature

Date

2. _____
Chairman, Dept's
Graduate Committee

Signature

Date

3. _____
Chairman, Faculty's

Signature

Date

Graduate Commission

4.

Dean, Graduate School

Signature

Date