Neka razmatranja o primeni OLAP tehnologije u malim i srednjim preduzećima

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U ovom radu su predstavljeni rezultati istraživanja relevantne naučne literature u oblasti primene inteligentnih tehnika i alata u preduzećima sa posebnim osvrtom na istraživanju mogućnosti primene OLAP tehnologije u malim i srednjim preduzećima u funkciji stvaranja konkurentne prednosti i pozitivnih poslovnih rezultata. U radu su prikazani rezultati implementacije razmatrane metodologije u pojedinim sektorima konkretnog preduzeća.

Ključne reči: mala i srednja preduzeća, OLAP tehnologija, studija slučaja

1. UVOD

Ključ uspeha koncepta poslovne inteligencije leži u mogućnosti da se poslovnim korisnicima, za potrebe donošenja poslovnih odluka, omogući brz i lak pristup informacijama koje se nalaze u skladištima podataka, a koje su neophodne za generisanje više-dimenzionalnih upita, kakvi se najčešće postavljaju u procesu odlučivanja. Tehnologija poslovne inteligencije obezbeđuje: prošle, sadašnje i buduće perspektive poslovanja preduzeća. Zajedničke funkcije poslovno inteligentnih tehnologija su: izveštaji (eng. reporting), "On-line" analitička obrada (OLAP), analiza (eng. analytics), pretraživanje podataka, otkrivanje znanja u podacima (eng. Data mining), upravljanje i ostvarivanje poslovnog uspeha (eng. business performance management), poređenje (eng. benchmarking), pretraživanje teksta (eng. tekst mining) i intuitivna analiza (eng. predictive analytics). U nastavku istraživanja detaljnije je izložena tehnologija interaktivnog analitičkog procesiranja – OLAP, koja je relativno mlada informaciona tehnologija s velikim potencijalom za primenu u poslovnom okruženju u malim i srednjim preduzećima u Srbiji. Arhitektura sistema poslovne inteligencije obezbeđuje okvir za ukupno planiranje sistema ili proizvoda, ista se sastoji od:

- zainteresovanosti klijenata i njihove potrebe za informacijama,
- unosa podataka,
- skladištenja podataka,
- analize podataka i
- automatskog i selektivnog širenja informacija.

Lim (2013) [1] opisuje skup različitih tehnologija, praktičnih rešenja i sistema za analizu kritičnih poslovnih podataka pod nazivom Business Intelligence and Analytics (BIA). Costa i Madeira (2004) [4] istražuju korišćenje distribuiranih skladišta podataka sa velikim brojem dimenzija predlažući DWS (Data Warehouse Striping) tehnike. Značajna pažnja velikog broja autora se poklanja metodologiji korišćenja "big data" tehnologija [9]. Uchida (2013) [4] analiziraju korišćenje "overlay cloud computing" arhitekture u razvoju metodologije poslovne inteligencije.

2. ANALITIČKA OBRADA PODATAKA - OLAP

Pri upravljanju informacijama preduzeća se najčešće suočavaju sa dve vrste tehnologije podataka:

- transakcijskim obradama u realnom vremenu - OLTP i
- analitičkim obradama - OLAP (eng. Online Analytical Processing).

Jedan od načina da se pristupi tim informacijama je korišćenje tzv. tehnologije interaktivnog analitičkog procesiranja - OLAP. Eminentni autori Golfarelli, Rizzi, Cella, ističu da je OLAP najvažnija i najviše korišćena komponenta poslovne inteligencije u te svrhe [5]. Prema Vitt i saradnicima, termin OLAP je uveo matematičar E. F. Codd 1993. godine, kada je kreirao set kriterijuma kojima bi trebalo da udovolje baze podataka nad kojima bi se primenjivao OLAP [6]. Slično viđenje iznose i Codd i Salley, kada naglašavaju da puni naziv OLAP grupe proizvoda proizlazi iz engleskih reči Online Analytical Processing, koji je 1993. godine predložio E. F. Codd, tvorac relacionog modela baze podataka, da bi označio vrste softvera za analizu poslovnih podataka [7]. Tehnike poslovne inteligencije (data warehousing, reporting, Online Analytical Processing /OLAP/, data mining, dashboards, enterprise reporting i dr.) ekstrahuju podatke iz postojećeg informacionog sistema i transformišu ih u oblik pogodan za odlučivanje. Implementacija tehnika poslovne inteligencije znatno povećava upotrebnost vrednost postojećeg informacionog sistema preduzeća, usled čega je interesovanje za poslovno inteligencijom veliko i stalno raste. Prema definiciji Internet servisa The OLAP Report [8] „OLAP je kategorija aplikacija (programskih rešenja) i tehnologija koje omogućavaju sakupljanje, obradu, i prezentaciju višedimenzionalnih podataka za potrebe analize, procesa odlučivanja i na kraju upravljanja sistemima“. Na Slici 1 predstavljena je pojednostavljena arhitektura klijent/server sistema OLAP.

U svojim radovima Power naglašava da je Nigel Pendse OLAP definisao kao alat koji obezbeđuje brz i konzistentan, interaktivni pristup zajedničkim (shared) višedimenzionalnim informacijama i njihovu analizu.

U tom smislu autori Golfarelli, Rizzi, Cella, navode da u praksi, višedimenzionalni upit znači dobiti jedan odgovor na upit tipa: „šta, zašto i šta ako[5].

Slika 1. Pojednostavljena arhitektura klijent/server sistema OLAP [8]

Takođe, Nigel Pendse sugerise da je alternativni i možda precizniji opis za OLAP kao brzu analizu višedimenzionalnih informacija - Fast Analysis of Shared Multidimensional Information (FASMI) [9]:

- "Fast" - sistem mora omogućiti odgovor na korisnikov upit, u pet sekundi, sa odzivom od jedne sekunde za prostije upite i do najviše dvadeset sekundi za najkomplikovanije zahteve.
- "Analysis"- sistem mora podržavati bilo koju poslovnu logiku i statističku analizu koja je relevantna za aplikaciju i krajnjeg korisnika.
- "Shared"- sistem obezbeđuje konzistentnost i sigurnost podataka u slučaju više korisničkog pristupa podacima.
- "Multidimensional" - sistem obezbeđuje višedimenzionalni konceptualni pogled na podatke, uključujući punu podršku za hijerarhije i višestruke hijerarhije.
- "Information" - ukazuje na sve podatke i informacije koje se dobijaju iz njih, gde god da se ovi nalaze i koliko god da su relevantni za aplikaciju.

Još jedna od postojećih modifikovanih definicija OLAP-a bi bila da je OLAP kategorija programskih rešenja koja omogućava rukovodiocima-manadžerima uvid u podatke kroz brz, konzistentan i interaktivan pristup, korišćenjem različitih pogleda na podatke proizašle iz operativnih, nestrukturiranih podataka, a na način kojim se naglašava dimenzionalnost podataka. OLAP je tehnologija koja se koristi za organizaciju velikih poslovnih baza podataka za podršku poslovnoj inteligenciji. OLAP baze podataka su podeljene na jednu ili više kocki, dok administrator organizuje i dizajnira svaku kocku, kako bi odgovarale načinu preuzimanja i analizi podataka. Time bi se omogućilo lakše kreiranje i korišćenje potrebnih izveštaja i izvedenih tabela i izveštaja izvedenih grafikona. OLAP kocke namenjenje su analizi velikih količina podataka metodama raslojavanja i

presecanja (engl. Slice and Dice Method). Poznati autori Liautaud i Hammond, naglašavaju da Drill-down/up - predstavlja analitičku tehniku koja omogućava korisniku da se kreće po nivoima agregacije podataka, tj., od najvišeg nivoa do odgovarajućih detalja podataka na najnižem nivou [10].

Ova funkcionalnost je moguća za dimenzije koje poseduju hijerarhiju. U skladištu podataka, takođe, moraju postojati odgovarajući agregati definisani za tu hijerarhiju, kako bi ova operacija bila brza i efikasna. Rotacija je karakteristika OLAP alata, koja omogućava pogled na podatke iz obrnute perspektive. Takođe Liautaud i Hammond ističu da OLAP sistemi izlaz najčešće prikazuju u preseku veličina predstavljenih X i Y osom. Zamenom veličina na X i Y osi dobija se tzv. rotirani prikaz izlaznih informacija [10].

OLAP tehnologija omogućava korisniku pristup i analizu „ad-hoc“ podataka, pregled informacija dobijenih kroz poređenja, analize podataka iz prošlosti i podataka izvedenih iz različitih "šta-ako" scenarija. OLAP aplikacije koriste analitičari, menadžeri koji često zahtevaju pregled visoko agregiranih podataka, kao što su ukupna prodaja jedne proizvodne linije preduzeća ili jednog regiona države itd. OLAP baza podataka ili analitička baza podataka je podvrgnuta promenama koje dolaze od strane više izvora podataka obezbeđujući snažnu analitičku pozadinu mnogim korisničkim aplikacijama. Jedan od mogućih prikaza OLTP/OLAP arhitekture dat je na sledećoj slici (Slika 2).

Slika 2. OLTP/OLAP arhitektura [4]

Za razliku od SQL upita, koji se postavljaju nad transakcionom bazom i koji daju odgovor na pitanje šta se nalazi u bazi podataka, OLAP ide korak dalje i ulazi u sferu značenja podataka i daje odgovore na pitanja da li su neke pretpostavke koje su izdvojene iz baze podataka istinite. Kimball (2002) ističe da OLAP stvara seriju hipotetičkih zakonitosti i veza između podataka i koristi sisteme upita da ih potvrdi ili opovrgne [11].

Multidimenzioni OLAP (MOLAP) omogućava izvršavanje OLAP analiza nad multidimenzionalnom bazom podataka (MDDB). Osnovna premisa ove arhitekture je predstavljana na slici, (Slika 3), da podaci moraju biti smešteni multidimenzionalno da bi se multidimenziono posmatrali i koristili.

Slika 3. Prikaz MOLAP arhitekture [4]

Multidimenzionalna baza (MDDB) je odgovorna za izvršenje svih OLAP zahteva. Prezentacioni nivo je integrisan logičkim nivoom aplikacije i obezbeđuje interfejs putem kojeg krajnji korisnici posmatraju i izvršavaju OLAP analize. Klijent/server arhitektura omogućuje većem broju korisnika da pristupe istoj multidimenzionalnoj bazi podataka.

Relacioni OLAP (ROLAP) pristupa podacima smeštenim u skladište podataka u cilju izvršavanja OLAP analiza. Premisa ROLAP-a je da su OLAP mogućnosti najbolje podržane direktno nad relacionom bazom podataka, tj., skladištem podataka. U svojim radovima Almeida, navodi da postoje još neke vrste OLAP alata kao što su [12]: WOLAP- Web-based OLAP, DOLAP- Desktop OLAP, RTOLAP- Real-Time OLAP, SOLAP- Spatial OLAP.

Skladišta podataka i OLAP sistemi daju kvalitet poslovnim informacionim sistemima i BIS. Njihovi korisnici u svakom trenutku i na svakom mestu imaju na raspolaganju ključne poslovne informacije i mogućnosti analize na vrlo jednostavan, brz i efikasan način, što je danas u poslovnom svetu vrlo korisno, može se slobodno reći i neophodno.

Četvrta grupa alata je posebno interesantna za menadžere. To su kontrolni paneli (eng. Dashboard). Poznati autor Few definiše kontrolni panel kao vizuelni prikaz najvažnijih informacija koje su potrebne da se postigne jedan ili više ciljeva [13]. Ove informacije se konsoliduju i prikazuju na jednom ekranu, tako da je moguće jednostavno pratiti status celokupne organizacije. Neki od elemenata koji se pojavljuju na kontrolnom panelu mogu prikazivati tendencije kretanja akcija, mape koje pokazuju prodaju bez obzira na geografsku lokaciju, kao i ključne indikatore ostvarenja rezultata (eng. KPI - Key Progress Indicator) koji ukazuju na to da li se ispunjavaju postavljeni ciljevi.

3. PRIMENE OLAP IZVEŠTAVANJA U PREDUZEĆU „LIPOVICA“

OLAP izveštavanje koristi ogromne baze podataka iz kojih su višestrukim filtriranjem dobijeni podaci i to sve za veoma kratko vreme omogućava da se iskoriste i primene iskustva drugih preduzeća koja su primenila koncept poslovne inteligencije. Takva preduzeća su u stanju da smanje ukupne operativne troškove, znatno povećaju produktivnost i da na najbolji način iskoriste svoje strateške prednosti.

U narednom delu rada prikazane su neke od primena koje se u svim preduzećima pa i u posmatranom preduzeću „Lipovica“ mogu izdvojiti kao zajedničke.

3.1. Primena u sektoru finansija

OLAP izveštavanje omogućava finansijskom sektoru mnogo brže, komfornije i svrsishodnije izveštavanje. Pored toga, značajno se unapređuje distribucija informacija.

3.2. Primena u sektoru prodaje

Prodajni timovi pre svega treba da budu orijentisani na kategoriju prihoda, a ne na kategoriju profita. Osnovni cilj primene OLAP izveštavanja u oblasti prodaje jeste da se usklade aktivnosti prodaje s korporativnim ciljem povećanja profita.

Osnovni problem, kad je u pitanju izveštavanje vezano za prodaju, jeste vreme koje je potrebno za prikupljanje podataka, analize, pravljenje i distribuciju izveštaja. To vreme se može meriti satima, a neretko i danima. OLAP izveštaji (Slika 4) omogućavaju timovima prodaje da brzo manipulišu informacijama vezanim za prodaju.

Slika 4. Interaktivni izveštaji za analizu prodaje [14]

3.2. Primena u sektoru marketinga

Udeo na tržištu je uobičajena mera uspeha u marketingu. Ključno pitanje koje se postavlja je: kako pridobiti velike kupce koji će maksimalno povećati dobit preduzeća? Vodeće banke danas posmatraju klijente na isti način kao što su nekad gledali na investicione planove: analiziraju njihovu profitabilnost i koncentrišu se na one s najboljim rezultatom.

OLAP izveštavanje u sferi marketinga omogućava preduzećima da posmatraju kupce na isti način. Koristeći bogat set algoritama i alata za pretragu, korisnici mogu dobiti korisne informacije kao što su kupovne navike, prodajne prognoze, ključni uticaji, kretanja na tržištu i efektivnost i kampanje. Informaciono komunikacione tehnologije i Internet su konstantno i značajno promenili način života ljudi i uslove poslovanja preduzeća, između

ostalog su drastično promenili i marketinške načine reklamiranja proizvoda/usluga i poslovne mreže, jer je svet postao jedno veliko tržište, gde se mala i srednja preduzeća poput preduzeća Lipovica, bore da prežive zbog jake interne i eksterne konkurencije. Sa takvom strukturom skladišta za korisničke podatke su sigurna da pristup samo podacima kao finalni proizvod procesa analize podataka predstavlja jednu jedinu verziju istine. Na ovaj način, proces donošenja odluka može da bude znatno kvalitetniji, od konkurentnih preduzeća.

3.3. Prednosti primene novog načina poslovanja iz iskustva korisnika – anketa

Pre uvođenja OLAP i inteligentnog sistema za podršku odlučivanju u preduzeću „Lipovica“ danima se čekalo da se nešto proknjiži, a sada se to radi u realnom vremenu. Takođe, od trenutka kada se pripreme oblice za transport pa do trenutka kada iste kupac preuzme prolazilo je po nekoliko dana.

Prikazana polazna struktura i način pristupa podacima u preduzeću Lipovica dovodi do još jednog pojma a to je pristup podacima koji se ne nalaze u jednom fajlu, folderu ili grupi. Ti podaci nisu najčešće odmah vidljivi i dostupni već je potrebno da se uradi filtriranje kako bi od mnogo horizontalno i vertikalno dobijenih vrednosti, istakli onu koja nam je potrebna. Pre uvođenja inteligentnih sistema za podršku odlučivanju u preduzeću su aktivirani i utrošeni određeni ljudski i vremenski resursi da bi se došlo do odgovarajućih rešenja, dok bi primenom OLAP tehnologije i realizacijom opisanog inteligentnog sistema za podršku odlučivanju, radne sate i dane provedene u traženju i filtriranju podataka mogli svesti na par sekundi, i to ukoliko se radi o ogromnim bazama podataka. U slučajevima da su to relativno manje količine podataka, kao što je slučaj šumskog gazdinstva „Lipovica“, rezultati bi bili trenutni. Isto tako do takvih rezultata bi mogao da dođe bilo koji radnik koji ima određene privilegije pristupa sistemu. Tehnološki su pojedinačne baze podataka su formirane od strane organizacionih jedinica (prodaja, praćenje ekosistema, šumski razvoj i stanje proizvodnje okruglog drveta) formirale jednu interkonekcionu bazu sa objedinjenim podacima iz svih nezavisnih baza kojoj će se ubuduće obraćati svi klijenti ukoliko žele da realizuju određene upite, što je značajno unapredilo organizaciju podataka u preduzeću „Lipovica“.

U poređenju sa istraživanjima drugih autora, primena metodologije poslovne inteligencije u kompanijama ostvaruje značajne poslovne rezultate sa različitih aspekata:

- analiza profitabilnosti koja se odnosi na tržište, profitabilnost proizvodnje ili kanala prodaje [15]
- zajedničko odlučivanje [16]
- razvoj različitih modela poslovnih procesa [17]
- analizu konkurentne pozicije firme [18]

Analizirajući budućnost razvoja poslovne inteligencije Golfarelli i ostali (2004) [19] ističu njenu značajnu primenu u analizi strategije kompanije i pronalaženju kritičnih proizvodnih procesa korišćenjem Business Performance Management (BPM).

4. ZAKLJUČAK

Rezultati istraživanja ovog rada ukazuju da je zahvaljujući uspehu implementacije OLAP funkcionalnosti u preduzeću „Lipovica“ menadžment došao do zaključka da je u periodu od 5 godina moguće proširiti kapacitete za 24% i izvršiti preraspodelu sadnog i reznog materijala koji bi doneli ukupni profit od 48% u odnosu na sadašnji period. Primenom OLAP tehnologije t.j. uvođenjem jedinstvenog informacionog softverskog rešenja u sve organizacione jedinice preduzeća „Lipovica“, ostvarila se višestruka korist, olakšana je komunikacija prema kupcima i dobavljačima, kao i interna komunikacija unutar samog preduzeća. Tako je sada komunikacija između komercijale i finansija značajno smanjena, jer informacije unose oni koji ih stvaraju, pri tom noseći odgovornost za to što je uneto, a i jedni i drugi mogu sami da dođu do svih podataka koji su im potrebni.

Na osnovu svega napred navedenog, zaključno razmatranje očekivanih rezultata se svodi na to da je moguće napraviti konceptualni model razvoja inteligentnih sistema za podršku odlučivanju u malim i srednjim preduzećima. Rezultati istraživanja ukazuju da projektovani koncept primene OLAP analitičkih baza podataka pruža veliki opseg mogućnosti za pronalaženje i dobijanje kvalitetnih informacija za potrebe poslovnog odlučivanja, takođe iz dokazanih polaznih stavova mogu se uvideti karakteristike primene metodičkih okvira razvoja inteligentnih sistema pri izradi aplikacija za podršku odlučivanju u malim i srednjim preduzećima. Ovaj model se može primeniti u svim preduzećima tako da se realizovanjem: OLAP-a, i drugih tehnika omogućava izrada korisnih izveštaja neophodnih za pravovremeno i tačno donošenje odluka, s obzirom da je znanje skriveno u ogromnim količinama poslovnih podataka malih i srednjih preduzeća i da ga je moguće ekstrahovati upravo primenom navedenih tehnika. Istraživanja iz oblasti konkurentnih prednosti malih i srednjih preduzeća u Srbiji pokazuju da je ono što neko preduzeće zna, način na koji to svoje znanje koristi i brzina kojom može da usvaja nova znanja, jedino što im danas u uslovima svetske ekonomske krize pruža sigurnu prednost u odnosu na konkurenciju.

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Some Considerations on the Implementation of OLAP Technology in Small and Middle Companies

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This paper presents the results of the relevant scientific literature in the field of the application of intelligent techniques and tools in companies. The paper puts an emphasis on the research of the possibilities of applying OLAP technologies in small and medium-sized enterprises in order to create a competitive advantage and positive business results. The paper presents the results of implementation of the discussed methodology in some specific sectors of the company.

Keywords: small and middle companies, OLAP technology, case study

1. INTRODUCTION

The key to the success of the business intelligence concept lies in the possibility of enabling quick and easy access to information contained in data warehouses to business users for the purpose of their making business decisions. They are necessary for generating multi-dimensional queries, commonly placed in the decision-making process. The technology of business intelligence provides us with the past, present and future perspectives of the business doing of an enterprise. The common functions of a business-intelligent technology are; reporting; Extract, Transform and Load functions (ETL), “On-line” Analytical Processing (OLAP) analytics, data searching, knowledge discovery in data (data mining), the management and realization of a business success (business performance management), comparison (benchmarking), text search (text mining) and intuitive analysis (predictive analytics). In the remainder of this paper, the technology of interactive analytical processing – OLAP, which is a relatively recent information technology of a great potential for use in the business environment of small and medium-sized enterprises, is discussed in more detail. The system architecture of business intelligence provides a framework for the overall planning of a system or products, and consists of:

- clients’ interest and their needs for information,
- data entry,
- data storage,
- data analysis and
- automatic and selective dissemination of information.

Lim et al. (2013) [1] describes a collection of different technologies, practices and systems for the analysis of critical business data called Business intelligence and analytics (BIA). Costa and Madeira (2004) [2] investigated the use of distributed data warehouses with big dimensions, proposing DWS (Data Warehouse Striping) technique. Significant attention of a large number of authors is paid to the methodology of using big data technology [3].

Uchida et al. (2013) [4] analysed the use of cloud computing overlay architecture in developing methodologies of business intelligence.

2. ANALYTICAL DATA PROCESSING - OLAP

In information management in an enterprise, the following two types of information technologies are most commonly observed:

- Transaction Processing in Real Time – the OLTP and
- Online analytical processing - OLAP.

One of the methods for accessing these information is the use of the Interactive Analytical Processing Technology – OLAP. The eminent authors Golfarelli, Rizzi, Cella, point out that OLAP is the most important and the most widely used component of business intelligence for that purpose [5]. According to Vitt and associates, the term OLAP was introduced by a mathematician, E. F. Codd, in 1993, when he created a set of criteria that should satisfy databases to which OLAP would be applied [6]. A similar opinion is also given by Codd and Salley, when they emphasize that the full name of the OLAP group of products is derived from the English words Online Analytical Processing, proposed in 1993 by E. F. Codd, the creator of the relational database model, for the purpose of indicating the type of software for analyzing business data [7]. The techniques of business intelligence – BI (data warehousing, reporting, Online Analytical Processing / OLAP /, data mining, dashboards, enterprise reporting, ETL, etc.) – extract data from the existing information systems and transform them into a form suitable for decision making. The implementation of the business intelligence techniques significantly increases the usable value of the existing information systems of an enterprise, resulting in a large interest in business intelligence, which is constantly growing. According to the definition of the The OLAP Report Internet service, “OLAP is a category of applications (software solutions) and technologies that enable the collection, processing, and presentation of multidimensional data for the needs of

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analysis, decision making and finally system management" [8]. Figure 1 presents a simplified architecture of an OLAP client/server system.

Figure 1. A simplified architecture of OLAP client / server system [8]

In his papers, Power emphasizes that Nigel Pendse defined OLAP as a tool providing fast and consistent, interactive access to shared multi-dimensional information and analysis. In this sense, the authors Golfarelli, Rizzi and Cella state that, in practice, a multidimensional query means obtaining a response to a question like "what, why and what if" [5]. Also, Nigel Pendse suggests that an alternative and perhaps more accurate description of OLAP is the Fast Analysis of Shared Multidimensional Information (FASMI) [9]:

- Fast – the system must provide a response to the user's query, in five seconds, with a response of one second for simpler queries, and up to twenty seconds for the most complex requirements.
- Analysis – the system must support any business logic and statistical analysis relevant to the application and the end user.
- Shared – the system ensures consistency and data security in the case of multi-user access to data.
- Multidimensional – the system provides a multidimensional conceptual view of the data, including a full support for hierarchies and multiple hierarchies.
- Information – indicates all data and information obtained from them, wherever these may be located, and irrespective of how relevant to the application the same are.

Yet another one out of the existing modified definition of OLAP would be the one according to which OLAP is a category of software solutions allowing managers to gain an insight into data through a fast, consistent and interactive approach, using different views of data, arising from operational, unstructured data, and in a way emphasizing the dimensionality of such data. OLAP is a technology used for the organization of large enterprise databases in order to support business intelligence. OLAP databases are divided into one or more

cubes, and the cubes administrator organizes and designs each single cube so as to make it suit the mode of downloading and data analysis. This would allow the easier creation and use of required reports. PivotTable reports and reports derived from charts. OLAP cubes are specially configured for the purpose of the analysis of large amounts of data, layering methods and cutting (the Slice and Dice Method). The known authors Liautaud and Hammond emphasize that Drill-Down/Up represents an analytical technique allowing the user to move around the levels of data aggregation, i.e. from the highest level to the corresponding details of the data at the lowest level [10]. This functionality is available for dimensions that have hierarchies. Appropriate aggregates, defined for the particular hierarchy, must also exist in the data warehouse in order for this operation to be quick and efficient. Rotation is a feature of an OLAP tool, which enables a view of the data from the reverse perspective. In addition, Liautaud and Hammond point out that OLAP systems usually display the output in an intersection of the magnitudes represented by the X and the Y axes. By substituting the magnitudes of the X and the Y axes, the so-called rotated display of output information is obtained [10].

OLAP technology enables users to access and analyse "ad-hoc" data, view information obtained through comparisons, analyse past data and the data derived from a variety of "what-if" scenarios. OLAP applications are used by analysts and managers, who often require a review of highly-aggregated data, such as the total sales of a single product line of the enterprise or one particular region, state, etc. OLAP databases or analytical databases are subject to changes originating from multiple data sources, providing a strong analytical background to many user applications. One possible preview of an OLTP/OLAP architecture is shown in Figure 2.

Figure 2. OLTP/OLAP architecture [4]

In contrast to SQL statements, which are placed in the transactional database and provide an answer to the question of what is in the database, OLAP goes a step further, entering the field of data meaning, and provides answers to questions whether some assumptions separated from the database are true. Kimball (2002) points out that OLAP creates a series of hypothetical laws and relationships between data and uses query systems in order to either confirm or deny them [11].

Multidimensional OLAP (MOLAP) allows performing an OLAP analysis over multidimensional databases (MDDB). The basic premise of this architecture is that data must be stored in a multidimensional way in order to be multi-dimensionally observed and used, which is presented in Figure 3.

Multidimensional database (MDB) is responsible for the execution of all OLAP requirements.

The presentation level is integrated by the logical level of an application and provides an interface through which end users observe and perform an OLAP analysis. The client/server architecture allows multiple users to access the same multidimensional database.

The Relational OLAP (ROLAP) approaches data stored in a data warehouse in order to carry out an OLAP analysis. ROLAP's premise is that OLAP capabilities are best supported directly over the relational databases, i.e. the data warehouse. In his papers, Almeida says that there are also some other types of OLAP tools, such as [12]: WOLAP – Web-based OLAP, DOLAP – Desktop OLAP, RTOLAP – Real-Time OLAP, SOLAP – Spatial OLAP.

Figure 3. Preview of MOLAP architecture [4]

Data warehouses and OLAP systems provide the quality of business information systems and business intelligence systems. At all times and in all places, their customers have access to critical business information and opportunities to carry out an analysis in a very simple, fast and efficient manner, which is rather useful, one could freely say necessary, in the business world today.

The fourth group of the tools is especially interesting for managers. These are control panels (Dashboard). A well-known author, Few, defines the control panel as a visual representation of the most important information needed to achieve one or more objectives [13]. This information is consolidated and displayed on a single screen, enabling an easy tracking of the status of the entire organization. Some elements appearing on the control panel can display the tendencies of stock movements, maps showing sales regardless of the geographic location, as well as the key indicators for achieving results (KPI – Key Progress Indicator), indicating whether they meet the set goals.

3. OLAP REPORTING IN THE COMPANY „LIPOVICA“

OLAP reporting uses huge databases, from which information is obtained through multiple filtering. In a short time, this generates a possibility of utilizing and applying the experiences of the other companies that have applied the concept of business intelligence. These companies are able to reduce their overall operating costs, significantly increase their productivity and make the best use of their strategic advantage.

The next part of the paper presents some of the implementations which, in all companies, and in the observed company “Lipovica” as well, can be singled out as common.

3.1. Implementation in the Financial Sector

OLAP reporting enables the financial sector much faster, more comfortable and more effective reporting. In addition, it significantly improves the distribution of information.

3.2. Implementation in the Sales Department

Sales teams should be primarily oriented towards the income category, rather than the profit category. The main aim of the OLAP reporting application in the field of sales is to align sales activities with the goal of increasing corporate profits.

When reporting related to sales is concerned, the main problem is the time needed for data collection, an analysis, the production and distribution of reports. That time can be measured in hours and often days. OLAP reports (Figure 4) enable sales teams to quickly manipulate with information related to sale.

Figure 4. Interactive reports for sales analysis [14].

3.3. Implementation Within the Marketing Department

A market share is the usual measure of success in marketing. The key question arising is: How to obtain big customers who will maximize the profits of the enterprise? The leading banks observe their clients today in the same way as they used to consider their investment plans: they analyse their profitability and concentrate on those generating the best results.

OLAP reporting in the field of marketing allows companies to observe customers in the same way. By using a rich set of algorithms and query tools, users can obtain useful information such as purchasing habits, sales forecasts, the key influences, the market trends and the effectiveness of the campaign. Modern information systems, VIS and the Internet have on a constant basis and significantly changed the lives of people and the conditions of the business doing of enterprises.

They have, among other things, drastically changed the ways of advertising and marketing products/services and the business network, because the world has become (a global village) a large market where small and medium-sized enterprises, such as the enterprise Lipovica, struggle to survive because of strong internal and external competition. Structured as such, storages for user-related data are only safe for accessing data as the final product of the ETL process, and they represent the only one version of the truth. In this way, the decision-making process can be of a much higher quality than the one of competing companies.

3.4. The Advantages of the Application of the New Manner of Business Doing from Users' Experiences – A Survey

Prior to the introduction of OLAP and intelligent decision support systems in the company "Lipovica", it would take days for something to be booked: now, however, the booking is performed in real time. Also, from the moment machine rounded posts were ready to be transported to the moment the buyer purchased the same several days would pass.

The shown original structure and the method of accessing data in the enterprise Lipovica leads us to yet another notion, which means accessing data not stored in a single file, folder or group. These data are usually invisible immediately and unavailable, but filtering is what should rather be done so that, from within many horizontally and vertically obtained values, the needed one could be highlighted. Before the intelligent decision support systems were introduced, certain human and time resources had been activated and utilized so that appropriate solutions could have been reached; on the other hand, by applying the OLAP technology and by the implementation of the intelligent decision support systems, the working hours and the days spent in searching for and filtering data could be reduced to just a few seconds, and all this if huge databases are the subject matter of our concern. In the event these are relatively small quantities of data, as in the case of the forest farm of "Lipovica", the results would be immediate. Also, any worker assigned certain system-access privileges could obtain such results. Technologically, the individual databases formed by the organizational units (the Sales, the Tracking of the

Ecosystem, the Forest Development and the State of the Production of Round Wood) have created a single interconnection database with the integrated data from all the independent databases, which in the future will be referred to by all clients, if they want to implement certain queries, which has greatly improved the organization of the data at the enterprise "Lipovica".

Compared to other studies, the application of methodologies of Business intelligence in companies realized significant business results from different aspects:

- Profitability analyses relating to market, product or channel profitability [15]
- Collaborative decision making [16]
- The development of executable business process models [17]
- Analysis of the competitive position of a firm [18]

Analysing the future development of business intelligence Golfarelli et al (2004) [19] highlight its important application in the analysis of the strategy, and finding time-critical operational processes using the Business Performance Management (BPM).

4. CONCLUSION

The results of this study indicate that, thanks to the successful implementation of the OLAP functionality at "Lipovica", the management have come to the conclusion that, in the five-year period, the capacity can be expanded by 24%, and that the planting and the cutting materials that would generate a total profit of 48% in comparison with the current period can be reallocated. By applying the OLAP technology i.e. by introducing unified information software solutions into all the organizational units of the company "Lipovica", a multiple benefit has been realized and communication towards customers and suppliers and internal communication within the company have been made easier. So, communication between the commercial department and the finance department is now significantly reduced, because information is entered by those who produce them, simultaneously bearing the responsibility for what has been entered, while, on the other hand, they both can obtain all the data they need. Based on the foregoing, the final consideration of the expected results comes down to the fact that it is possible to make a conceptual model of the development of intelligent decision support systems in small and medium-sized enterprises. The research results show that the designed concept of applying an OLAP analytical database provides a large range of options for finding and obtaining high-quality information for decision making. From the established starting positions, it is also possible to see the characteristics of the implementation of the methodical framework for the development of intelligent systems for the preparation of applications for decision-making support in small and medium-sized enterprises. This model can be applied to all enterprises, so that by the implementation of OLAP and the other techniques it is possible to prepare useful reports necessary for timely and accurate decision making, given the fact that knowledge is hidden in huge amounts of business data of small and medium-sized enterprises and that it is possible to extract exactly by using the above techniques. Research studies in the field of the competitive advantages of small and medium-sized enterprises in Serbia reflect that what a

company knows, the way in which it uses the knowledge it has and the speed in which it can adopt new knowledge is the only one thing that ensures them a reliable advantage over their competition in the conditions of the global economic crisis today.

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