ABSTRACT

The present invention describes a method and system for software analytics using business intelligence. The method includes receiving application parameters from a user for an application. The method also includes receiving, data related to the application based on the received application parameters. The method further includes designing an orthogonal dimension model for the application based on the received application parameters; and modeling the received data into the designed orthogonal dimensional model.

REF FIG: 1

CLAIMS

What is claimed is:

1. One or more computer readable storage devices comprising computer-executable instructions causing a computer to perform a method for software analytics using business intelligence comprising:

   receiving, an application parameter from a user for atleast one application;

   receiving, data related to the application based on the received application parameters;

   designing, an orthogonal dimension model for the application based on the received application parameters; and

   modeling, the received data into the designed orthogonal dimensional model.

2. The method as claimed in claim 1, wherein, the application parameters comprises identifying atleast one application from a plurality of applications for which decision support is required.

3. The method as claimed in claim 1, wherein, the application parameters further comprises identifying potential questions for the identified applications.

4. The method as claimed in claim 1, wherein, the data related to the application comprises any one or combination of version history, bug history, email archives, source code, deployment logs, root cause reports, impact analysis reports and code review reports of the application.

5. The method as claimed in claim 1, wherein, designing the orthogonal dimension model comprises:

   identifying, atleast one business process wherein the identification includes gathering business requirements;

   identifying, atleast one grain from the identified business processes;

   identifying, atleast one dimension from the identified grains;

identifying, atleast one fact from the identified dimensions and
instructing, to initiate the modeling of the orthogonal dimensional model.

6. The method as claimed in claim 5, wherein the grain is business definition of measurement event that creates a fact.

7. The method as claimed in claim 5, wherein the dimension is a group of hierarchies that defines the context for facts.

8. The method as claimed in claim 5, wherein the fact is a measure when the dimensions are true.

9. The method as claimed in claim 1, wherein, the modeling comprises displaying the orthogonal dimensional model to the user.

10. The method as claimed in claim 1 further comprises providing an interactive user interface for displaying the information, prompting data entry by users and receiving the information associated with the method.

11. A computer system for software analytics using business intelligence comprising:
a processor; and
memory storing computer-executable instructions causing the computer system to:
receiving, an application parameter from a user for atleast one application;
receiving, data related to the application based on the received application parameters;
designing, an orthogonal dimension model for the applications based on the received application parameters; and
modeling, the received data into the designed orthogonal dimensional model.

12. The system as claimed in claim 11, wherein, the data related to the application is received from one or more than one version control systems.

13. The system as claimed in claim 11, wherein, the modeling comprises displaying the orthogonal dimensional model to the user.

14. The system as claimed in claim 11 further comprises providing an interactive user interface for displaying the information, prompting data entry by users and receiving the information associated with the system.

Dated this 12th day of December, 2013

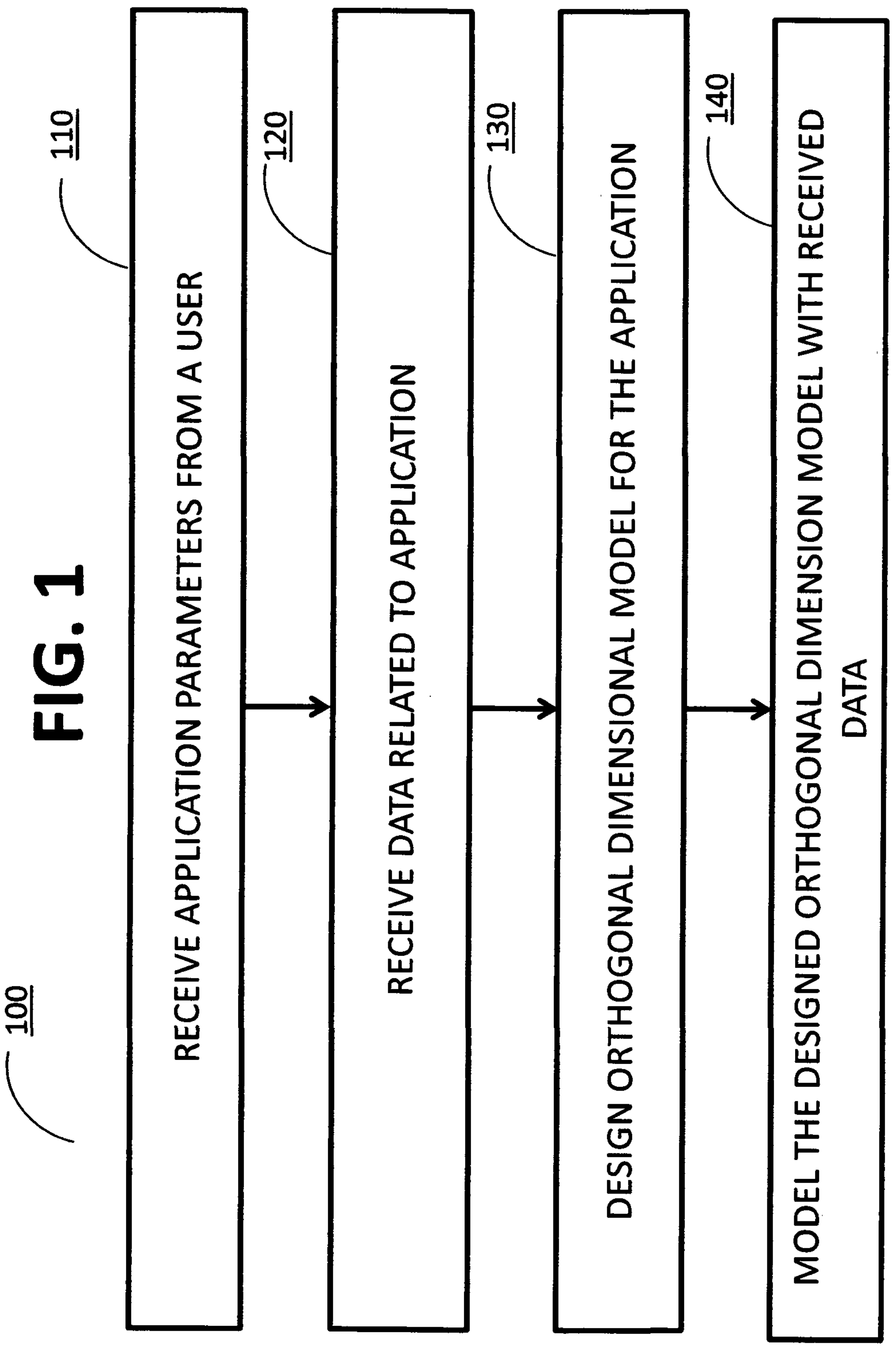
[illegible]

Ajay Kumar Sarkar
Infosys Limited
Patent Agent No 1652

17 DEC 2013

ORIGINAL

FIG. 1


100
110
RECEIVE APPLICATION PARAMETERS FROM A USER
120
RECEIVE DATA RELATED TO APPLICATION
130
DESIGN ORTHOGONAL DIMENSIONAL MODEL FOR THE APPLICATION
140
MODEL THE DESIGNED ORTHOGONAL DIMENSION MODEL WITH RECEIVED DATA

5875/CHE/2013

[illegible]

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

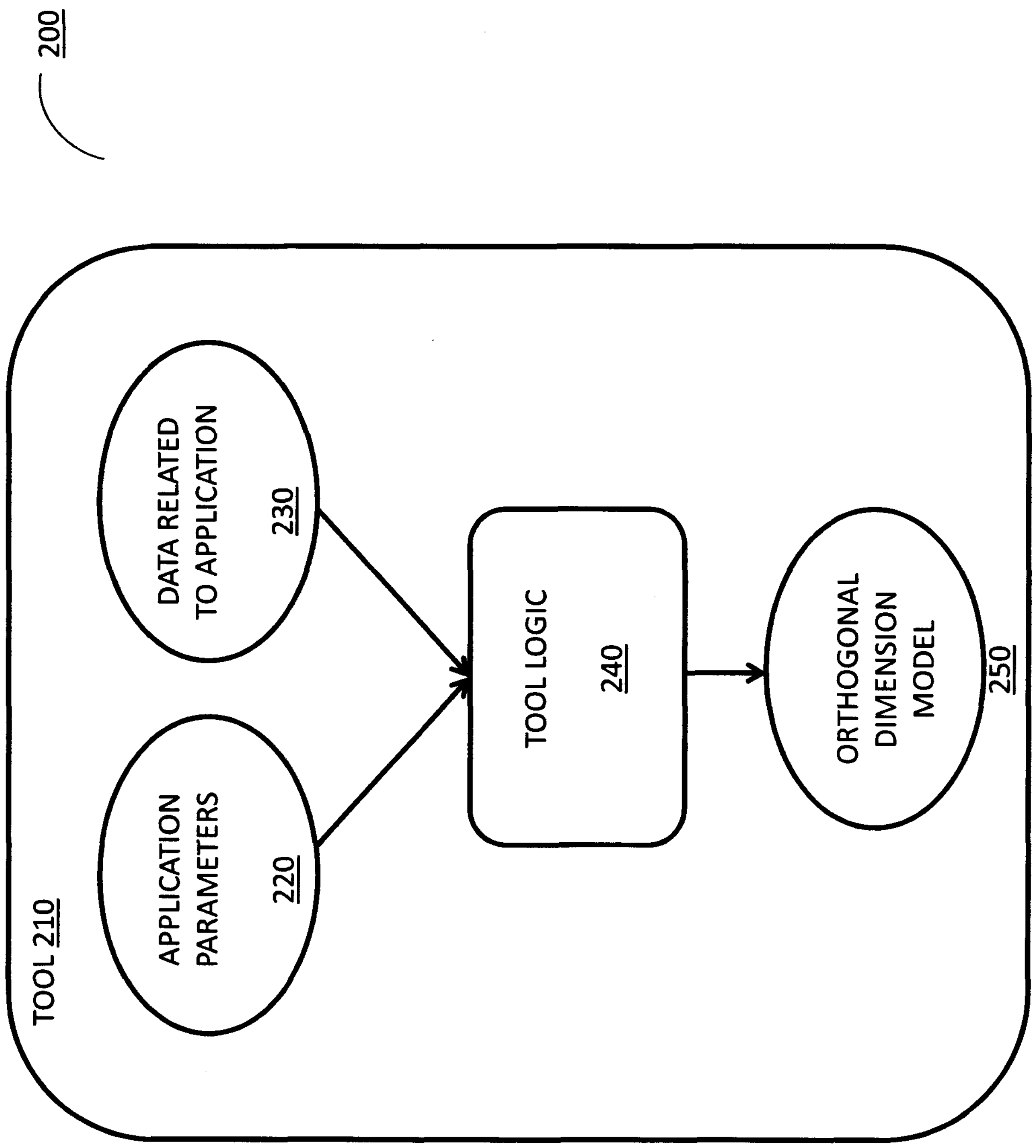

200
TOOL 210
APPLICATION PARAMETERS 220
DATA RELATED TO APPLICATION 230
TOOL LOGIC 240
ORTHOGONAL DIMENSION MODEL 250

FIG. 2

[illegible]

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

FIG. 3

300

Application Parameter(s) 310	**Question(s) 320**
Anomaly Detection	Which areas of the project are buggy? Which authors are responsible? . .
Bug triaging	How long will it take to resolve the bug? What should be the severity of the bug? Whom to assign the bug? . .
Expertise detection	Which authors are more experienced in the project? Which authors have more domain knowledge? Which authors are good at bug fixing? . .
Test case prioritization	Which test cases to test more? . .
Efficient re-factoring	Which code to re-factor? . .
Release readiness	Is my software ready for a release? . .
Judging stability	Which project artifacts are not stable? Which project artifacts are complex? . .
Impact analysis	Which artifacts to change when a artifact is changed? . .
Software Readability	Which project areas need refinement in readability? Which Authors contribute more to better readability? . .

[illegible]

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

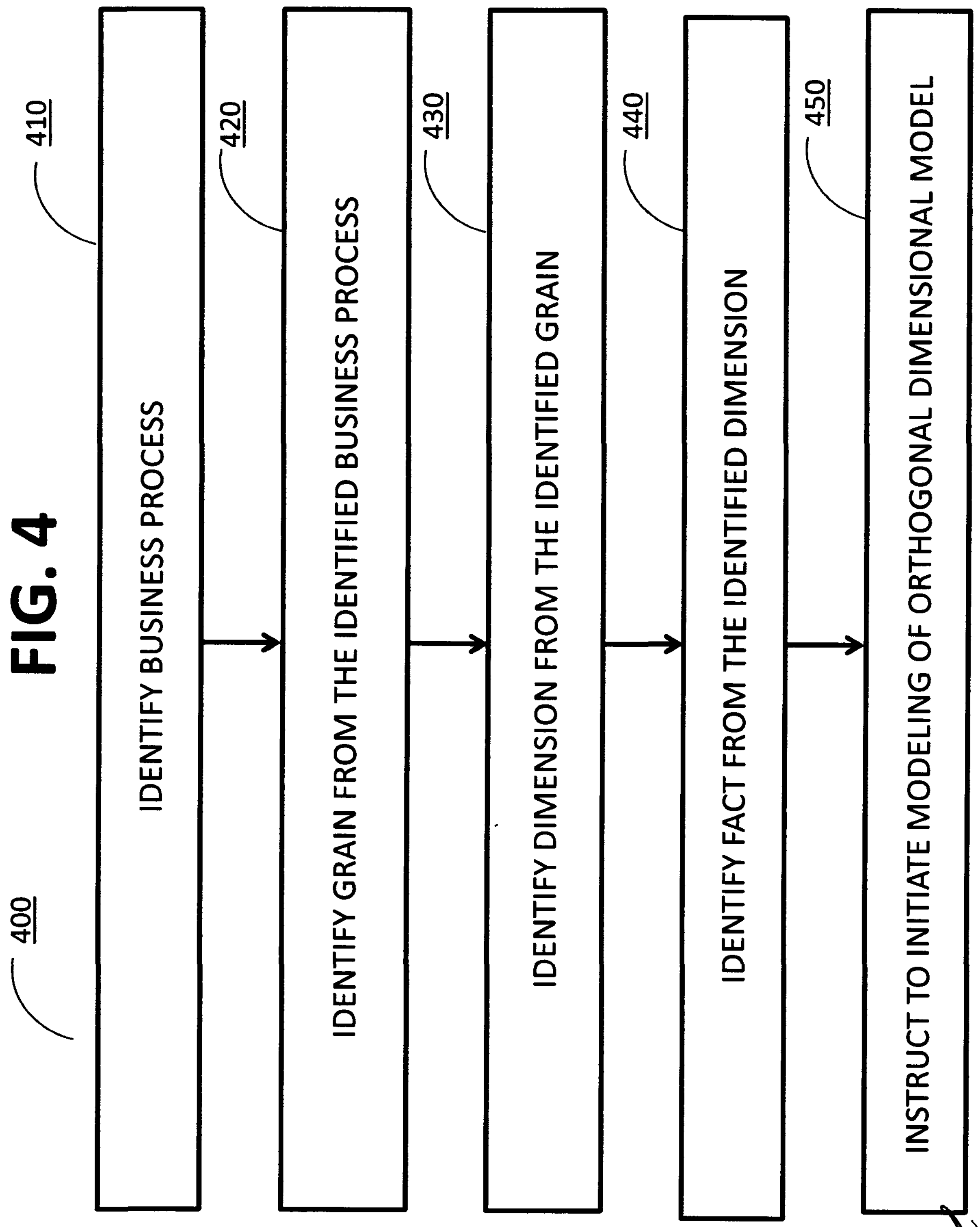
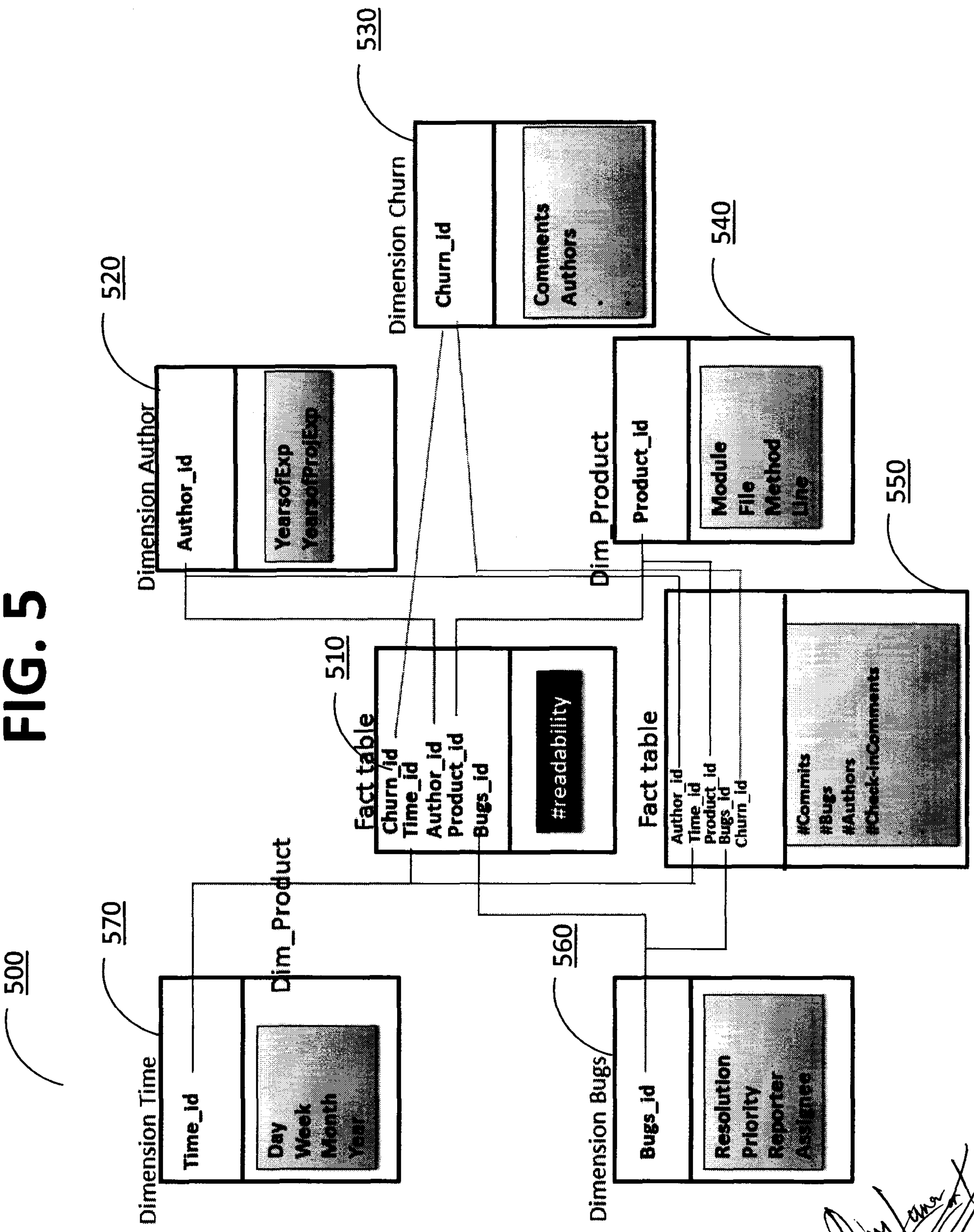

400
410
IDENTIFY BUSINESS PROCESS
420
IDENTIFY GRAIN FROM THE IDENTIFIED BUSINESS PROCESS
430
IDENTIFY DIMENSION FROM THE IDENTIFIED GRAIN
440
IDENTIFY FACT FROM THE IDENTIFIED DIMENSION
450
INSTRUCT TO INITIATE MODELING OF ORTHOGONAL DIMENSIONAL MODEL

FIG. 4

[illegible]

Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

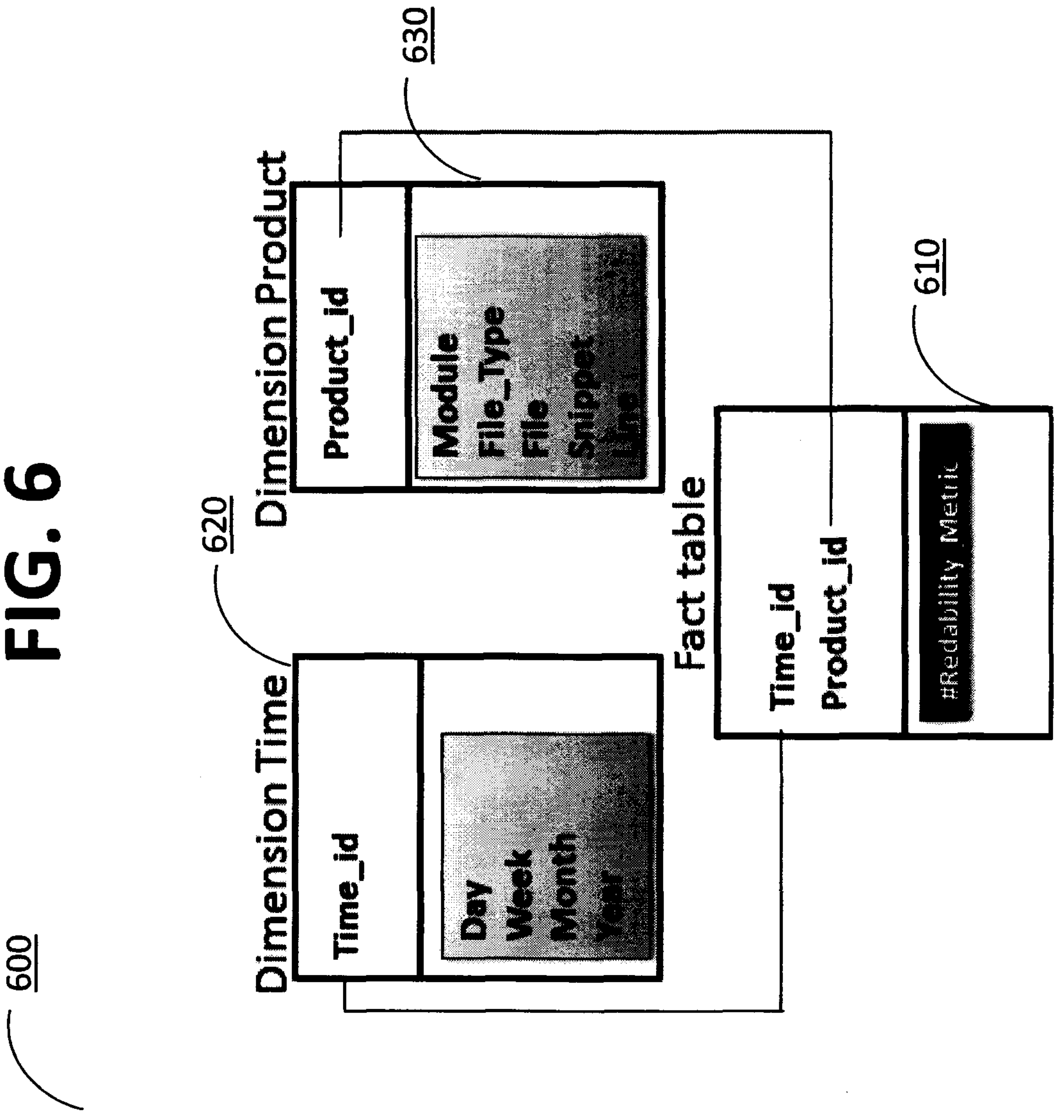
FIG. 5



[illegible]

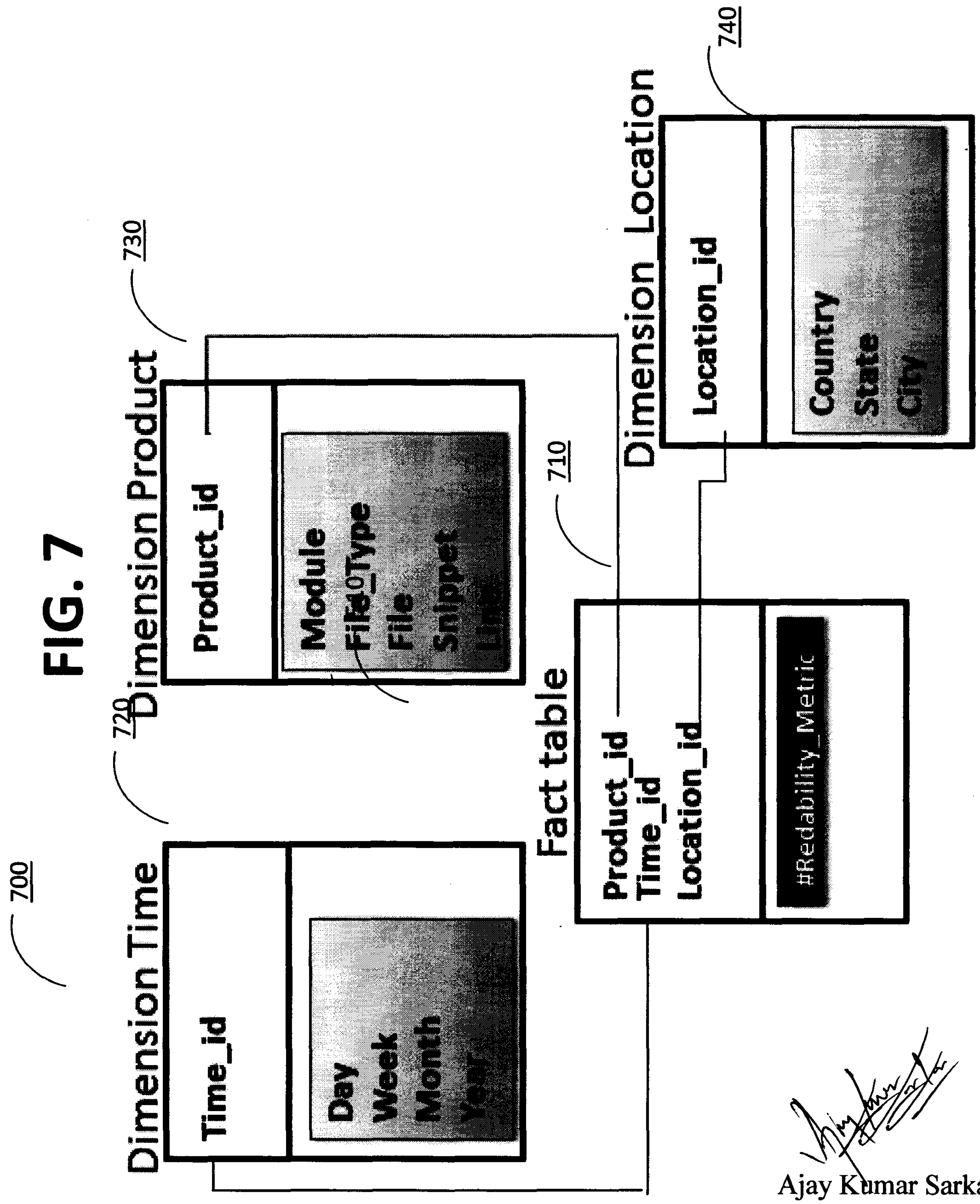
Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

FIG. 6



[illegible]
Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

FIG. 7



[illegible]
Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

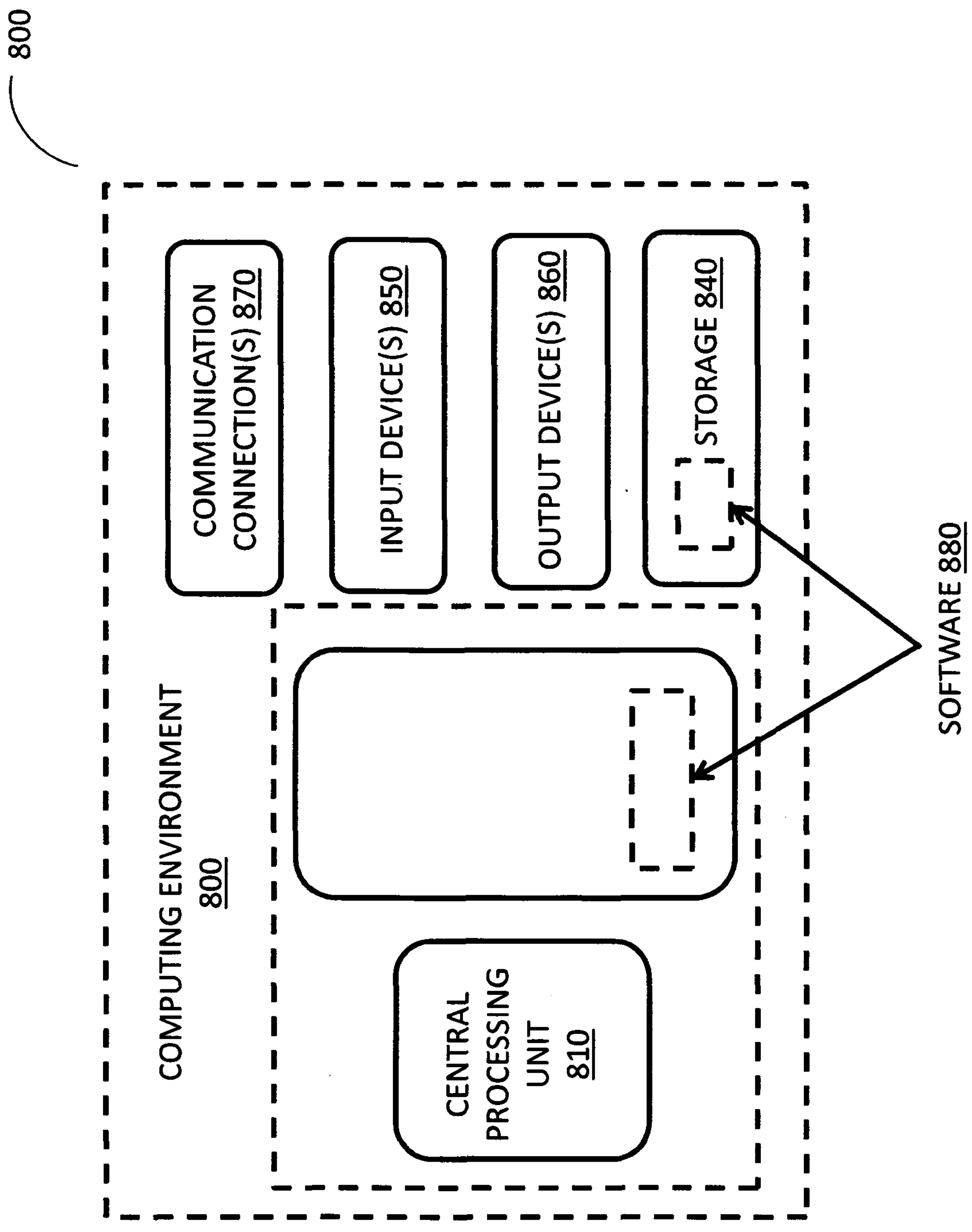

800
COMPUTING ENVIRONMENT 800
CENTRAL PROCESSING UNIT 810
COMMUNICATION CONNECTION(S) 870
INPUT DEVICE(S) 850
OUTPUT DEVICE(S) 860
STORAGE 840
SOFTWARE 880

FIG. 8

[illegible]
Ajay Kumar Sarkar
Infosys Limited
Agent No. : 1652

METHOD AND SYSTEM FOR SOFTWARE ANALYTICS USING BUSINESS INTELLIGENCE

BACKGROUND

[1] The invention generally relates to software analytics, and more particularly, to a method and system for software analytics using business intelligence.

[2] Generally, software analytics is applying analytics on software which lead to actionable changes to a project. While 'mining software repositories' (MSR) based bug prediction, bug localization, expertise location etc., come under the purview of software analytics, the scope of software analytics is much broader. There are some of the questions managers and developers have to grapple with routinely during software maintenance- "Why did this release have more bugs? Which files do I have to test more? Which open bugs are difficult to fix?" The answers to these questions impact a number of decisions related to tasks such as quality assurance, task allocation, project planning and so on, and thus has a bearing on the project success. Unfortunately, even though some of these decisions are critical and affects the quality of software, they are largely based on experience and gut feeling.

[3] Researchers have realized this problem and have been investigating tools and techniques to mine the huge data generated by software projects to aid software maintenance. However, the focus of these researches largely target specific problems, such as bug prediction, expertise location, bug triaging, bug localization and so on and not on providing decision support in general. In addition, there exists prior work on helping the developers to prevent bugs such as bug prediction. These techniques analyze the historical information in version control systems and issue tracking systems and predict which module or files could be buggy. A majority of the techniques are based on supervised machine learning and the output of the technique is a Boolean function as to whether a given file (or module) could be buggy or not. Few other techniques are based on various formulas involving features such as code churn, complexity and past bugs and yield a probability value (ranging between 0 and 1) that a given file is buggy. In the current state of the art the prediction is not very reliable. Also, existing techniques do not provide the

manager or maintainer any insights as to why a given file or module is buggy and what action could be taken by the maintainer. Also managers generally need to take various decisions during maintenance. Existing bug prediction techniques do not provide any such knowledge or decision support to the managers or maintainers.

[4] Although approaches have been taken to address difficulties mentioned above, there is a need for providing decision support to the managers and make better decisions by drilling down and rolling up and getting better insights from the data. Hence, there is a need of a method and system for software analytics using business intelligence to address the aforementioned issues.

SUMMARY OF THE INVENTION

[5] An object of the invention is to provide a method and system for software analytics using business intelligence. A variety of techniques can be used for applying business intelligence to software analytics.

[6] Another object of the invention is to use the data related to applications to provide rigorous drill down and roll up operations decision support for the user. This is achieved by the invention by identifying the various data needs of users, extracting the data from application history, and modeling that data into various orthogonal dimensions to enable user to take informed decisions. This allows a user to efficiently manage the task of application development and maintenance.

[7] As described herein, a variety of other features and advantages can be into the technologies as desired.

[8] The foregoing and other features and advantages will become more apparent to one skilled in the art from the following detailed description of disclosed embodiments, which proceeds with reference to the accompanying drawings.

[9] To achieve the objectives mentioned above, a method for software analytics using business intelligence is provided. The method includes receiving application parameters for atleast one application from a user. The method also includes receiving data related to application based on the received application parameters. The method further includes designing orthogonal dimension model for the application based on the received

application parameters. The method also includes modeling the received data into the designed orthogonal dimensional model.

[10] In another embodiment, a computer system for software analytics using business intelligence is provided. The computer system includes a processor for processing data and carrying out operations of the system. The computer system also includes memory storing computer-executable instructions causing the computer system for receiving application parameters for atleast one application from a user; receiving data related to application based on received application parameters, designing orthogonal dimension model for the application based on the received application parameters and modeling the received data into the designed orthogonal dimensional model.

BRIEF DESCRIPTION OF DRAWINGS

[11] The accompanying drawings, which constitute a part of this disclosure, illustrate various embodiments and aspects of present invention and together with the description, explain the principle of the invention.

[12] FIG. 1 is a flowchart representing steps involved in an exemplary method for software analytics using business intelligence described herein.

[13] FIG.2 is a diagrammatic representation of an exemplary system for software analytics using business intelligence described herein.

[14] FIG. 3 is an exemplary list mentioning possible application parameters and potential questions for application parameters described herein.

[15] FIG. 3 is an exemplary list mentioning possible application parameters and potential questions for application parameters described herein.

[16] FIG. 4 is a flowchart representing steps involved in an exemplary method of designing orthogonal dimensional model described herein.

[17] FIG. 5 is a diagrammatic representation of an exemplary dimensional model for software readability described herein.

[18] FIG. 6 is a diagrammatic representation of an exemplary dimensional model for software readability with two dimensions described herein.

[19] FIG. 7 is a diagrammatic representation of an exemplary dimensional model for software readability with three dimensions described herein.

[20] FIG. 8 is a block diagram of an exemplary computing environment suitable for implementing any of the technologies described herein.

DETAILED DESCRIPTION

Example 1

Exemplary Overview

[21] Embodiments of the present invention include a method for software analytics using business intelligence. The method includes receiving application parameters for at least one application from a user. The method also includes receiving data related to application based on received application parameters. The method further includes designing orthogonal dimension model for the application based on the received application parameters. The method also includes modeling the received data into the designed orthogonal dimensional model.

Example 2

Exemplary Method of Software Analytics using Business Intelligence

[22] FIG.1 is a flowchart of an exemplary method *100* of implementing the software analytics using business intelligence described herein and can be implemented for example in a system such a s shown in Fig.2. The technologies described herein can be generic to the specifics of operating systems or hardware and can be applied in any variety of environments to take advantage of the described features.

[23] At *110*, application parameters for atleast one application are received from a user. Such application parameters can include identifying atleast one application for which decision support is required. Also these application parameters can include identifying potential questions for the identified application.

[24] At *120*, data related to the application is received from the operational databases based on the received application parameters. This is a process of extracting data from the databases, transforming them to maintain data consistency and loading into warehouse or data marts for further uses. The data related to application can be any one or a

combination of version history, bug history, email archives source code, deployment logs, root cause reports, impact analysis reports and code review reports of the application. The data related to application is not limited and can include various others based on the requirements and the inputted application parameters.

[25] At *130*, an orthogonal dimensional model is designed for the application based on the received application parameters. Deigning the orthogonal dimensional model is the most crucial task in building business intelligence. It is defined as a methodology for logically modeling data to maximize analytical query processing and ease of use.

[26] At *140*, the data which was received at *120* is modeled into the orthogonal dimensional model which was designed at *130*. This orthogonal dimensional model can be but not limited to a multidimensional cube. The cube consists of the aggregated fact information in each level of each dimension. The orthogonal dimensional model is then published for visualization to the user. This visualization can be either reports or dashboards based on the user requirements.

[27] The method *100* and any of the methods described herein can be performed by computer-executable instructions stored in one or more computer-readable media (storage or other tangible media) or stored in one or more compute readable storage devices.

Example 3

Exemplary System for Software Analytics using Business Intelligence

[28] FIG.2 is a block diagram of an exemplary system *200* implementing the software analytics using business intelligence described herein. In the example, one or more computers in a computing environment implement tool *210* that accepts as input application parameters *220* and data related to applications *230*. The system *210* includes tool logic *240*, which processes application parameters *220* and data *230* to design and model an orthogonal dimensional model *250*. The orthogonal dimensional model is then published for visualization to the user by means of display. This visualization can be either reports or dashboards based on the user requirements.

[29] In practice, the systems shown herein, such as system *200* can be more complicated, with additional functionality, more complex inputs, and the like.

[30] In any of the examples herein, the inputs, outputs and orthogonal dimensional model *250* can be stored in one or more computer- readable storage media.

Example 4

Exemplary Applications

[31] In any of the examples herein, an application can be any computer software that causes a computer to perform useful tasks beyond the running of computer itself. The application is sometimes called as a software application, program or app. Examples of application include and not limited to accounting software, enterprise software, graphics software, media player etc. The application can be any software capable of being developed or maintained in enterprise.

Example 5

Exemplary Applications Parameters and Potential Questions

[32] In any of the examples herein, FIG.3 provides an exemplary list *300* mentioning possible application parameters *310* and potential questions *320* for application parameters *310* that a manager may need for decision making. The first and foremost step in software analytics using business intelligence is to identify and understand the requirements of software development and maintenance. Understanding requirements essentially means identifying application parameters and potential questions in software development and maintenance where decision support is required.

[33] For example, Expertise detection is one of the applications parameter in software life cycle which involves certain decisions such as 'Which developer should be to assigned a task' etc. To take informed decisions, managers seek answers for certain questions for each of the applications to guide them to take smart decisions.

Example 6

Exemplary Method of Designing Orthogonal Dimensional Model

[34] FIG.4 is a flowchart of an exemplary method *400* of designing orthogonal dimension model. Designing an orthogonal dimensional model is defined as a methodology for logically modeling data to maximize analytical query processing and ease of use. The process of designing an orthogonal dimensional model is basically a multistep process.

[35] At *410*, a business process is identified wherein the identification of the business process includes gathering business requirements. Apart from identifying the business requirements, data availability and data quality issues are investigated at this step.

[36] At *420*, a grain is identified from the identified business processes. This forms the crux of the dimensional model. A gain is defined as business definition of the measurement event that creates a fact.

[37] At *430*, a dimension is identified from the identified grains. The dimension is a group of hierarchies that defines the context for facts.

[38] At *440*, atleast one fact is identified from the identified dimensions. The fact is a measure when the dimensions are true.

[39] At *450*, modeling is initiated once all identification is complete.

[40] For example, for business data with dimensions as item, location and time the grain is 'items sold in a location for a day'. Similarly if application data is considered with dimensions product, author, time a grain can be number of products changed by an author in a day. Once grain is defined identifying dimensions and facts is fairly simple. 'For the grain items sold in a location for a day', dimensions are items, location, time and fact is #items sold, similarly for the grain 'number of artifacts changed by an author in a day' the dimensions are artifacts, author, time apart from identifying the dimensions a hierarchy must be defined for each of the dimension. For artifacts the hierarchy can be modules, files, methods etc., for authors the attributes are years of experience, years of experience is project etc., such attributes form a two level attribute hierarchy. Fact is a measure or the value when the dimensions are true. For the above grain, fact is #artifacts.

[41] Following the identified granules a star schema is designed which is the simplest representation of a dimensional model. From the grain definitions, various dimensions and their hierarchies are identified. All dimensions are then classified for application into two groups i.e. application specific dimensions and generic dimensions. Application specific dimensions are dimensions which are specific to an application for e.g. Product, Authors, Churn, and Bugs etc. Whereas generic dimensions are generic in nature for e.g. Location, Time etc. Facts typically form the metrics for the various application parameters and aggregated information such as #authors, #files, #changes, #loc, #bugs etc. for software analytics.

[42] The dimensional models are easily extensible and can accommodate unexpected new data.

Example 7

Exemplary Dimensional Model for Software Readability

[43] FIG.5 is the diagrammatic representation of dimensional model for software readability *500* and can be implemented, for example, in a system such as shown in FIG.2.

[44] In the example, the shown model *500* has two fact tables, the first fact table *510* measures readability using an exemplary metric. The second fact table *550* has the aggregated information such as #Commits, #Bugs, #Authors, #Check-in comments etc. The grain for this dimension model is 'readability of a snippet for bug fixing by an author in a day' and the dimensions are Product, Bugs, Author, and Time. Here, the second fact table *520* consists of aggregated data such as #Commits, #Bugs, #Authors etc. The grain for this fact table is 'Commits made for a snippet by an author for bug fixing in a day'. It uses aggregated information of first fact table in the dimensional model as both are at the same level of granularity. The various dimensions are represented in model *500* are Author *520*, Churn *530*, Product *540*, Bugs *560* and Time *570*. The dimension such as product *540* and time *570* has user defined hierarchy whereas Bugs *560*, Churn *530*, Author *520* dimensions has attribute hierarchy.

Example 8

Exemplary Dimensional Model for Software Readability with Two Dimensions

[45] FIG.6 is the diagrammatic representation of dimensional model for software readability with two dimensions *600* and can be implemented, for example, in a system such as shown in FIG.2.

[46] In the example, the shown model *600* represents a dimensional model with software readability as a fact table *610* and time *620* and product *630* as dimensions with hierarchy.

Example 9

Exemplary Dimensional Model for Software Readability with Three Dimensions

[47] FIG.7 is the diagrammatic representation of dimensional model for software readability with three dimensions *700* and can be implemented, for example, in a system such as shown in FIG.2.

[48] In the example, the shown model *700* represents a dimensional model with software readability as a fact table *710*. The dimensions in the hierarchy are represented and time *720*, product *730* and location *740*.

Example 10

Exemplary General Process

[49] The general process for software analytics using business intelligence is the use of application information for providing decision support to users. The users can be various developers or managers working involved in the task of application development and or maintenance.

[50] The process can identify various information needs of user required in application development and or maintenance. The process involves receiving of application related information from sources and modeling that information into various orthogonal dimensions by generating an orthogonal dimensional model to enable the developers or managers to take informed decisions.

[51] The system can allow dropdown choices to be able to select, and based on the selection, provide required information in form of orthogonal dimension model.

Example 11

Exemplary Computing Environment

[52] The techniques and solutions described herein can be performed by software, hardware, or both of a computing environment, such as one or more computing devices. For example, computing devices include server computers, desktop computers, laptop computers, notebook computers, handheld devices, netbooks, tablet devices, mobile devices, PDAs, and other types of computing devices.

[53] FIG.8 illustrates a generalized example of a suitable computing environment 800 in which the described technologies can be implemented. The computing environment 800 is not intended to suggest any limitation as to scope of use or functionality, as the technologies may be implemented in diverse general-purpose or special-purpose

computing environments. For example, the disclosed technology may be implemented using a computing device comprising a processing unit, memory, and storage storing computer-executable instructions implementing the enterprise computing platform technologies described herein. The disclosed technology may also be implemented with other computer system configurations, including hand held devices, multiprocessor systems, microprocessor-based or programmable consumer electronics, network PCs, minicomputers, mainframe computers, a collection of client/server systems, and the like. The disclosed technology may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices

[54] With reference to FIG. 8, the computing environment *800* includes at least one processing unit *810* coupled to memory *820.* In FIG. 8, this basic configuration *830* is included within a dashed line. The processing unit 810 executes computer-executable instructions and may be a real or a virtual processor. In a multi-processing system, multiple processing units execute computer-executable instructions to increase processing power. The memory *820* may be volatile memory (e.g., registers, cache, RAM), non-volatile memory (e.g., ROM, EEPROM, flash memory, etc.), or some combination of the two. The memory *820* can store software *880* implementing any of the technologies described herein.

[55] A computing environment may have additional features. For example, the computing environment *800* includes storage *840*, one or more input devices *850*, one or more output devices *860*, and one or more communication connections *870.* An interconnection mechanism (not shown) such as a bus, controller, or network interconnects the components of the computing environment *800.* Typically, operating system software (not shown) provides an operating environment for other software executing in the computing environment *800*, and coordinates activities of the components of the computing environment *800.*

[56] The storage *840* may be removable or non-removable, and includes magnetic disks, magnetic tapes or cassettes, CD-ROMs, CD-RWs, DVDs, or any other computer-readable media which can be used to store information and which can be accessed within

the computing environment *800*. The storage *840* can store software *880* containing instructions for any of the technologies described herein.

[57] The input device(s) *850* may be a touch input device such as a keyboard, mouse, pen, or trackball, a voice input device, a scanning device, or another device that provides input to the computing environment *800*. For audio, the input device(s) *850* may be a sound card or similar device that accepts audio input in analog or digital form, or a CD-ROM reader that provides audio samples to the computing environment. The output device(s) *860* may be a display, printer, speaker, CD-writer, or another device that provides output from the computing environment *800*.

[58] The communication connection(s) *870* enable communication over a communication mechanism to another computing entity. The communication mechanism conveys information such as computer-executable instructions, audio/video or other information, or other data. By way of example, and not limitation, communication mechanisms include wired or wireless techniques implemented with an electrical, optical, RF, infrared, acoustic, or other carrier.

[59] The techniques herein can be described in the general context of computer-executable instructions, such as those included in program modules, being executed in a computing environment on a target real or virtual processor. Generally, program modules include routines, programs, libraries, objects, classes, components, data structures, etc., that perform particular tasks or implement particular abstract data types. The functionality of the program modules may be combined or split between program modules as desired in various embodiments. Computer-executable instructions for program modules may be executed within a local or distributed computing environment.

Storing in Computer-Readable Media

[60] Any of the storing actions described herein can be implemented by storing in one or more computer-readable media (e.g., computer-readable storage media or other tangible media).

[61] Any of the things described as stored can be stored in one or more computer-readable media (e.g., computer-readable storage media or other tangible media).

Methods in Computer-Readable Media

[62] Any of the methods described herein can be implemented by computer-executable instructions in (e.g., encoded on) one or more computer-readable media (e.g., computer-readable storage media or other tangible media). Such instructions can cause a computer to perform the method. The technologies described herein can be implemented in a variety of programming languages.

Methods in Computer-Readable Storage Devices

[63] Any of the methods described herein can be implemented by computer-executable instructions stored in one or more computer-readable storage devices (e.g., memory, magnetic storage, optical storage, or the like). Such instructions can cause a computer to perform the method.

ALTERNATIVES

[64] The technologies from any example can be combined with the technologies described in any one or more of the other examples. In view of the many possible embodiments to which the principles of the disclosed technology may be applied, it should be recognized that the illustrated embodiments are examples of the disclosed technology and should not be taken as a limitation on the scope of the disclosed technology. Rather, the scope of the disclosed technology includes what is covered by the following claims. We therefore claim as our invention all that comes within the scope and spirit of the claims.