INFORMATION AND COMMUNICATIONS TECHNOLOGIES

THE DEVELOPMENT OF A MODEL FOR THE CONSOLIDATION OF INFORMATION IN SMALL AND MEDIUM-SIZED ENTERPRISE (SME) CLUSTERS

Prof. Emil Denchev[1]

Abstract: The aim of this study is to improve the level of information support of a cluster by developing a model of an ERP system that consolidates information at the cluster level. The research tasks are: - a survey of the clusters, members of the Association of Business Clusters (ABC) in Bulgaria, analysis of the results of the survey and drawing of conclusions for the identified information support problems, analysis of the alternative solutions of the information problems, development of a conceptual model of an ERP system, development of a universal software model and software module for generating consolidated information. The model is approbated using the MS Dynamics Navision ERP system. The proposed solutions allow consolidation of cluster-level information, either horizontal or vertical, for the needs of cluster management.

Keywords: conceptual model, software module, ERP system, SQL queries.
JEL: C680 Computable General Equilibrium Models.

[1] D.Sc.(Econ), Department "Information Technologies and Communications", University of National and World Economy

Introduction

The ERP (Enterprise Resource Planning) systems allow for multiple business processing that enables a small and medium enterprise (SME) cluster to exploit the capabilities of the system. Following a survey of the clusters - members of the Association of Business Clusters (ABC) in Bulgaria[2], it was found that there is a problem with the aggregation of the information of the individual companies in the cluster, which problem is not resolved with the means of the basic functionality of the ERP systems (Isystems, 2017; Gartner, 2016; Kapp, Latham & Ford-Latham, 2016).

To consolidate the information at a cluster level, it is necessary to develop a model for an ERP system, that includes as alternative solutions modern technology solutions with ETL (Extract, Transform, and Load) tools, including BI (Business Intelligence) platforms (Tableau, QlikView, etc.) and technologies from the Big Data group. Since the BI platforms and the Big Data group technologies are expensive solutions of complex ICT architecture, they are mostly employed by big (joint-venture) firms. A better solution for the SME clusters in Bulgaria is to use SQL queries from the group of the Incumbent Batch ETL Tools, since they are free, do not require additional training, the ERP system provides for interface for their formulation and they can be scheduled for automatic execution and executed as stored procedures.

The purpose of the proposed model is to develop such ERP systems that would allow the consolidation of the data for the individual companies from the cluster and the use of this consolidated information for the management of the cluster.

1. ALTERNATIVE SOFTWARE SOLUTIONS FOR CONSOLIDATION OF INFORMATION

For the purpose of this study, we examined and analysed the features of modern technological solutions, including ETL tools, which can

[2] The study is published in the article "Problems and solutions in the information support of clusters of small and medium-sized enterprises (SMEs)", Research Papers of UNWE, volume 2, 2017.

be used to consolidate data from different sources, including database. ETL tools are organized into four categories:

- Incumbent Batch ETL Tools;
- Cloud Native ETL Tools;
- Open Source ETL Tools;
- Real-Time ETL Tools.

Incumbent Batch ETL Tools

Until recently, the ETL tools in the world were for "batch" current (day-to-day) processing. Historically, most businesses used their free computing resources to perform "batch" processing with ETL tools to consolidate data during off-hours (usually at night). For example, your bank account used to be updated one day after you made the financial transaction.

Such incumbent batch ETL tools are - IBM InfoSphere DataStage; Informatica PowerCenter; Microsoft SSIS; Oracle Data Integrator Enterprise Edition.

Cloud Native ETL Tools

With IT moving to the ‘cloud’, more and more services based on cloud ETL have emerged. Some of them offer real-time support.

Such cloud ETL tools are - Alooma; Fivetran; Matillion; Snaplogic; Stitch Data.

Open Source ETL Tools

ETL has its own pool of open source tools and projects. Most of them were created as a modern management layer for scheduled workflows and batch processes.

Open source ETL tools are - Apache Airflow; Apache Kafka; Apache NiFi; Talend Open Studio.

Real-Time ETL Tools

If you calculate salaries or taxes, you do not need your data in real time. However, most modern applications require a real-time access to data from different sources. For example, when you upload information on

a new item in your e-store, you will want your customers to see it right away, not a day later.

Real-time processing generated a change in architecture: from a model based on batch processing to a model based on distributed message queues stream processing. Real-time ETL tools are - Alooma; Confluent; StreamSets; Striim.

Except the above ETL tools, two modern technologies - Business Intelligence (BI) and Big Data, are also of interest, since they include ETL elements in their functionality.

Business Intelligence (BI) solutions

With classic Business Intelligence (BI) solutions, standard ERP, CRM, POS and other transaction systems are at the bottom of corporate IT architecture. The data, collected by them is integrated at a higher level with ETL tools, Master Data Management tools. The next level comprises the Data Warehouse storage systems, and the above level - the BI tools for statistical purposes, Data Mining and Operational Analysis (OLAP). The top of this classical architecture is for the platforms for corporate collaboration and Enterprise collaboration.

Business Intelligence systems rely on more sophisticated data detection and data management tools - their retrieval, transformation and saving in Data Warehouse with ETL tools. The principle is that, to make a managerial decision, the quality of information is just as important as its quick delivery and easy visualization through Dashboards. For this reason, the big business management software vendors provide for Data Management tools, as part of their BI solutions, that manage input / output data to generate ad hoc reports and specialized analyses. [6]

Big Data

Big Data is a new generation of technologies and architectures that allow extracting data from very large volumes of data (of over dozens of terabytes). Big Data technologies generate information from data of a different structure - structured or unstructured, at very high velocity.

Big Data platforms increase the speed of discovery-oriented analysis and reduce data engineering efforts that are not productive. Most

importantly, due to the large capacity of Big Data platforms, organizations can upload all data from their source systems instead of selecting data related to the analysed issue. At first glance, this approach seems to be associated with "data surpluses" but in fact it allows two major sources of delays to be eliminated, namely the time it takes to write programs to extract only the necessary data and the time it takes to return to core systems with data sources several times when interim findings from the analysis generate new issues requiring new data (Enterprise Information Systems, 2010).

Conclusions

BI and Big Data solutions are licensed, designed to handle very large volumes of data (tens and hundreds of terabytes a day in banks, telecoms and social networks), require complex IT infrastructure, long configuration times, and a short response time.

The SME clusters in Bulgaria at this stage, on the one hand, do not have the above-mentioned needs for the processing of large volumes of data, including unstructured data and for response time (in real time), and, on the other hand, do not have significant financial resources to purchase and support real-time, BI and Big Data solutions.

Due to the above reasons, to consolidate (aggregate) data of SME clusters, we have chosen **SQL queries** that can be assigned to the group of **Incumbent Batch ETL Tools.**

SQL queries

Structured Query Language (SQL) has been developed for the management of relational databases. SQL is a multifunctional language for working with databases with control structures for: creating, modifying, and deleting data; defining data (tables, columns); restricting access to database elements by working with groups and individual users; data management operations such as backup creation, block copying and updating; and transaction processing (Microsoft SQL Server, 2016).

The standard form of SQL is called ANSI-SQL, but every database management system (DBMS) maker has its own SQL implementation. In SQL Server of Microsoft, which is a relational DBMS, the SQL is labelled

Transact / SQL, while Oracle's SQL is called PL / SQL. However, in practice, all DBMS for relational databases read SQL, although most also have their own specific syntax.

This means that most of the database queries developed for use with a specific database are transferable from one product or tool to another. For example, SQL queries written for the Microsoft SQL Server database used in Microsoft's MS Dynamics Navision ERP system can be used on an ERP system with an enterprise database such as Oracle without significant changes. In addition, SQL is used by languages such as Java, C ++ and others because of the opportunities it provides in the field of data processing and database management (Microsoft Dynamics365, 2017).

SQL queries from the group of ETL tools for "batch" current processing are particularly suited to SMEs clusters as, in practice, they are:

- Universal - applicable to different ERP systems that use relational DBMSs;
- Free - included in the DBMS of the ERP system, for which software fees have already been paid;
- They are executed from one environment - the DBMS of the ERP system offers an interface for their setting and execution;
- They are executed as a "bundled" current (daily) task – their execution can be pre-set, and they can be run as a "package" of stored procedures every day (off-hours, e.g. every night).

2. THE CONCEPTUAL MODEL OF DEVELOPMENT

The developed conceptual model includes 12 stages. The stages described in the conceptual model will allow the creation of a database with consolidated (aggregated) information for the cluster companies.

1. The existing DBs in the ERP system are listed;
2. The existing DB tables are listed;
3. The schemas, relationships and keys – primary (PK) and foreign (FK) are analysed;

4. A new DB Cluster is created;
5. Two new tables are created in DB Cluster (Clusters and Enterprises);
6. Data is entered in the new tables (Clusters and Enterprises);
7. A column EnterpriseID with PK is added to part of the tables of the DB of every firm;
8. The enterprise ID is entered in the new column;
9. The tables of a company are copied in DB Cluster (DB);
10. Data for the rest of the companies is added in the tables of DB Cluster (DB);
11. The data in DB Cluster is updated;
12. Consolidated reports on the cluster management are extracted from DB Cluster.

3. THE SOFTWARE MODEL OF DEVELOPMENT

The developed software model includes execution (single or cycle) of certain stages described in the conceptual model and implemented with SQL commands. The syntax of the commands is for SQL Server / Oracle / MS Access and for MySQL, which will make the developed software model more universal, because the most widely used in the world and in Bulgaria ERP systems (MS Dynamics Navision, Oracle, SAP, etc.) use the above-mentioned database management systems (DBMS). The execution of the steps will develop a Cluster database of summarised information about the companies from the cluster. Part of the steps are performed once, and another part periodically (daily) as a stored procedure, which is scheduled as an off-time task.

The software model is approbated to the MS Dynamics Navision ERP system, with SQL commands running from Microsoft SQL Server Management Studio environment [3].

4. GUIDELINES FOR THE FUTURE USE OF THE MODEL

4.1. The software model for development of ERP systems is designed to aggregate data from several clusters of SMEs of a horizontal or vertical type. This is possible because it is a model of data management not of business logic and user interface. The new database contains two additional tables - clusters and companies, allowing consolidating information not only at a cluster level, but also at the level of a group of clusters of a different (horizontal or vertical) type.

4.2. In future, the ERP system can use only the new database of consolidated information, every cluster company working with a view of its information, which will optimize the use of disk space and reduce redundancy.

5. CONCLUSION

In the context of a fast-growing and dynamic business environment, to make quick and accurate decisions, the managers of a SME cluster need to have consolidated (aggregated) cluster-level information.

The use of integrated enterprise information systems for Enterprise Resource Planning (ERP) by SMEs clusters requires upgrading the core functionality of the ERP systems to consolidate information at the cluster grouping level.

The study and the analysis of the alternative solutions for the potential problems for the development of the basic functionality of the ERP systems allows to choose and develop a solution for data consolidation, which is in line with the specifics of the SME clusters in our country, including price, configuration time and applicability.

The proposed conceptual and software models for the development of the basic functionality of the ERP systems make it possible to standardize the process of their upgrading.

The approbation of the developed model and the developed software module allows for extracting reports of consolidated information at the cluster level from the ERP systems the SMEs use.

The implementation of the model will provide for added management value in the functioning of SME clusters, by creating opportunities for:

1. Access to "**good**" practices and extant "**know-how**" included in the business information system for enterprise resource planning (ERP system), in the form of developed industry business model and business processes. This is important because SMEs do not have sufficient resources (financial, material, human, etc.) to act independently in solving problems related to change and optimization (reengineering) of business processes and gaining competitive advantages;

2. Cluster management to optimize the relations with the contractors (customers and suppliers) of the firms, by summarizing the quantities of the ordered items (goods and services), contracting bigger discounts in the price, lowering the production costs and thus lowering prices (at competitive prices) or making higher profit at the existing prices or "**economies of scale**", as well as optimizing material planning for production, staff management, etc.

3. At any given point in time, the cluster management will have **online** access to information resources (references and reports) on the status of each of the firms from the cluster as well as consolidated (aggregated) information at cluster level, which can be used for both the needs of operational management and for analysis, strategic forecasting and planning of the activity.

References

http://www.isystems.bg/reshenija/erp-sistemi (last accessed on 10.06.2017)

https://www.microsoft.com/en-us/dynamics365/home (last accessed on 15.06.2017)

https://www.microsoft.com/en-us/sql-server/sql-server-2016 (last accessed on 18.06.2017)

Enterprise Information Systems. (2010). *Concepts, Methodologies, Tools and Applications: Concepts, Methodologies, Tools and Applications,* Idea Group Inc (IGI).

Gartner, Magic. (2016). *Quadrant for Business Intelligence and Analytics Platforms.*

How to Use Big Data to Make Faster and Better Business Decisions, Thor Olavsrud, CIO US.

Kapp, Karl M., William F. Latham, Hester Ford-Latham. (2016). Integrated Learning for ERP Success: A Learning Requirements Planning Approach, *CRC Press, Apr 19*.

BUSINESS management

D. A. Tsenov Academy
of Economics, Svishtov

Year XXVII * Book 4, 2017

CONTENTS

Submitted for publishinq on 15.12.2017, published on 20.12.2017,
format 70x100/16, total print 50

ISSN 0861 - 6604

BUSINESS management

PUBLISHED BY
D. A. TSENOV ACADEMY
OF ECONOMICS - SVISHTOV

4/2017

BUSINESS management 4/2017

TO THE READERS AND AUTHORS OF "BUSINESS MANAGEMENT"

The journal of "Business Management" publishes research articles, methodological articles and studies, review articles, book reviews, commentaries and good practices reports.

1. Volume:

- Articles: between 12 – 20 pages;
- Other publications (review articles; book reviews, etc.): between 5 – 10 pages.

2. Submission of materials:

- On paper and electronically at one of the following e-mail addresses: bm@uni-svishtov.bg or zh.tananeeva@uni-svishtov.bg

3. Technical requirements (the article template is can be downloaded from the webpage of the journal):

- Format – Word for Windows 2003 (at least);
- Font – Times New Roman, size 14 pt, line spacing 1,5 lines;
- Page size – A4, 29–31 lines and 60–65 characters per line;
- Line spacing 1,5 lines (at least 22 pt);
- Margins – Top – 2.54 cm; Bottom – 2.54 cm; Left – 3.17 cm; Right – 3.17 cm;
- Page numbers – bottom right;
- Footnotes – size 10 pt;

4. Layout:

- Title of article title; name, scientific degree and scientific title of author – font: Times New Roman, 14 pt, capital letters, Bold – centered;
- Employer and address of place of employment; contact telephone(s) and e-mail – Times new Roman, 14 pt, capital letters, Bold – centered.
- Abstract – up to 30 lines; Key words – from three to five;
- **JEL** classification code for papers in Economics (http://ideas.repec.org/j/index.html);
- Introduction – it should be from half a page to a page long. It should state the main ideas and/or objectives of the study and justify the relevance of the discussed issue.
- The main body of the paper – it should contain discussion questions, an outline of the study and research findings/main conclusions; bibliographical citation and additional notes, explanations and comments written in the footnotes.
- Conclusion – it should provide a summary of the main research points supported by sufficient arguments.
- References – authors should list first references written in Cyrillic alphabet, then references written in Latin alphabet.
- Graphs and figures – Word 2003 or Power Point; the tables, graphs and figures must be embedded in the text (to facilitate language correction and English translation); Font for numbers and inside text – Times New Roman, 12 pt;
- Formulae must be created with Equation Editor;

5. Citation guidelines:

When citing sources, authors should observe the requirements of **APA Style**. More information can be found at: https://www.uni-svishtov.bg/default.asp?page=page&id=71#jan2017, or: http://owl.english.purdue.edu/owl/resource/560/01/

6. Contacts:

Editor in chief: tel.: (++359) 631-66-397
Co-editor in chief: tel.: (++359) 631-66-299
Proofreader: tel.: (++359) 631-66-335
E-mail: bm@uni-svishtov.bg; zh.tananeeva@uni-svishtov.bg;
Web: bm.uni-svishtov.bg
Address: "D. A. Tsenov" Academy of Economics, 2, Em. Chakarov Str., Svishtov, Bulgaria