Journal of
Information Systems Engineering
and Business Intelligence

Vol.5, No.2, October 2019
Available online at: http://e-journal.unair.ac.id/index.php/JISEBI

One-Pot Synthesis of Requirements Elicitation for Operational BI (OBI) System: in the Context of the Modern Business Environment

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Article history:

Received 18 June 2019
Revised 9 August 2019
Accepted 28 August 2019
Available online 28 October 2019

Keywords:

Business Context, Business, Intelligence, Business Networks, Protocols, Modern Business, Environment, Operational Business, Intelligence Requirement, Elicitation, Requirement, Methodology

Abstract

Background: Requirement elicitation is the first step for any project. The available BI requirement elicitation approaches are focused more towards: the top pyramid of the management, less focus on the business aspect of an organization, historical in nature, emphasis on data mining and data warehousing aspects, no clear separation between requirements, and lack of proper linkage between the requirements. The demand of BI shifts towards the operational front for last couple of years. The use of Operational BI is gaining more popularity among industry and business communities because of increased demand of real time BI. It provides a powerful analysis of both operational and business information in current time for all levels of the users in the organization.
Objective: In the modern business environment, the business operates on networks that demands multi-level decision-making capabilities as compared to the traditional business approaches. Operational BI is one of the business information systems that support the modern business environment and provides timely decision-making information to all the users in the organization. The requirement elicitation methodology for Operational BI system is found open for research. A new approach for requirement elicitation for an Operational BI system is presented in this paper, which highly suits to the organizations in the modern business environment.
Methods: A top down technique is employed in the proposed requirements methodology that focuses on the business context of an organization. The proposed requirement elicitation approach is highly suited for the organizations that operate in the modern business environment. This approach overcomes several limitations in the existing BI requirement approaches. A case study is presented to support the proposed requirement elicitation approach for OBI system.
Conclusion: This approach has several advantages like fast development, clear definition, classification of various types of requirements and proper linkage between the requirements without any loss or missing of gathering requirements. Finally, it is to conclude that the proposed approach acts as a one-pot synthesis of requirements elicitation for Operational BI system.

I. INTRODUCTION

The term BI refers [1] to technologies, applications and practices, whereas the Operational BI (OBI) delivers information and empowers all the users to make better decisions. Requirement elicitation is the first step for any project. The requirement elicitation approaches of BI project are different from conventional IT projects. In the available BI requirement gathering approaches are limited to top pyramid of the management [2], emphasis on data warehouse [3, 4, 5, 6] and data mining perspectives [1]. In addition, the existing DM-BI requirement methodologies are less focused on the business aspects of an organization on daily basis [7], lack of clear separation, and a proper linkage between the requirements that supports for single level decision making. The use of BI in the organizations has increased towards the operational front for the last couple of years. The term OBI is now a well-used phrase in the

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doi: http://dx.doi.org/10.20473/jisebi.5.2.131-145

industry. It provides a powerful analysis of both operational and business information in current time for decision making to all levels of users in the organization.

An operational system is more commonly referred as a transaction system that captures daily transactions of an organization. The transaction system describes the behavior of an organization in current time, whereas the BI system is a data-driven that leverages data mining and analytics the functionalities uses the historical data stored in a data warehouse or data mart. A combination of operational and BI systems will form as OBI system. Thus, requirement elicitation for operational systems are different from the available BI practices. Now a days, the business is functioning on the network. A business network is owned by the business enterprise [8], where the scope of the network is to support both informational and operational requirements. Here, the term modern business environment is defined as 'organizations that operate a business using the network'. In the modern business environments, business operates on networks which demands multi-level decisions making capabilities as compared to the traditional business approaches. Early attempts of building the OBI system are merely a replication of operational data into DW-DM systems without any data integration from operational systems. The requirements collection and definition process of traditional operational information systems are different from the data warehouse systems [9]. BI system becomes more operational with the age [7]. Thus, the only bubble in BI is that the OBI becomes the order of the day. Nowadays, the OBI is emerging as a new paradigm which is aimed at providing solutions for ubiquitous BI.

In spite of several requirement elicitation approaches for DW and BI systems are reported [1, 3, 10, 11, 12, 13], [14] in the literature by the academia and consultants, it is noticed that there is no method available for requirements elicitation for OBI system in the modern business environment. This motivated to write this paper. The demand of the OBI system is rapidly increasing day by day in almost all industry and businesses communities which will continue further two more decades. The paper is aimed at to present a new approach for requirement elicitation for OBI system in the context of the modern business environment. This approach can eliminate the limitations of the existing BI requirements gathering approaches. It offers several advantages like focus on the business context of an organization, clear separation of requirements, proper linkage between the requirements, supports for multilevel decision capabilities, simultaneous collection of requirements by multiple users. The main contribution of this research work are presented as follows: (if) we present a clear classification of OBI requirements into five categories, (ii) we present a holistic view of the OBI requirements for each category and their linking from one category to the other category, (iii) we present an approach for requirement development for the proposed system and (iv) a case study to quality the proposed requirement elicitation approach. The proposed approach offers several benefits to BI professionals, consultants, analysts, and helps practitioners as a guideline for the implementation of OBI in network business organizations.

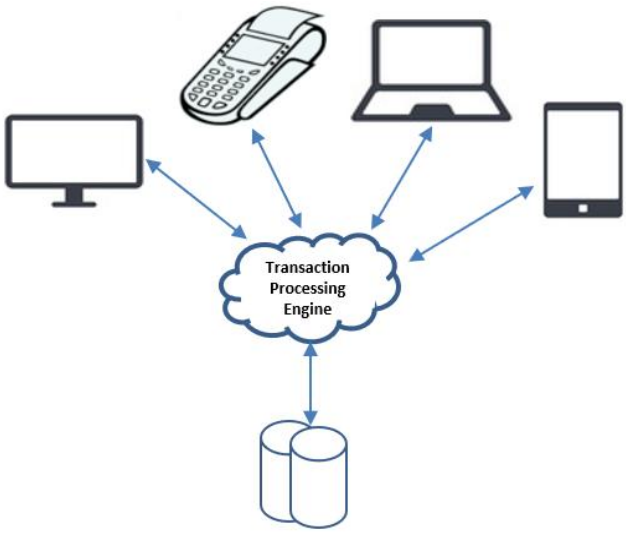

Fig. 1 Transaction Processing System

Transaction processing is the heart of the operational systems. A transaction processing system receives inputs from various business applications that reside on client machines like computers, laptops, point of sale terminals, mobile gadgets and so on which will feed to a transaction processing engine (TPE) as shown in Fig. 1. Further, these transactions are stored in a database. Each transaction refers a smallest operation in the business in the form of an

entity. This entity may be a customer call, or an order or an invoice or payment. These systems are mainly used to run Intraday and Inter day transactions of the core business operations of an organization which is known as transaction or operational systems. In the modern business environment, operational systems work as wheels of the business. This means that the business functions smoothly by executing the core business operations of an organization on continuous basis without any destruction. More popularly, these systems are known as Online Transaction Processing (OLTP) Systems.

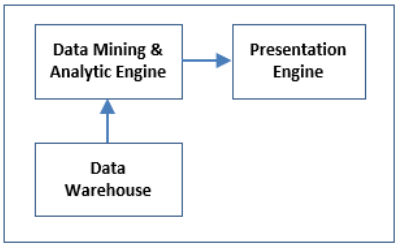

Fig. 2 Typical BI System

A typical BI system consists of three major blocks: data warehouse, data mining cum analytical engine and presentation engine which is shown in Fig. 2. The data warehouse maintains historical data of an organization [1] that provides quick access to data mining engine for processing of data [15]. The results of the processed data are accessible to the users through a presentation engine in one or more forms like analytics, visualization, dashboards, and reports.

A pragmatic view of the OBI system is shown in Fig. 3 that comprises of four major blocks as operational data sources, data warehouse, operational processing engine and presentation engine. The operational processing engine consists of two sub-modules known as process analytics and data mining. The operational data is processed by analytics engine and discovers meaningful patterns, whereas data mining engine extracts knowledge from historical data stored in a data warehouse. The discovered patterns and knowledge are fed to the presentation engine. The processed operational data will store in a data warehouse. The output of presentation engine is operational intelligence which is defined here as a ubiquitous BI or BI for all users. The OBI system will identify and detect events from the activities of business processes. Further, the users of the OBI will able to monitor performance of multiple business services. In a study conducted by Ulrich Christ [6] that the OBI provides a real-time information to all levels of users. Thus, operational users can understand the business at a detailed level from operational front for real time decisions, whereas strategic users can understand the business functioning from data analytics perspective which is obtained from present and past data.

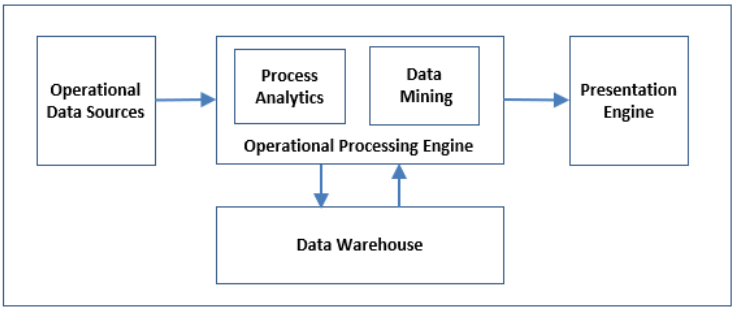

Fig. 3 Typical Operational BI System

The remainder of the paper is organized as follows. Section 2 covers current requirement elicitation practices of various DW-BI systems. Section 3 covers the proposed methods for requirement elicitation that include categories of OBI requirements, holistic view of OBI requirements, a process for requirements development. Section 4 a case study is presented to qualify the proposed approach. Section 5 presents a discussion on the proposed requirements model. Finally, Section 6 covers the conclusions and future work.

II. Literature Review

The requirements elicitation process for DM-BI projects were defined [1] that has a five-steps. This process starts with understanding the project domain, knowing project's data domain, project scope, identification of human resources with appropriate skills and select the correct DM-BI tool. In addition, a set of templates was defined to document the requirements of the system. In [10], the requirements development for BI and the BI portfolio were presented, which has three steps as opportunity analysis, business case and portfolio. The goal of opportunity analysis is to identify how BI can improve business results to the users like executives, managers and analysts. The outcome of opportunity analysis is a qualitative business case that describes three broad areas, namely management, customer, and operating processes. The opportunity analysis and the resulting business case are the key inputs to the third step which is known as the portfolio. This approach overcomes the weaknesses of traditional BI requirement approaches and establishes the basis for developing requirements. The outcome of this approach is a well-structured set of BI requirement documents that drives the development of BI databases and applications. Further, this approach creates a business value by enhancing the business process. In [16] requirements analysis for DW were described that considers both information and quality-of-service requirements which is based on Model Driven Architecture. The advantage of this approach was a clear separation of concerns to model requirements without losing the connection between information and quality-of-service requirements.

A designing of ETL processes for the OBI systems were presented [17], which is centered around a layered methodology. This starts with modeling the business processes of the enterprise, and their information requirements and service level objectives. Finally, it proceeds systematically through logical design and physical implementation. A key feature of this methodology was the use of a unified formalism for modeling the operational business processes of the enterprise as well as the processes for generating the end-to-end information views required by operational decision-making. In another study describes information requirements analysis for DW systems [5], which uses an activity model approach that has four phases as Initialization, As Is, To Be and Modelling. Each phase has set of activities. In this approach, more focus was given to DW requirements and less focus on the business process requirements. It was envisaged that information requirements for DW systems are significantly different from the conventional information systems. The major activities of initialization phase are user identification and major business application. The activities of As Is phase includes analysis of information supply, identification and aggregates creation whereas the activities of To Be phase includes analysis of information demand, aggregate information supply and information demand, assign priorities, increase the level of detail, homogenize information requirements and review priority assignment. The modelling phase activities are creation and evaluation of data schemas.

Matteo Golfarelli has discussed [11] several approaches for requirements gathering of DW projects in terms of their strengths and weaknesses. In this study, it was stated that the key steps to success of a DW project are requirement analysis and the conceptual design of the system. Several improvements to the requirements approaches were presented [5, 42] which include goals defined, task specification, as exploratory data analysis and recommended tools for process documentation, model-building, and pattern-finding. Requirements driven DW development approach [18] were described that has four stages as requirement engineering, conceptual, logical and physical designs. The requirements engineering phase deals with the goals, decisions, information and their relationships. The conceptual design covers Facts, dimensions, aggregations, sophistication needs, meta-data. The logical design covers representation in DDL of the DW package to be used, whereas physical design covers physical layout of DW. The requirement elicitation process for most commonly used DM methodologies were described [19] that emphasis on the necessity of business understanding as the starting point for any DM project.

Industry leader SAS has developed [20] a rapid a requirement methodology for warehouse projects, which is known as Sample, Explore, Modify, Model and Assess in short SEMMA. This methodology begins with the extraction of sample data. Further, analysis is performed on the extracted data to explore the data to model the system. The third phase involves entailing data to data mining tool. The miner performs tasks like statistical representation of sample data, applying exploratory statistical and visualization techniques, select and transform the most significant predictive variables, model the variables to predict outcomes and confirm a model's accuracy. The fourth phase involves running data mining tool on the selected data. The last phase comprised of evaluating the results from models.

Chapman et al. has described [21] requirement elicitation approach for DM projects, which is known as CRoss-Industry Standard Process for Data Mining (CRISP -DM). This methodology uses a hierarchical process model that has four levels of abstraction as general to specific, generic task, specialized task and process instance. In this approach, business understanding is starting point for any data mining project. The data mining process is divided into a few phases and each phase consists of a set of generic tasks. These generic tasks act as second level abstraction which is intended to be general enough to cover all possible data mining situations. The third level comprises of specialized tasks which describes how the actions in the generic tasks should be carried out in certain specific

situations. The fourth level consists of the process instance which is a record of the actions, decisions, and results of actual data mining engagement. The life cycle of a data mining project was described into six phases that include business understanding, data understanding, data preparation, modelling, evaluation and deployment. The advantage of this approach is that the sequence of the phases is not rigid and flexible to move back and forth between different phases.

In [22], a methodology for DM projects was proposed which is popularly known as P3TQ (Product, Place, Price, Time, and Quantity). This methodology has two major parts as modeling and data mining. The modeling part provides a step-by-step guide for development and building a mode. This modeling part addresses a business problem or opportunity, which is mainly depends on business circumstances. The data mining part provides a step-by-step guide for mining the data to produce the required model as identified in the first part. The second part consists of a series of stages, which are to be completed to get proper mining information. A process for Requirement Elicitation for BI Projects (REP-BIP) were proposed [13], which has four phases as (i) viability study (ii) elicitation and analysis (iii) specification and (iv) validation. This process is based on Sommerville's elicitation approach. Further, these phases are grouped into various categories like planning, development and change requirement. Ulrich Christ [6] has defined that OBI is a part of the enterprise data warehouse architecture, that has direct access to operational sources and integration of data systems.

A conceptual modeling framework for developing advanced business analytics was presented [23], which is based on the business objectives of an organization. This framework has three complementary modeling views known as (i) Business, (ii) Analytics, and (iii) Data preparation. The Business view represents an organization in terms of strategies, actors, decisions, analytics questions, and required insights. This view includes activities of elicit and clarify analytics requirements, which includes to identify the types of analytics that the user needs. The Analytics view represents the core design of an analytics system in terms of analytical goals, machine learning algorithms, quality requirements, and performance metrics. This view identifies the design tradeoffs, captures the experiments (to be) performed with a range of algorithms, and selection of algorithms. The Data preparation view mainly represents, data preparation mechanisms, algorithms and relevant tasks. This view expresses task like the structure and content of data sources as well the design of data preparation. These three views are joined together to link an enterprise strategies to analytics algorithms and data stores and preparation to achieve the business objective.

According to [24], business reporting system has to a generic pattern which is a common across organizations and technology architectures. In order to have a generic pattern of reporting, the business user on one end of the reporting continuum and the data sources on the other end. Based on the needs and requirements of the business user, the data is captured, stored, consolidated, and converted to desired reports using a set of predefined business rules. In order to have a successful reporting system, reporting requirements and information delivery are properly aligned [25]. An approach to formalize DW information requirements was proposed [26], which is based on a demand-driven methodology. In this study, a method for transforming information requirements to the conceptual model of a DW was described, which make distinction between quantifying and qualifying data and to arrive DW conceptual model.

III. METHODS

The requirements elicitation is the first phase of any software development life cycle [27]. It consists of a set of activities that comprise the collection of information from the stakeholders, users, and customers of the organization, which is the basis for the entire project. The collected requirements are used for the design and development of the system. Several authors [5, 9, 11, 12, 14, 16, 18, 30] reported requirements engineering methodologies for BI projects, which are primarily focused on DW and DM aspects. The available BI requirement approaches are broadly classified into various categories such as data mining [1], use cases [3, 31], model driven [32], data driven [5, 42], Goal oriented [12, 33, 34, 43], and business process oriented [35, 36, 37].

In [2] the most commonly followed approach for BI alignment strategies such as top-down and bottom-up approaches were studied. The top-down approach is known as *strategic*, whereas the bottom-up approach is *tactical*. In top-down approach, the goals of entire organization are identified first and then communicates metrics for these goals. The Goal driven approach [43] employs a top-down technique that focuses to align DW design with corporate strategy and business objectives. The adaptation capability of BI systems was described [38] as 'BI agility'. The terms BI agility is stated that BI systems have to react to unforeseen or volatile requirements in a given time frame results from increasingly complex and dynamic organizational environments. The BI agility is studied in terms of Actions and implementation levels. In this study, the BI actions are divided into four action categories as 'principles', 'methods', 'techniques', and 'technologies' with three levels of implementations (L1, L2 and L3) where L1 is the lowest. From this study, it is observed that most of the identified Agile BI actions are falling under implementation level (L2), this means there is a lot of room for real world Agile BI actions. An integrated data modeling methodology

for the DW was proposed [39], which is a combination of goal-driven, data-driven, and user-driven approaches. The goal-driven approach produces subject areas and Key Performance Indicator (KPI) of the core business, whereas the data-driven stage produces subject-oriented enterprise data schema. The user-driven approach yields analytical requirements that cover measures and dimensions of each subject. This study does not cover the removal of redundant requirements and validation of the same.

The author has chosen a top-down approach for requirements elicitation for the OBI system because the implementation OBI will fall under strategic control rather tactical. The data collection for this study is primarily various reputed conferences and journal papers on the proposed theme over the internet. The methodology adopted for this research is quantitative descriptive approach. The proposed approach is validated with a case study.

A. Categories of Operational BI Requirements

The main aim of requirement engineering is a gathering of requirements pertaining to the system under study. Thus, requirements elicitation is the first and foremost activity for any software application development. Essentially, BI system provides information to strategic users for better decision-making, whereas the OBI system provides information to all the users of the organization in terms of both operational and strategic decision-making. The requirement of the OBI system is classified into five categories as shown Fig. 4.

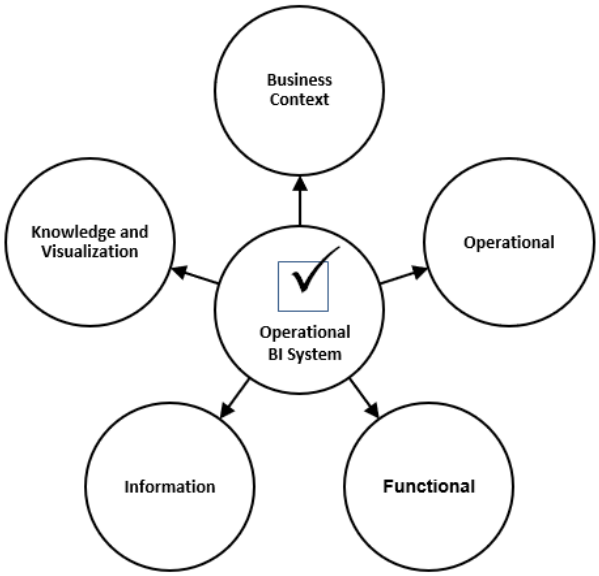

Fig. 4 Categories of Operational BI requirements

Further, each category of requirements is drill down to the lowest level to understand the smallest business operation in the organization. The requirements are analyzed to establish a proper linkage between the requirements from one category to other as well as to design a holistic OBI system to support for all the users of an organization.

B. Holistic View of Operational BI Requirements

The holistic view of OBI requirement elicitation system is shown in Fig. 5. The top row in the figure represents various types of requirements abstraction in short requirement categories. In this approach requirements are collected using top down technique. Thus, it begins from the business context of an organization. Further, these requirements are aggregating to other categories as operational, functional, information and knowledge and visualization. The requirements of one category different from the other category. The linkage between various requirements within the category is represented with down arrows. A proper linkage between one category with another is represented by horizontal arrows. This approach is simple and straight forward that supports backward looking of gathering requirements. Hence, no missing of requirements will not happen at the same time duplication of requirements can be easily identified. Further, validation of the requirements is ensured.

1) Operational Requirements

The business context requirements are elicited from strategic level users of an organization which is the crux of the OBI system. These requirements exemplify the business specific information about an organization that refers to business verticals specific information, type of business organization and the key stakeholders. These requirements are mainly referring to core business service offerings, and business processes associated with each business service. The key stakeholders are identified and map them to the corresponding business processes as well as business services. Further, the other categories of abstraction are aggregated from the business context requirements.

a) Business Services

These requirements are referring to the core business services within the business vertical in the organization. The core business services are defined as the essential business services of an organization to ensure the smooth functioning of the business. Thus, each business vertical will have a set of separate business services. The business services can be further divided into sub-services or sub-sub services based on the on the complexity of the service offered by the organization.

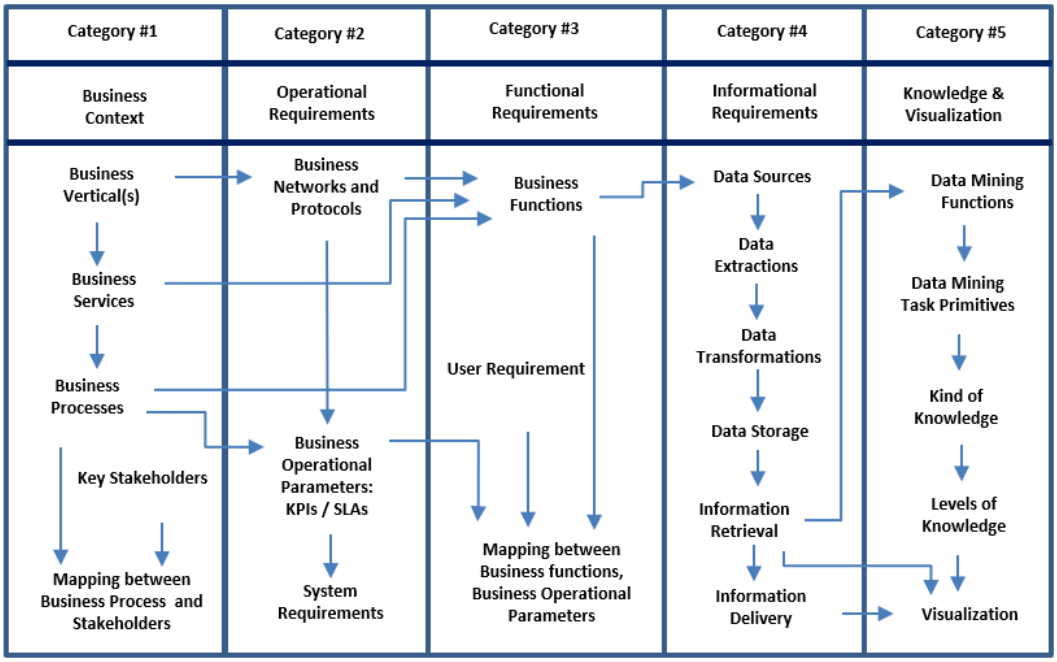

Fig. 5 Holistic view of Operational BI requirements

b) Business Processes

Each business organization can have predefined business processes through which business services are made available to the users. All business processes requirements are identified from the corresponding business service/sub-service. In addition, requirements of critical activities associated for each business process will be studied, which indicates the objectives of an organization while remaining solution independent.

c) Key Stakeholders

The stakeholders will play a major role in any organization for smooth functioning of the business services. Thus, the stakeholders who are associated either directly or indirectly to the organization are to be identified. The stakeholders can be classified into multiple categories based on the nature of the business functions, services and process perform on regular basis. The requirements of each category of stakeholders will be studied with reference to the business context of an organization. Further, stakeholders' requirements are analyzed to identify interdependence of business services between common stockholders. In case more than one stakeholder can share similar business services and then such business services are combined to make effective operation of the business otherwise their business services are separated.

d) Business processes and stakeholders mapping

In this, business processes are mapped to the stakeholders that depends on the type of business processes they operate. All business processes are mapped to the corresponding stakeholders for all available business services of an organization. Further, common stakeholder if any manages multiple business process in the organization will be studied and accordingly the business processed are mapped to them.

The final output of the business context requirements category comprised of a business context diagram that includes list of core business services of an organization, list of all business processes, category of stakeholders and mapping of business processes to the corresponding stakeholders. A single business context diagram can meet the requirements of a small and mid-size organizations, whereas multiple business context diagrams are required for large and enterprise organizations.

2) Operational Requirements

Operational requirements are the second most important category of requirements, a well-defined operational requirement can provide a better design of the network business organization. In this, how business services are connected within the organization and outside the organization will be studied specially on network aspects of the business. Business operational requirements are crux of the OBI system which is the fundamental to the organizations in the modern business environment. In addition, requirements related to "how business network meets the business challenges" will be studied in terms of business operation, network and protocols of an operational system. These requirements cover critical measurements like facts and business dimensions in the context of network operations of the organization. These operational requirements include critical metrics that are to be measured for the performance of the business operations and processes which may fall under KPIs or SLAs of the system. The system requirements will be studied with respect to the organizational aspects of the system and how business is performed.

a) Business Network Protocol

These requirements describe how business units connect within the business vertical of an organization. New business models use technology to connect people, organizations and resources in an interactive ecosystem in which amazing amounts of value can be created and exchanged [8]. Business network protocols are set of rules for establishing communication between the organizations to make business operation. These requirements will have multiple layers which include details like common message structure; type and priority for the business service to function smoothly. Business units within the organization will communicate with other at multiple layers according to the rules defined at each layer that allow business to run on time, accurately and efficiently.

b) Business Operational Parameters: KPIs/ SLAs

To measure the efficiency of business operations, key performance areas and service levels are to be defined for each business process. The defined KPIs/ SLAs of the various business processes are mapped to the respective business services within that business vertical. An approach for eliciting and structuring business indicators in a DW was proposed [14] that aims to elicit the business indicators from decision makers of an organization. Then, these business indicator hierarchies are built and associate to business functions. Further, these functions are visualized with the aid of the use case diagrams.

c) System Requirements

System requirements are those statements to identify the essential resources and capabilities that are required to run business services and processes of the business to make timely access to all the users of the system.

3) Functional Requirements

This category of requirements includes not only functional but also user requirements of the system. The functionality of the system is described with the aid of the business functions. The business function describes a specific task which is to be performed by the user. Thus, the user will perform set of tasks to achieve specific functionality of the system. Therefore, the requirements that are related to business functions and user are collected from the user's point of view. The user requirements are captured by the user with the aid of use cases that describe typical interactions between the user and the system.

The business function is a task which is performed by the user either one time or routinely to carry out certain activity within the organization. These business functions will form a business process and set of business process will constitute a business service. The requirements of the business functions are studied, developed from the business processes and the business services.

a) User Requirements

Modern business operates differently to their targeted customers and creates a value by offering their products and services [40]. The user requirements are important in the system for accessing all the services of business organization on daily basis. A mapping between business functions and business operational parameters will be made. The identified operational parameters are mapped to the business functions for efficient monitoring of the business process and services of an organization. The user requirement analysis is crucial in designing a data warehouse that effects all almost all decisions that are implementation in a BI system. The various approaches of user requirement analysis were presented [41] that are classified into four categories; data-driven approach, user driven approach, goal driven approach and mixed driven approach. It outlines their strengths and weaknesses within different contexts. The user driven approach gives priority to user requirements [42] and encourages high end user participation during DW design process [43].

4) Information Requirements

The information requirements of the OBI system include both operational and BI systems. Thus, all data related requirements of an organization will be studied in detail covering operational and analytical systems. The information requirements are majorly classified into the following major types which include all types of data sources to the system, data transformation included the quality and preprocessing of data to the target system requirements, data storage in a data warehouse as well level of dimensionality of data that is required and finally information delivery requirements to the end user.

a) Data Sources

The operational systems consist of variety of data sources that acts as source of data to the OBI system. The data available from these source systems in various formats such as text files, XML files, emails, html and databases. All data sources exist within and outside the organization will be studied that including the mode of data availability (online or offline), data generation capacity of the source systems, data structure and format of data.

b) Data Extraction

The data extraction requirements ensure smooth extraction of data from several data systems that require certain administrative requirements. The requirements include type of data, time intervals for extraction, and time period for extraction of data from source systems. In addition, this includes various methods for dealing missing values, uncertainty values, exceptions in the data sources while extraction and these methods will improve the quality of the extracted data.

c) Data Transformation

The main function of data transformation is that the extracted source data will be transformed to the target of data source in terms of structure and format. These requirements include mapping between source and target systems, merging, conversion and splitting of the data before to move data into the target system. The data transformation activity mainly depends on the granularity of the data and the level of data dimensionality. These granularity requirements will help to measure the performance of the business functioning at a grass root level.

d) Data Storage

The storage requirements include an estimate on the amount of storage required for detailed and summary data. In addition, the amount of storage space required for historical data to be stored in a data warehouse. The other storage requirements like the level of detailed data required to store the data warehouse, a few data marts required, and types of aggregations that must be kept in the data warehouse. Information captured and stored by OLTP systems [28] represent the footprints of business operation (i.e. processes and activities). OLAP requirements - according to the business needs and available data, the relevant business processes are identified for modeling. The next step is identification of the relevant fact table, which declare the grain. Then the dimensions of the fact table to be identified. Finally, all the facts are identified for each of the fact table.

e) Information Retrieval

Information retrieval is the process through which tracing and recovery of required information from stored data system and to respond to the user as per their request. The queries entered by the user in the system will be processed in the system and then generate results to the user. The generated results will be sent to the user for their decision-making which is in text, graph or report formats. These requirements include type of search option to be provided in the system to the users for accessing of information from the available data contents in the system.

f) Information Delivery

In analytical processing, the response time requirements [15] are greatly relaxed compared to those of traditional operational processing. The primary purpose of BI is to improve the quality of decisions [29] while decreasing the time it takes to make them. Thus, OBI has to respond as fast as to the needs of the business to anticipate business problems in advance in providing a better decision and planning to the uses. To achieve the purpose of the system, a low latency data system is required which can be obtained by the tight integration between operational and BI systems. The concepts of in-memory or Mem Cache techniques can be used to achieve faster analytics. Information delivery requirements include what, how and when to deliver the information to various types of users based on information access requirements. In addition, ad-hoc reporting, drill down, and drill up, slicing and dicing requirements that are need for information delivery will also be included.

5) Knowledge and Visualization Requirements

These requirements are significant for extracdtion of knowledge as well to the presentaiton layer of extracted knowledge to various users of the system. The knoweldge requirements are studied from the business context requirements of an organization with reference to the type knowledge that is to be extracted and presented. These requirements includes study of Metadata details for idetnfication, storage, processing, querying, and represetnation of varous patterns of various data elements.. The data mining primitives facilate the users to interact knowledge requirements with the help of data mining queries. These primitives include set of task relevant to knowledge data access, type of knowledge, knowledge discovery process, threshold levels for varoius pattern evaluation. The type of knowledge to be mined will be decided based on data mining functions. The extraction of knoweldge from the data is obtained with the help of suitable data mining functions that include: concept description, correlation, association, classification, clustering prediction, forecasting, optimization. The visualization requirements includes ho to present the extrcted knowedge to the user in a simple means by the use of simple tables, graphs, charts, dash boards, comparative table, decission trees, surfaces, scallter plots, link graphs, 3-D Cubes.

C. *Requirement Development Approach*

A proposed requirement development process for the OBI project is envisaged in figure 4 which consists of a project executive committee (PEC). The PEC is a group or department within the organization which consists of a team of strategic level resources in the capacity of CXOs. The PEC team will define the scope of the work of the OBI project and identify the business context requirements.

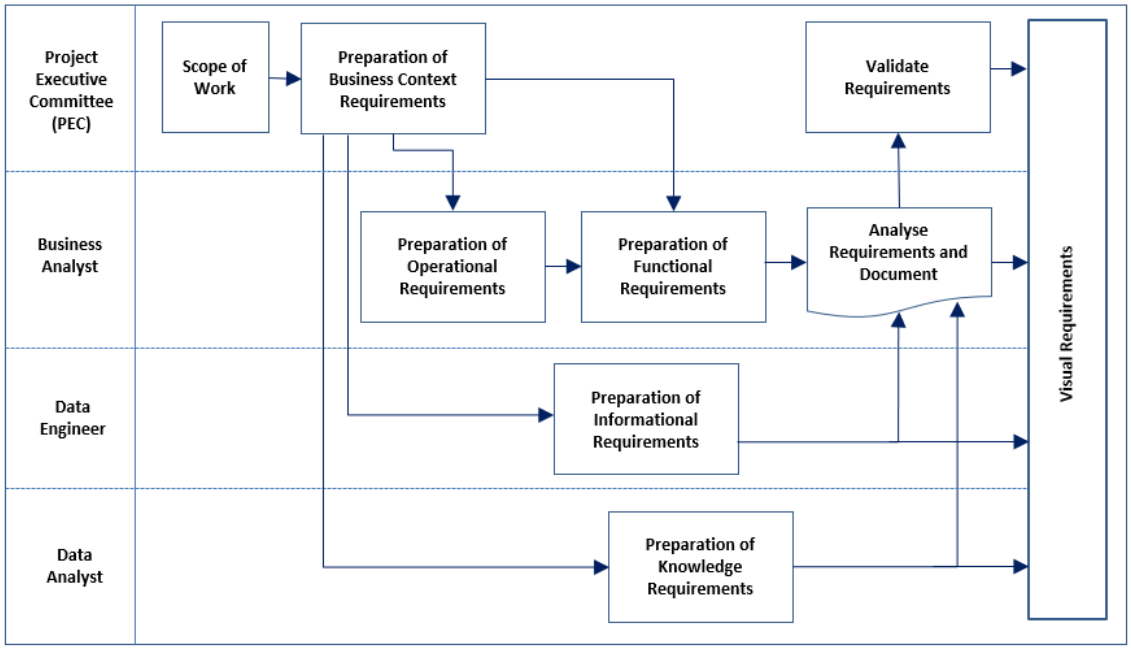

Fig. 6 Requirement development process for Operational BI

These business context requirements will act as inputs to the next level resources as a Business Analyst, Data engineer, and Analyst for the gathering of the rest of the requirements of the system. Business Analyst(s) will elucidate operational and functional categories of requirements that are analyzed and documented. Data engineer collects information requirements and maintains standards for project management within the organization. The PEC strives to standardize, coordinate with other requirement teams to establish proper a linkage between business context requirements with all other types of requirements. In addition, PEC will introduce economies of repetition in the execution and brings business value to the project.

IV. RESULTS

To quality the proposed approach, a case study is presented to implement an Operational BI for the Financial Inclusion project for a rural bank called Gramin Bank of Aryavart, Lucknow, Utter Pradesh, India. This project is aimed at to create an OBI system that provides a timely decision-making information to users such as the managers and field staff of the bank. The rural bank would like to extend banking services to the citizens in un-banked areas. The typical service offerings by the bank to the village citizens are opening of an account, cash deposit, cash withdrawal and fund transfer. The bank appoints Banking Correspondent who extends banking services to the citizens on behalf of the bank. The field staff is deployed by the in the village, who are called Agents, of the pre-allotted geographical area by the Government. Each agent carries a Point of Sale (PoS) terminal that is pre-loaded with a banking software and equipped with a SIM. The Agents are available to the villager at notified locations in the village. The citizens will approach the agent and perform banking services.

TABLE 1
BUSINESS CONTEXT REQUIREMENTS DISCOVERED IN THE ELICITATION ACTIVITY

Name	**Description**	
Type of requirement	Business context requirements	
Business Vertical	Financial Inclusion	
Business Services	• Savings account opening • Cash deposit • Cash withdrawal • Fund Transfer • Account closer • Balance check • Last 5 transactions	
Business processes	• Agent registration • Data entry of customer registration • Account opening validation - Photo Identification, Support docs verification • Account balance before amount withdrawal • Account balance checks before fund transfer • Biometric – fingerprint validation • Updations of customer fingerprint • Monitoring of various business processes and reports	
Stakeholders	• Senior management from Bank • Field manager/ Operational manager • Business correspondent • Customer and Agents	
Mapping between key stakeholders and business process	Agent	Customer account opening Account opening validation: Photo and support docs verification
	Bank	Agent registration Biometric – fingerprint validation
	PoS	Account balance before amount withdrawal Account balance check before fund transfer
	Filed Manager	Monitoring of business process and reports

For opening a bank account, the details of the citizen are to be entered in the Point of Sale terminal and then collect identification details of the citizen such as address proof and photograph. In addition, they collect fingerprints of individuals. The collected customer details are transmitted from the POS terminal through SIM and record transaction

details in the bank servers. Bank server will send an acknowledgement to the PoS terminal about the status of the transaction. Once an account is opened the customer can permit to operate cash deposit and withdrawals. The customers who would like to deposit cash from their account approach the Agent, agent enters particulars of individuals account number, and collect fingerprints for biometric identify which are validated with the bank's server. Cash withdrawal is also performed in the similar way, whereas for fund transfer the source and destination account details with the amount to be transferred.

To initiate the project, the stakeholders are the senior management of the bank, Business correspondent, a manager who monitors the application on a day to day basis, senior IT implementation staff. All these stakeholders are the part of the Project Executive Committee. In the meeting, the process of elicitation and requirement management approach is discussed. Next to this meeting, the responsibilities of each member were defined. The preparation of Business context requirements is identified as the primary responsibility of Project Executive Committee.

TABLE 2
ONE OF THE FUNCTIONAL REQUIREMENTS DISCOVERED IN THE ELICITATION ACTIVITY

Name	Evaluation of the village customers over the last two years
Description	Show the numbers of accounts opened in the last two years, allowing the application filters, high, active, moderate, low, and inoperative.
Type of requirement	Business context requirements
Additional inputs	(i) The system must allow grouping of detailing information by pre-established criteria such as Age, Material status, village, and district, and branch. (ii) The system must allow filtering of data by day, week, month, quarter and year. (iii) The filer value high, refer that the customer has operated at least five times in a month, moderate is referred as three times in a quarter, low refers at least once in every six months and inactive means those accounts are not transacted at least once in year since opening. (iv) The filter could be on product as well Agent wise also.

The manager and filed staff are interested to know about the status of financial transactions of all the customers happening in different villages on a real time basis. In addition, the manager would like number of attempts for successful validation of fingerprints, the summary of limits checking of transaction in the failure case, and the commission earned.

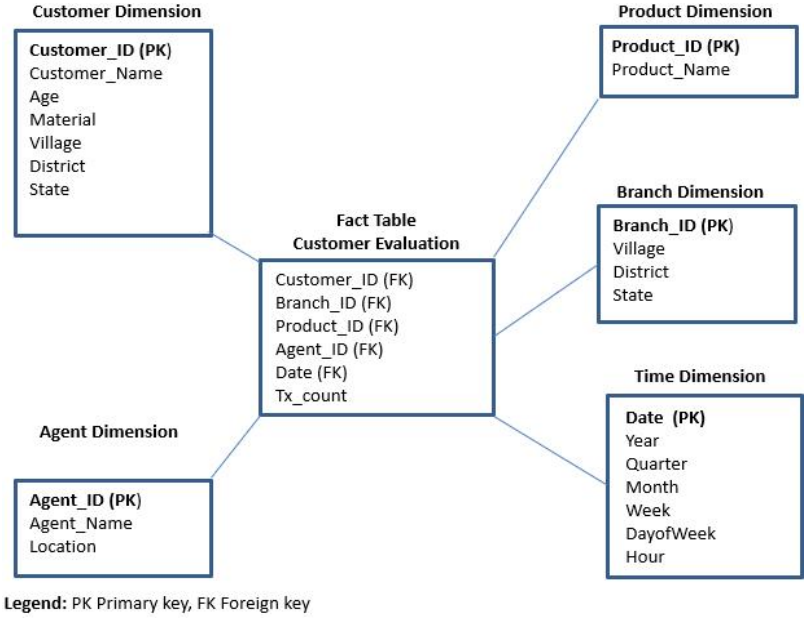

Fig. 7 Requirement development process for Operational BI

A fact table for customer evaluation with the corresponding dimension tables are given in the fig. 7. The proposed approach is highly suited to the organizations in the modern business environment that overcomes several limitations in the existing DW and BI requirement elicitation approaches.

V. DISCUSSION

A process for requirement elicitation for an Operational BI system is presented which is different from the available requirements approaches of data warehouse and BI systems. Most commonly, the BI projects are strategically driven and the success of the BI projects depends on the understanding on the business functioning. The requirements of the Operational BI system has driven a top down approach as this focuses on the objective or goals of the organization. This requirements approach focuses on the business context of an organizaion which highly suits to the modern business environment.

The elicitation of requirements approach is focused on the business content of an organization which is pivotal of the system. Once, the Operational BI business context requirements are identified, elaborated, analyzed and validated. The proposed approach employs a top down technique for collection of all five categories of the requirements. The collection of requirements begins with the understanding of business context requirements of an organization which are further breakdown into various levels that include details of the business verticals, core business services, business process and events which is a crux to function for any type of organization in the modern business environment. In addition, operational, functional, and information, knowledge and visualization requirements of the system are studied in detail that are aggregated from the business context requirements. All these categories of requirements abstractions are independent of each other and a proper linkage between inter and intra category of requirement abstractions are established. All these requirements are level wise, hence several actors can study the requirements simultaneously. In addition, these requirements are grouped in such a way into various categories which supports to design a multi level decision support system as opposed to the single decision BI system.

For organization has more than one business vertical, then all corresponding business services and associated processed will be studied separately. This facilitates to create multiple business context diagrams. Thus, the proposed approach sports for any number of business verticals. without the domains of the business. A detailed understanding of operational sources and related metrics of an organization is studied in operational requirements which helps to design a better operational decision system.

Nowadays, business operates on the network and the proposed model covers business networks and business related requirements. The operations of various business units of an organization will be studied under business networks and protocols that facilitates the proposed model for network business organizations for providing on time, accurate decision making for all the levels of users across the organization. Business become network businesses in these days. Thus, the proposed model suits for network business organizations as compared to current BI requirement methodologies. Finally, the knowledge requirements cover the type of mining approaches to be applied for extraction of knowledge and as well as meta-data requirements. The visualization requirements provide the basic needs of the presentation layer that includes details such as dashboards, graphs, data visualization and analytics to the users in provding a better understanding on working of the system.

The proposed requirements elicitation approach is highly suitable for a generic business organization with a focus on operational aspects of the business. The limitations of the proposed approach is for a highly domain specific business organization. The proposed requirement approach can be useful for BI consultants, practitioners, data engineers and analysts for development of the full cycle of requirements for an Operational BI system.

VI. CONCLUSIONS

In this paper, a new approach for requirement elicitation for an OBI system is presented. The proposed approach focused on a top down technique for collection of requirements that supports backward looking of gathering requirements.This approach emphasized on the business context which refer to business core services and business process of an organization. The requirements of an OBI system are classified into five different categories such as business context, operational, functional, information, and knowledge and visualization. A proper linkage between the various categories of requirements are presented. A process for requirement development for an OBI is presented and explained. A clear advantage of the proposed requirement elicitation process is that it empowers requirement team to focus on the business context for network business organizations. The advantages of the proposed approach over available DW and BI requirement methodologies are envisaged as follows: a clear classification of various categories of requirements, well defined linkage within the category as well from with another category of requirements. Thus, it is less likely to miss any requirements that would be otherwise lost during a gathering of multiple stakeholders and provides simultaneous access of requirements of various individuals. Redundent requirments are easly to idetnfiy and

support for validation of the requirments. It is to conclude that the proposed approach acts like one pot synthesis of requirements elicitation for OBI system. The proposed requirements elicitaion approach for Operational BI can be used as a guideline for BI practitioners, consultants and analysts for projectd implentation. Further, this work can be extended to other case studies of different business verticals having different organizational size.

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