CHAPTER 4

PRE-DOMAIN DEVELOPMENT

4.1 Introduction

Pre-Domain development is one of the essential factors for successful requirement elicitation [143]. The main purpose is to understand domain for quality requirements. Pre-Domain development is the process to identify, document and record characteristics of systems in an explicit domain. This process is complex one, involving many activities that are related to each other. Pre-Domain development that experts in a problem domain play an important role in requirement elicitation process [144]. Although requirements elicitor having much knowledge of software project, they don’t know or understand their problem domain where project is to be developed and deployed. Incomplete domain knowledge allows the elicitor to perform poor requirement elicitation results lead to generate low quality requirements, products or even lead to project failure. Requirement elicitation is actually one of the most critical step in requirement engineering, several methods and tools have been studied and designed to support requirement elicitation activities. However, these tools and procedures are general, in the sense that problem-specific domain knowledge is not used and that they did not supports domain knowledge utilization. To achieve support for domain knowledge utilization a method is needed by which an elicitor better understands the domain. In this thesis a method is proposed to discuss the issues of pre-domain development and to represent domain knowledge for effective requirement elicitation.

4.2 Pre-Domain Development Model

The auxiliary stages of Pre-Domain development model are as follows:

- Identification of domain stakeholder
- Domain knowledge acquisition
- Domain analysis
- Domain verification and validation
Figure 4.1: Pre-Domain Development process
Fig 4.1 shows various activities of pre-domain development process. The actual process of pre-domain development model is divided into four stages as shown in the model. The working of each stage is discussed in the next sections.

**4.2.1 Identification of Key Domain Stakeholder**

Domain stakeholders identification is the first step in pre-domain development. Domain stakeholder understands a person or a group of persons united somehow in their common interest in, or dependency on the domain. The objective of this step is to ensure that all relevant key domain stakeholders are identified. Each stakeholders profile is accessed for each stakeholder group to thoroughly investigate its perspective with respect to each domain attributes of stakeholders. The procedure for identification of key stakeholders is shown in the Domain_Stake_Identification() algorithm.

**4.2.1.1 Algorithm**

Domain_Stake_Identification()

{

D: Problem Domain

D = (S₁, S₂, S₃...Sₙ) denotes set of key domain stakeholders

Where D ∈ D

dₐ: represents Domain Attributes

dₐ = (dₐ₁, dₐ₂, dₐ₃ .......... dₐₙ)

D ∈ dₐ // Domain Stakeholders attributes are related to defined problem domain.

// For Stakeholders Identification a function is defined

Æ (Dₛₐ, dₐ): ∈ D // Each domain stakeholders is identified on the basis of Domain attributes defined in problem domain //

}
4.2.2. Domain Acquisition

Domain acquisition is the process to obtain facts about the domain, i.e. capturing, collecting, and recording facts and domain terminology from domain stakeholders. It is important to write down and document the domain descriptions about them, and of roughly structuring these descriptions. These documents are known by the term Domain Description Document unit $D_dU$. Domain acquisition is the important stage of pre-domain development involves preparation and study of domain documents, a client interaction, preparation for client interaction process, preparation, recording and classification of domain description documents, finally reviews of the acquisition process performed as shown in the $Domain\_Acquisition()$ algorithm.

4.2.2.1 Algorithm

Domain\_Acquisition ( )

{

Step 1: Domain Document Gathering

Step 2: Evaluation of Domain Document

Step 3: Communicate Client for $D_dU$  // $D_dU$: Domain Description Document unit

Step 4: Preparation of $D_dU$

Step 5: Understand Domain Terminology T.

Step 5: Domain Stakeholder Interaction

Step 6: Recording Domain Information

Step 7: Classification of Domain description document unit represented by $D_dU$

$$D_dU = (D_dU_1, D_dU_2, \ldots, D_dU_n)$$

Step 8: Review of $D_dU$

}
4.2.2.2 Domain Acquisition Process

The acquisition process proceeds in the following steps listed below:

a) Study of domain description documents unit DₜU:
   - Gathering all such documents from various sources
   - Assessment of gathered documents.
   - Through reading of relevant documents.

b) Client Interaction:
   - Start interaction with the clients for the purpose of establishing assurance and trust.
   - Preparation for the recording of DₜU.

c) Preparation of systematic questionnaire based interviews for client interaction:
   - Formulation of questionnaire for client Interaction.
   - Distribution of questionnaire in connection with casual interaction with clients.
   - Gathering of more or less complete questionnaires.

d) Recording of DₜU:
   - Recording can be done on the paper, or electronically, either by the interviewed and questioned domain stakeholders or by the domain engineer interviews.
   - Result can be recorded on the paper, or on some storage medium.
   - Recorded documents consisting of one or more DₜU.

e) Categorization of DₜU:
   - To reduce complexity, a problem domain can be divided into several sub domains
   - Each DₜU is examined individually and separately from the assessment of other domain description document unit.
   - Each DₜU may contain as many of DₜU attributes as are relevant and can be ascertained.

f) Review Acquisition process:
- All DdU once collected and indexed, they are examined as to whether those that have been elicited from a necessary and sufficient collection.
- Whether they fulfill the requirement of domain and are accurate, some of them need to be rejected or more re-required

4.2.3. Domain analysis

Domain analysis means analyzing the DdU, with the aim of forming concepts from these, as well as to discover inconsistencies, incompleteness’s within these DdU domain description document units. The above characterization of the domain analysis mentions, concept formation and identifies that documents gathered are complete and consistent or not. This means there is no negatives: inconsistencies, and incompleteness’s, while achieving the positive concept formation as shown in Domain_Analysis () algorithm.

4.2.3.1 Algorithm

Domain_Analysis ()

{

Input:

DdU_i: Domain Description Document i_{th} Unit // Source Document

DdU_j: Domain Description Document j_{th} Unit // Target Document

String DdU_i, DdU_j, wd, wd1;

String Tokenizer st = new String Tokenizer (DdU_i);

String Tokenizer st1 = new String Tokenizer (DdU_j);

while (st.hasMoreTokens () && st1.hasMoreTokens ( ))
{

wd=St.nextToken();

}
4.2.3.2 Consistency and Completeness test

The incompleteness and consistency test as shown in the above domain_analyis() algorithm. Inconsistency of a domain description document $D_d U$ have some pairs of texts where one text describes one set of properties, while another text describes an opposite “set of properties, that is, property $P$ and not $P$. Incompleteness of domain description documents $D_d U$ have a description which leaves open some of the value some entities, some of the function argument value relation, some of the process behaviors, or which indicates some alternative possibilities of entity attributes, function argument pairs or behavior alternatives, without indicating describing all such.
4.2.4 Domain Verification

Domain verification is a process having resulting analytic documents, in which some domain descriptions document unit $D_dU$ are being analyzed in order to ascertain whether what being described satisfied certain properties. In domain verification step the domain model is examined and verified to check whether our domain model “hang together,” such as the domain engineers wants. Domain verification process gets the domain model right as shown in the Domain Verification ( ) algorithm.

4.2.4.1 Algorithm

Domain Verification ( )

{

Step 1: Examine domain model.

Step 2: Reanalyze the domain.

Step 3: Perform Informal reasoning.

Step 4: Understandability of domain document $D_dU$.

Step 5: Perform testing of domain document $D_dU$.

Step 6: Using Inference rule for formal proof.

Step 7: Check and compare with other existing system.

}

4.2.4.2 Perform Informal Reasoning

The purpose of informal reasoning is to understand carefully phased series of arguments, which, as a whole, convinces an audience for the validity of what is concluded. Informal reasoning provides support to domain verification process.
4.2.4.3 Testing of DₜU

Testing of domain description unit DₜU means that a DₜU is provided with set values for relevant arguments with the description then being evaluated for those arguments. The test then results in a final value of the description for those arguments.

4.2.4.4 Checking Formal proof

Formal proof means to understand a given DₜU, a statement to be proved and a proof that the DₜU satisfies the statement: this proof refers to a proof system for the language in which the DₜU is expressed, and is otherwise a sequence, compose from steps, where each steps in the sequence is like a theorem, a statement, and where pairs of steps in the proof sequence are related and justified, by the axiom and the inference rules.

4.2.4.5 Model Analysis

Model checking means to understand a method for formally verifying usually concurrent system whose usually have common feature, behavior and functionality. Finally the system is compared with existing system and analyzes it.

4.2.5. Domain Validation

Domain validation is a process, and the resulting analyzed documents, in which some DₜU are being co-inspected by domain stakeholders and domain engineers, and in which whatever is being described is being positively and negatively reviewed with reference to the elicitation report and with respect to whatever the stakeholders might realize about their domain. Formally in validation phase domain model is examined and validated to make sure that gathered domain knowledge modeled with domain stakeholder thinking. Domain validation process gets the right domain model. The steps of domain validation process is shown in Domain_Validation() algorithm.
4.2.5.1 Algorithm

Domain_Validation ( )
{
D_dU : Domain Description Document unit
D_mU: Domain model modeled by the Domain Engineer
T = {t_1, t_2, t_3,...t_n} // Terminologies defined in Domain
String D_dU, D_mU;
String T;
String C_1, C_2;
String Tokenizer st_1 = new String Tokenizer (D_dU);
String Tokenizer st_2 = new String Tokenizer (D_mU);
C_1 = st_1.countTokens();
C_2 = st_2.countTokens();
if (C_1 = = C_2)
print ("Documents are same");
else
print ("Documents are Different");
while (st_1.hasMoreTokens () && st_2.hasMoreTokens () )
{
wd_1 = st_1.nextTokens ( );
wd_2 = st_2.nextTokens ( );
if ( wd_1 = = T && wd_2 = = T)
print ("Valid Documents: No Discrepancies Found");
else
print ("Invalid Documents: Discrepancies Found");
}

4.2.5.2 Domain Documents Validation

In order to perform domain validations, the validators need the following input documents: (i) List of domain stakeholders (ii) Domain acquisition documents questionnaire, and the collection of indexed D_dU (iii) Rough-sketch of terminology.
narrative, and possibly if produced the formalization documents that constitute the D₃U properly (iv) Domain analysis and concept formation documents. The validators need to access all basic documents produced in the domain modeling effort and compare it.

4.2.5.3. Domain Documents Validation procedure

Domain validation proceeds as follows: Domain engineers sit together with stakeholders and review, line by line, the domain model, holding it up against the previously elicited domain description units, while then noting down any discrepancies. Thus domain validation can be an iterative process, alternating possibly with further domain verification, further elicitation report work, further domain analysis, and with further domain modeling work.

4.3 Conclusion

In this chapter a model for Pre-domain development is proposed. The proposed model discuss the key problem areas of domain development process, starts with identification of domain stakeholders, acquiring the domain knowledge to better understand the domain. Domain analysis can be performed to analyze the problem domain thoroughly. Finally the domain is verified and validated to show the correctness of domain knowledge gathered.