Abstract: Requirement Engineering (RE) plays an important role for a success or failure of the product and is recognised as most critical factor in entire software development process. Inconsistencies and terminology conflicts are one of the major problems in information management Applications. Knowledge management is a difficult and complex process. To build the accurate and reliable Knowledge based information system Requirement Engineering Activities must be integrate, combined and improved by new knowledge Management and representation techniques. The purpose of this paper is to present the model of knowledge base requirement engineering Approach using Ontology.

Keywords: Requirement Engineering, Ontology, Knowledge Management.

I. INTRODUCTION

Software engineering is the engineering discipline provides the guidelines for the development of the software. The SE process goal is to find out what the client wants, preparing requirements catalogue, architecture design which could be capable of handling all the requirements, coding, testing and integration of separate parts, testing, deploying and maintaining the software system. [1].

Requirements engineering (RE) is the 1st step of software engineering. It starts with the method of discovering, eliciting, documenting and maintaining the requirements for a particular computer-based system.

Requirement engineering is recognized as the most important stage of the entire software development process. Typically, more than 40% of errors discover in a software project are due to requirement engineering, whereas they have ten additional times of prices to fix these errors than other errors[2].

The area in Requirement Engineering contains certain challenges especially in Elicitation and Analysis which are lack of clarity of requirement, lack of communication, incomplete and contradictory knowledge named a few [3].

The groups of software engineering and knowledge engineering share a variety of common topics. Whereas software engineering research has been endlessly troubled towards a better abstract software modeling during the last couple of years, the knowledge engineering community has been eager to market various modeling approaches to conceive and conceptualize a domain of knowledge.[4]

Data, information and knowledge are basic building blocks and are very critical in information system. Often we used this concept interchangeably. But there are key differences when we apply this concept in information science. Data is collection of event and facts or observation in unorganized way. Information required a set of data or facts because data can be structured and transform into a structured form which is called information. Human beings are the entity who process the data and form into information such as computation, calculation. And finally knowledge is the process of understanding the information and linking it with other related information in the system which is precise and has well-meaning and also it has ability to link with other previous knowledge[5]

![Figure 1 Relationship](image)

Business knowledge is considered to be useful for requirements analysts to thoroughly collect business stakeholders’ expectations of the system as initial requirements. It suggests that understanding and modeling the interacting between crucial users can help identify unknown
users, and also assist users organize their thoughts and ideas purposefully[6].

Acquisition of knowledge is a most important and critical process in the fields of knowledge management and engineering. Knowledge is obtained from different sources, such as Internet, media, document, printed material and reports, and experts. Knowledge acquisition process contains the elicitation, analysis, collection, modeling and validation of knowledge for projects of knowledge management and engineering [7].

KM is a method comprises the phases of acquiring, creation, sharing and management of knowledge, knowledge acquisition process plays important roles among the stakeholders distributed geographically in shared understanding of requirements. Incomplete communication and coordination are one of the challenges faced by most of the GSD organizations because they have variety of stakeholders in different locations around the world. Insufficient communication can become one of the reasons to harm the trust and relationship in result it could causes the lack of shared understanding, in these situation, Knowledge Management become useful to handle the communication and coordination issues in GSD and knowledge sharing is necessary keeping the people update and shared understanding among members of team.[8].

There are number of effective information, data management techniques and systems exist. Knowledge pattern is more complicated and complex than data and information and it is tough to process and represent by computer. Management of knowledge is tough for the traditional available information management techniques as the result of the following reasons.

- Data sources consisting of data and knowledge are available to specific applications.
- Knowledge holds in numerous sources result to be redundant and inconsistent.
- Lack of central combined and logical coordination of knowledge management activities.

Many researchers powerfully argue that ontology based knowledge management capable to handle the problems of modern information systems. Ontology is an effective and efficient technology that permits integration of concerned resources, sharing the proper knowledge and avoids irrelevant information.[9]

Among the cluster of knowledge-driven requirement engineering strategies, ontology-based requirement engineering is extremely standard. It provides formal illustration for both requirement documents and knowledge. It describes the matter domain with varying degrees of formalization quality and expressiveness. It is well suited as an evolutionary approach. It is employed to support requirements management and improve the traceability of requirement artifacts. Thus it outperforms different ancient knowledge-based approaches[2].

Rest of the paper section II contains brief information of Related Work section III contains the proposed Method and Approach section IV contains the Ontology based knowledge Model. Section V contains Evaluation and Results and finally conclusion.

II. RELATED WORK

[7] Presents the literature review of knowledge acquisition techniques and performs the analysis of them for selecting a knowledge acquisition method for acquiring knowledge on product functionality efficiently. The main purpose of his research is to thoroughly analysis the knowledge acquisition techniques and their use.[3]

[10] Describes Role of ontologies in Requirement Engineering. He elaborates the use of ontologies in different stages of SDLC. During the stage of development it helps designers of the system to use a next level of knowledge and re utilize it is normally the practice in software engineering. At the stage of runtime, ontology may help, for example, information integration between different software’s. At development time, domain ontology can be helpful in a way that it facilitates the shared understanding between stakeholders of the system.

[11] Presents that ontology is an important concept in the information system which can represent knowledge describe the domain and make the reason about it which can be shared among the communities and integrate with other systems. He further elaborates the useful aspect Ontology development and its use.

- It helps to distribute the common understanding of concepts among software systems as well as people.
- The reuse of domain knowledge is one the major aspect of ontologies.
- Assumptions about domain are explicitly managed.
- It distinguished domain knowledge from operational.

The commonly used pattern and practices in the RE that use functional requirements and data models along with use cases and discover the classes from one or all of the approaches. They used different mechanisms to build these models such as sequence diagrams, activity graphs or consistency guidelines. These methods are used to build the solution oriented application, but they do not correctly evaluate the domain of application, and also they do not provide assistance for the elicitation or acquisition of functional requirements[12].

A method of automated Ontology building from structured, Unstructured and Textual source has been introduced and various tools and techniques are identified. Said by [13]
The comprehensive survey on the current ontology based knowledge management approaches concludes that following are the general limitations in the management of knowledge:

- There is no appropriate mechanism and appropriate approach for knowledge management
- The knowledge management systems which are currently in use are static in nature.
- Closed knowledge management
- Knowledge integration is still a challenge between software Agents and human.

III. PROPOSED METHOD AND APPROACH

In order to drive the conceptual model our study is based on existing knowledge Management Literature.

This paper is focused on ontology based knowledge model that will be consumed by knowledge base system. Our proposed approach consists of three phases:

1) Domain knowledge Acquisition.
2) Knowledge Modeling
3) Knowledge Management(Storage)
4) Knowledge Reuse &Integration

Our aim is to construct the knowledge Model based on ontology for knowledge based system we distribute our proposed framework into 4 phases.

1) Domain Knowledge Acquisition

Knowledge acquisition is the process of extracting the knowledge from different sources by applies the knowledge Acquisition techniques.

(Burge, 1998) discussed three Knowledge elicitation categories.

Direct methods are those that enhance the understanding about the domain obtain directly from the expert through interviews, case studies and prototyping, so the required information is obtained by asking direct questions or from direct observation. While in indirect approach the needed information is not requested directly example are Document analysis, Questionnaires. The benefit of indirect approach is extra information may be collected in contrast to direct approach but analysis is required after elicitation. Interviewing phase is the process of asking the questions from the domain expert about the domain and how they carry out their responsibilities. The questions list can be formless, semi-formed, or planned. If the interviewer is not well-known with the domain than it becomes very difficult for him to exactly decides which questions should be asked. So the success of an interview relies on the queries asked and on the flexibility of the domain expert to share their knowledge[14].

The knowledge engineer built the model based on information obtained during the different acquisition techniques i.e. interview and then validate with the domain expert. In a number of situations, the models will be designed interactively with the professional, especially if there are tools accessible for model creation.[14].

There are different approaches used to acquire the domain knowledge are from learning objects and non-learning objects. In case of learning objects types of input could be structured data, semi-structured Data and Unstructured Data. Tools are available to build the knowledge from these resources. In case of non-learning objects human experiences, thoughts, practiced approaches are the examples.[13]

In order to acquire the knowledge our model is based on different knowledge acquisition techniques like semi-automated from learning objects and manual from non-learning objects combined approaches. Our model focuses on gathering initial data from learning objects with various tools discussed in Literature review and then from non-learning objects. In case of knowledge acquisition from non-learning objects our model concentrate on direct interviewing (structured, semi structured) with stake holder and indirect
approaches of documents analysis to elicit the domain knowledge. Data from various experts systems have been collected and analyzed.

2) Knowledge Modeling

The Data and facts appear after applying various requirement engineering approaches for knowledge acquisition could be structured or unstructured. To represent this data into a meaningful way there is need a model to where to transfer the data into knowledge which must be clear in semantics and also understandable by machines and human beings.

Domain model contains the knowledge of domain. Domain Model usually contains the structure of the domain and comprises subset of the general world knowledge. Its simplification is Conceptual Model, which represents the conceptual relationships between the objects in the domain Eriksson (1999).

Ontology belongs to the field of Artificial Intelligence is a way of specification of a Concept Explicitly.

According to Noy and McGuinness (2001) there are seven essential steps to construct ontology.
1) Define the Scope of the system.
2) Think about the reusing already developed ontologies.
3) Extract the important terms in the ontology
4) Define the classes and the class taxonomy
5) Define the properties of classes slots
6) Define the facets of the slots
7) Create instances

So Identifying the purpose and scope of ontology purpose is why choosing the ontology and scope contain intended users of the system.

The Ontology conceptual model includes the domain concepts and relationships among those concepts. Concepts can be organized with a class chain hierarchy called super classes and child class’s concept. Relationships between concepts can be organized in two main categories. One is Hierarchical and 2nd is associative relationship. Hierarchical relationship consist the hierarchy between super classes, child classes. Associative relationship makes the relationship between those concepts which does not have the same hierarchy. A generic ontology structure model can be represented as indicated by the pictures below:

Transform the conceptual description into a formal model, that is, the outline of the domain found within the previous step is written in an exceedingly a lot of formal method, although not nonetheless its final kind. Concepts are typically identified through axioms that disallow duplicate interpretations for the meaning of same concepts. Concepts are organized as hierarchically in a structuring relation.

Different tools are available to model the domain i.e. protégé, CMAP Editor. We have used protégé to implement the formalized ontology due to its extensive features.
Following below figure shows the sample Crop knowledge model developed in protégé.

3) Knowledge Management

There is need of persistence storage of Ontology for its regular use. There are many storage model are discussed in Literature storing Ontology as Graph etc. Relational databases are regularly used as a source for persistent storage of ontologies to ease fast operations such as efficient searching and finding the relevant records, and to exploit the benefits of relational databases management systems. A recent improvement in ontology organization in the relational database society is a novel approach proposed by Oracle. A
A method has been proposed in RDBMS to support ontology driven semantic matching directly using SQL. A set of system-defined tables are used to store the Ontology data. A special set of operators are introduced which includes new indexing schemes. A database user can therefore reference the ontology data straight by applying these new operators.

Semantic Technologies features support storing, loading and operations on RDF/OWL models. Each RDF model consist a set of triples i.e. subject object predicate relationship organized in the shape of RDF/OWL graph of directed labeled edges. The edge is the relationship that connects an object node to a subject node and is label by a predicate.

Efficient and scalable management of RDF data is a primary challenge at the heart of the Semantic Web. Many accepted RDF storage space solution use relational databases to ensure scalability and effectiveness. The Relational architectures that make use of a triple-store as their primary data storage scheme consist of Oracle, Sesame, and 3-Store, R-Star, RDF Suite, and Redland. (2) The property table.[15]

4) Knowledge Reuse and Integration

SPARQL are used to apply queries across diverse data sources which have or have not homogenous structure, whether the data is kept native as RDF store or view as RDF. SPARQL have capabilities for querying and optional graph patterns. SPARQL supports constraining queries by source RDF graph. The simpler form of the graph pattern is triple pattern. The result of SPARQL queries applied to knowledge base is results sets or RDF graphs. Thus the retrieval of knowledge from diverse sources and integrate them is one of the powerful property of SPARQL.

Queries over RDF knowledge bases are rows in shape of triples joined together. While this is a very concise representation of answers to users' information needs, it is similar to the case that users wish to explore the knowledge database so as to find more about a certain topic or subject. It is therefore necessary to supply the users with tools that allow them to explore an RDF knowledge base content[16] [17].

Figure 4 System Architecture
V. EVALUATION AND RESULTS

We have applied this knowledge Management Model in creating a control group in the university located in Islamabad, Pakistan. Two Teams were constituted each team consists of four students. Each member of team was selected by their academic grades obtained in the selected courses. Both teams have given training about the ‘X’ domain. Both teams had given tasks to transform the given domain knowledge to formal model and then reuse. Team A developed the system through traditional modeling approaches and finally shifted into RDBMS. While Team B used our proposed ontology based Knowledge modeling and management Approach.

Table 1: Comparisons of Results

<table>
<thead>
<tr>
<th>Phases</th>
<th>Traditional Development RDBMS</th>
<th>Ontology base knowledge Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (days)</td>
<td>Time (days)</td>
<td></td>
</tr>
<tr>
<td>Specifications Development</td>
<td>27</td>
<td>40</td>
</tr>
<tr>
<td>Implementation &amp; Test</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Verification &amp; Maintenance</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td>79</td>
</tr>
</tbody>
</table>

The obvious difference in the maintenance was faced when new concept with different attributes is added to RDBMS it reveals new Table and requires extra development time. While adding concepts in existing Ontology does not require structure change as it contains homogenous structure thus reducing maintenance time.

Following is the comparison of support capabilities which will help application programmer to build Applications.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Traditional RDBMS</th>
<th>Ontology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data organization</td>
<td>Tables</td>
<td>Classes, attributes, relationships, and instances</td>
</tr>
<tr>
<td>Relationships</td>
<td>Lack user specified explicitly defined relationships</td>
<td>Precise and well defined</td>
</tr>
<tr>
<td>Semantic Capabilities</td>
<td>Not Available</td>
<td>Strong</td>
</tr>
<tr>
<td>Search Criteria</td>
<td>Term based</td>
<td>Concept base</td>
</tr>
<tr>
<td>Inference Rules</td>
<td>Not Available</td>
<td>Present</td>
</tr>
<tr>
<td>Reasoning</td>
<td>Not Available</td>
<td>Present</td>
</tr>
</tbody>
</table>

Figure 6 Comparison

VI. CONCLUSION

This paper presents a Requirement Engineering based knowledge management Model using Ontology. We have proposed the model of knowledge management which consists four phases 1) knowledge Acquisition 2) knowledge Modelling 3) Knowledge Management 4) Knowledge Reuse and Integration.

The proposed approach provides better solution for some knowledge Management and its reuse. Our next focus is on applying this proposed framework on building the agriculture domain ontology that will be consumed by system, which takes input from user, search database as well as ontology and displays the list of matched records through which user may able to get sufficient knowledge on the query he applies.

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REFERENCES


