

Business Performance Benchmarking based on Medical Services Data:Gynecology Clinics Case

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Abstract - This paper describes data analysis model for benchmarking of two competitive gynecology clinics, based on databases from medical information system of those enterprises. These enterprises have similar software and equal database structure in their information system, so data from these databases are comparable.

I. INTRODUCTION

In competitive environment an enterprise need to establish system of continual improvement based on data that present working results. It also need to compare business performance to other enterprises of the same type in aim to evaluate business processes regarding important parameters having competitive organizations performance as a kind of orientation.

Benchmarking is set of management techniques that enable analysis of business process performance of an enterprise comparing to other enterprise. This comparison is made according to performance indicators values, computed from data that are stored in everyday working processes [1].

It is not easy to do benchmarking. There are several types of benchmarking techniques, but most important part of any benchmarking is getting real process data from business process of a company. The difficulty is in availability of data - some companies consider their working data as internal business secret. Other difficulty is in diversity of data formats and structures, even if core business process are digitalized, i.e. using computers for storing data about business processes.

In this paper we present two competitive gynecology clinics information systems running on the same platform, almost identical user interface and identical database structure [2]. The database structure support core business process regarding patients and medical examinations data. Benchmarking of these two clinics business performance is enabled because of availability of data given from these enterprises and the fact that both databases have equal structure, so comparison of data doesn't have an obstacle of possible need for transformations at eventually divergent technology and structures of data sources. This paper contributes with model of data analysis structure and methods that enable comparison of business performance data, that are derived from clinical data from gynecology clinics' information system database.

II. INFORMATION SYSTEM OF GYNECOLOGY CLINICS

The two gynecology clinics, just like all other enterprises have three segments of business processes:

TABLE I. BUSINESS PROCESS CATEGORIES

BASIC service	SUPPORT activities	MANAGEMENT
Medical examinations	Documents	Decisions
Medical treatments	Finance	Monitoring
	Maintainance	Quality assurance
	Supply	Standards compliance
	Human resources	

Information system (IS) of gynecology clinic is applied for basic business process support for both of private clinics "Dr Ljiljana Bursic" Zrenjanin and "Dr Nada Hrnjak - Eremic" Zrenjanin. Each IS consists of the same four aspects, (Table I). Figure 1. presents a deployment diagram of software module deployment.

TABLE II. STRUCTURE OF INFORMATION SYSTEM OF BOTH GYNECOLOGY CLINIC

Hardware	Two PC computers, one for physician specialist and one for technician / secretary
Software	Two modules of medical software – administrative and medical
Lifeware	Two employees: MD (physician specialist) and medical technician / secretary
Orgware	Regular procedure of patients treatment

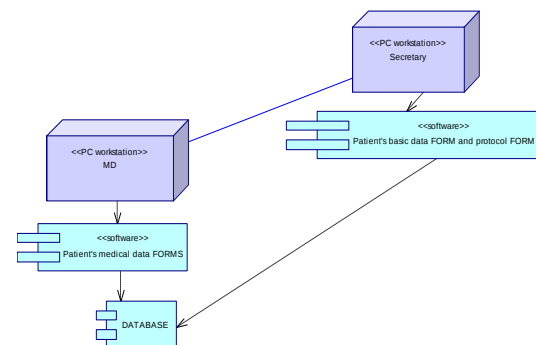


Figure 1. Deployment diagram of both gynecology clinic information system

Figure 2. Software module for medical technician – basic patient data and protocol

Figure 3. Software module for MD (physician specialist) in "Dr Ljiljana Bursic" version of user interface

Figure 4. Software module for MD (physician specialist) in "Dr Nada Hrnjak-Eremic" version of user interface

Software module for the two clinics differ in user interface elements organization and some automatisms (at second version of user interface, Figure 4, automatical creation of text regarding entered examined parameters), but cover the same medical and patient data.

User interface is developed under Microsoft Visual Studio 98 development environment (VB6) and database DBMS is Ms Access 97.

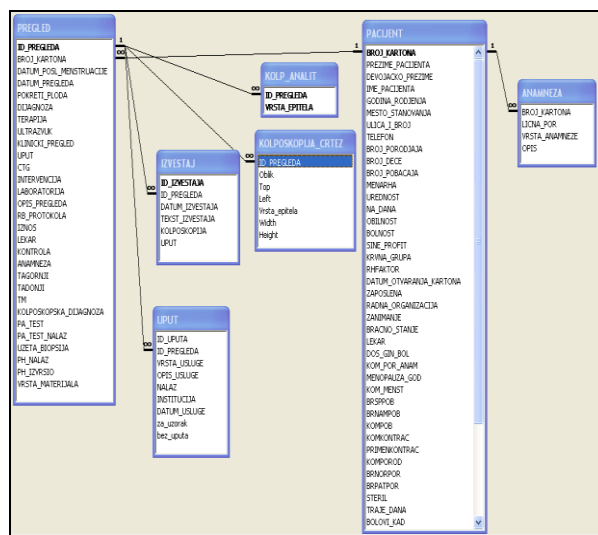


Figure 5. Structure of relational database of both gynecology clinic

At Figure 5, the structure of database is shown. There are two most important tables in the relational database: Patient (Pacijent) and Examination (Pregled).

Other tables are: Report (Izvestaj), External examination order/recomendation (Uput), Colposcopy analytical and drawing (Kolposkopija Analiticki, Kolposkopija Crtez), Anamnesis (Anamneza).

III. DATA ANALYSIS MODEL FOR BENCHMARKING OF GYNECOLOGY CLINIC

A. Research questions

Business performance could be examined regarding:

1. internal audit, where business performance indicators are computed and validated at some point of time (having current state of business) or during time (having information about progress of business, examining effects of management directed activities regarding changes etc.)

2. external audit, comparing to standards levels or comparing to other companies business performance. Benchmarking usually perform comparison to the data that describe "best in class", i.e. data that describe the best performing enterprise in the group of the same type organizations.

In this case, we can perform internal and external business performance evaluation, but only with two enterprises, comparing to each other. Since we have only basic process data support in databases, research questions for this paper are:

1. Can we compare business performance of these two clinics?

2. Which indicators do we need and which indicators do we have?

3. What are the results of this comparison and can we have a general conclusion on business performance success according to computed values of these indicators?

B. Rresearch hypothesis and assumptions

Lets start with the original Balanced Scorecard Approach[3] that emphasize four segments where business performance indicators should be defined: customer, internal process, learning and growth, financial. All these indicators are designed according to strategy, mission and vision of the company.

According to balanced scorecard [4], lets assume that strategy goals for these clinics are moving them in these directions (during time):

1. Satisfied customer (patient).
2. Smoothly operating and improving internal process.
3. Constantly improving processes by learning.
4. Expanding business to new services and new customers.
5. Positive financial results.

According to previously defined research questions, there are following hypotheissis and assumptions.

H1. We can compare business performance of two clinics with basic process data, but with these assumptions (since we dont have available data for financial/maintainance/suppy supporting processes, but only for basic processes):

FINANCIAL SEGMENT

A1. Both clinics have equal costs for maintainance and supply.

A2. Both clinics have the same charges (costs for services in medical examinations and treatments) to patients.

A3. Both clinics give the same sallary to employees.

INTERNAL OPERATIONS SEGMENT

A4. Internal process is operating smoothly (which means constant availability and functionality of all material and human resources and devices).

A5. Both clinics have equal and standard set of basic services (medical examinations and treatments) to customers (patients) and will not add new services during time.

C. Business Performance Indicators

Having these assumptions, financial data could be derived from basic process computed data. This way, business performance, i.e. business success of these two clinics can be compared regarding basic process activities with indicators that describe them.

Having all assumptions because of availability of data, in aim to define business performance indicators, we will focus on strategic goals:

1. Satisfied customer (patient).

4. Expanding business to new customers.

First we give general business performance indicators (Table III), and then we specify goal-oriented business performance indicators, i.e. those according to previously defined strategic goals and available data from database (Table IV).

TABLE III. GENERAL BUSINESS PERFORMANCE INDICATORS

Number of patients.
Number of active patients.
Number of passive patients.
Number of medical examinations.
Number of medical therapy treatments.
Number of medical examinations by diagnosis.
Number of medical therapy treatments by types.
Number of ultrasound examinations.
Number of colposcopy examinations.
Number of clinical examinations.
Number of CTG examinations.
Number of interventions.
Number of laboratory results examinations.
Number of PA tests examinations.

TABLE IV. GOAL-ORIENTED BUSINESS PERFORMANCE INDICATORS

Goal: Satisfied customer (patient).
Metrics indicators:
Number of patients.
Number of active patients.
Number of passive patients.
Number of related patients (patients that are in any relationship with some other patient).
Number of patients left and moved to competitive clinic.

Goal: Expanding business to new customers.
Metrics indicators:
Number of new patients (date of first medical examination, i.e. creating a medical record for a patient).
Number of patients by residence (living) in a certain city/village.
Number of patients by age.
Number of patients by occupation (employment).
Number of patients referred to certain MD (physician).
Number of patients came from other clinic.

D. Computing results of Indicators with Sample Data

In this section we will present value of indicators computed from both databases in period of 1st November 2004 to 1st November 2005, which was software testing period for Dr Hrnjak's version of software (which means that some patients data could not be entered because of software testing and could not be considered as complete database), while Dr Bursic's version was already fully running. Data about patients and examinations that were entered to database after that date is not available for public presentation, but is stored internally at each clinic.

For each of specified indicators separate SQL query has been entered. Values from queries from both databases were exported to MS Excel and integrated for comparison.

We give example for the indicator:

Number of patients by residence (living) in a certain city/village.

SQL query:

```
SELECT Count(PACIJENT.BROJ_KARTONA) AS [Broj pacijenata],
PACIJENT.MESTO_STANOVANJA
FROM PACIJENT
WHERE
(((PACIJENT.DATUM_OTVARANJA_KARTONA)>#1/11/2004#
And
(PACIJENT.DATUM_OTVARANJA_KARTONA)<#1/11/2005#))
GROUP BY PACIJENT.MESTO_STANOVANJA;
```

Query results:

Broj pacijenat	MESTO_STANOVANJA
1	ARADAC
1	BAN KARABORBEVO
1	KARABORBEVO
2	KLEK
1	Kumane
2	LAZAREVO
2	Melenci
1	MIHAJLOVO
2	MUŽLJA
1	Novi Bečej
1	RADOJEVO
1	TOMAŠEVAC
1	ZLATICA
33	Zrenjanin

Figure 6. Query results for dbHrnjak database

Broj pacijenat	MESTO_STANOVANJA
4	Konak
1	Krajišnik
8	Kumane
1	L Selo
6	Lazarevo
2	Melenci
1	London-Zrenjanin
4	Lukićevo
2	Lukino Selo
35	Melenci
1	Mihajlovo
23	Mužlja
6	N. Bečej

Figure 7. Query results for dbBursic database

Graphical representation of data comparison for both data sources is given at Figure 8. (without numerical data at Y axis).

Obviously, in both cases, there are more patients from Zrenjanin, then from other cities or villages. This fact is related to number of citizens in Zrenjanin comparing to those living in villages.

Other important notice is that dr Hrnjak data should be considered as only software testing data (they are not complete), while dr Bursic data should be considered as fully completed, since testing period has already passed.

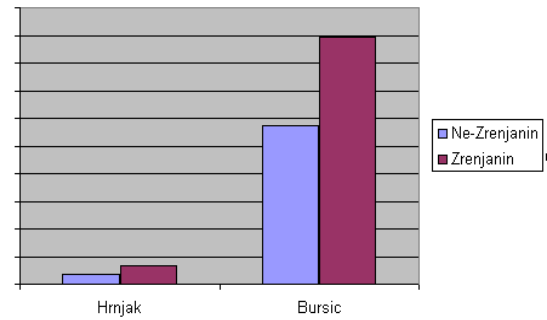


Figure 8. Graphical presentation of number of patients by residence in Zrenjanin and other city/village (ne-Zrenjanin) comparison from dr Hrnjak and dr Bursic database.

E. Discussion

In previous sections we have defined three research questions. Now, it is time to discuss their answers.

1. Can we compare business performance of these two clinics?

Since we have only restricted data - with only clinical data and the amount of data for software testing period for one of them, we cant compare business performance of these two clinics. We tried with assumptions that could enable our focusing on clinical data to be basis for performance indicators definition, but these assumptions make too simplistic, i.e. not realistic working conditions.

2. Which indicators do we need and which indicators do we have?

We need indicators that cover all aspects of business process - basic process, but also supporting processes, which is not available in this case.

We have defined general indicators that describe patients (customers) and medical examinations and treatments (services). We also defined goal oriented indicators, with assumed goals, also focused only on basic processes.

3. What are the results of this comparison and can we have a general conclusion on business performance success according to computed values of these indicators?

We show methodology and technology used for computing indicators and visual presentation, needed for comparison. It has been shown that results are computable and could be visually presented. We cant have results of benchmarking for each of indicator, since we didnt have all the needed data available. Other important aspect is the need for more automated approach, i.e. using DataWarehouse tools for computation automation, such as MS Analysis Services.

By computing each of specified indicator, if we had complete data for each of clinics, we could have separate conclusions regarding each aspect examined. To have a general conclusion about the business performance success, we should have a decision model [5] that would include all relevant indicators values [6].

IV. CONCLUSION

In this paper we presented information system of two gynecology clinics. They have equal structure, starting with hardware, software, orgware and lifeware components. Software support has similar user interface and equal database structure.

Equal database structure gives possibility of easy benchmarking of data. This software supports only basic business process, i.e. medical examination and treatment data, without any support process data (such as finance, maintainance, supply etc).

This paper contributes with the model for benchmarking of business performance regarding gynecology clinics, by defining general and goal oriented performance indicators. We also show, at sample data, that this model is computable and could be visually presented, by using sql queries and graphs in MS Excel.

The need for complete database and the database for longer time period, as well as the database with support

process data is needed for benchmarking that could cover all business aspects. We also point out the need for more automated software tools for data analysis, such as DataWarehouse tools, like MS Analysis Services.

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