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A Conceptual Framework of a Cloud-Based Customer Analytics Tool for Retail SMEs

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Abstract
Since customers are seen as a strategic element in a company's downstream supply chain, many retail organizations have been employing a customer-centric business strategy and started investing into such technologies and solutions known as customer analytics that are capable of processing huge amount customer data for enhanced decision making. Customer analytics has been of significant importance in most developed economies around the world particularly for large organizations. The off-the-shelf analytics solutions provided by vendors are perceived to be unmanageable, risky and unaffordable especially for Small and Medium Enterprises (SMEs) operating in retail sector. This becomes more vital for the SMEs in developing countries especially in the Eastern part of Europe where they constitute a noteworthy part of the economy. The majority of the SMEs in these countries lack of facilities, infrastructure and abilities to perform such analytical applications. Not being able to extract strategic knowledge using customer data is a missing component for them to be competitive and sustainable in the market from relationship marketing point of view. The aim of this paper is to propose a conceptual model that addresses this problem by providing retail SMEs with a cloud-based open platform for customer data analytics and knowledge extraction. The platform will be able to connect with numerous apps already employed at the retail SMEs, acquire customer data and then perform customer analytics in order to produce a rich set of reports and knowledge.

Keywords: customer analytics, business intelligence, cloud-based computing, knowledge extraction, retail SMEs

1. Introduction

1.1. Use of word-processing software

Customer analytics is a set of technologies that enables companies to acquire the competency of making accurate, timely and effective decisions at all levels regarding customer management processes [1]. It refers to applying various analytics techniques to customer data which may be generated through the internal business processes (the operational data stores) or could be acquired through external and open data sources [2]. The term customer analytics was originated from analytical customer relationship management but it goes beyond its analytical capabilities that are applied in customer management processes. Customer analytics consists of more sophisticated tools and technologies which are capable of processing huge amount of customer data. The main functionalities concerning an analytical customer management solution are associated with four dimensions of customer relationship management, namely customer identification (selection of target customers, customer segmentation/profiling), customer attraction (direct marketing, campaign management), customer retention (customer loyalty including scoring models, one-to-one marketing, complaints management, customer churn modeling, behavioral and clickstream analysis), and customer development (customer lifetime value modeling, up/cross selling, market basket analysis) [1], [3], [4].

The structure of any customer analytics solution consists of four layers. On the bottom, there is the Data Infrastructure layer where customer data and information are stored. On top of this layer there is the Data Integration layer in which the data is turned into information by extraction and integration processes. The next layer is dedicated to more advance processing and reporting and as such it includes Online Analytical Processing cubes: a multi-dimensional view of customer information that allows users to drill data. The fourth and final level of the framework is the analytical environment, which is a domain of business users who use analytical tools to query, report, analyze, mine, visualize and most importantly act on the data [2], [5], [6], [7], [8], [9]

Customer analytics has been of significant importance in most developed economies around the world particularly for large organizations. The off-the-shelf analytics solutions provided by vendors are perceived to be unmanageable, risky and unaffordable especially for SMEs operating in retail sector [10], [11]. This becomes

more vital for the SMEs in developing countries especially in the Eastern part of Europe where they constitute a noteworthy part of the economy.

SMEs form the backbone of EU economy by accounting for 99.8 per cent of non-financial enterprises in 2012, which equates to 20.7 million businesses. In employment terms, SMEs also provide an estimated 67.4 per cent of jobs in the non-financial business economy in 2012. Especially, in wholesale and retail trade, SME employment and added-value are positive and higher than those of large businesses [12]. For example, in Turkey, SMEs corresponds for 78% of employment, 55% of total added-value, 65,5% of total sales, 50% total investments, (2008 data) 59% of total exports (2009 data). Trade and commerce is the SME sector with the highest export and added-value on aggregate in 2007 [13]. The retail sector (organized and unorganized) is expected to reach US$313 billion in 2012 and grow with 10% CAGR until 2016 [14]. The online trade volume in Turkey is booming too. The value of goods sold online has grown 61.1% from 2006 to 2011, predicting online sales in Turkey grow an additional 54% in real terms—that is excluding inflation—between 2012 and 2016 confirming that Turkey's e-commerce sector is one of the fastest growing in the world [15].

The majority of the retail SMEs in the above-mentioned countries lack of facilities, infrastructure and abilities to perform such analytical applications. Moreover, many SMEs lack the skills and the technical / economic capacity to attract the necessary funding in order to make the transformation to a more ICT oriented business cycle. Most of the SMEs in the retail sector rely on a back-office of simple PC-based apps; a few do employ business support systems such as ERPs or other type of information systems. In the majority of cases, data analytics and extracting strategic knowledge based on modern ICT systems is absent, especially within the context of customer management. Also, since most of the existing cloud-based analytics solutions do not fit to firm requirements [16], building a cloud solution specific to sectoral requirements can be of significant importance. The proposed model aims to address these problems by providing retail SMEs with a cloud-based open platform for customer data analytics and knowledge extraction.

The rest of the paper is organized as followings. In Section 2 and 3, recent work on similar frameworks pertaining analytics applications for SMEs as well as related literature regarding the current status of business/customer analytics market for SMEs are provided. Section 4 presents the proposed conceptual model and its components. Finally, Section 5 concludes the study by providing some discussions on potentials benefits of the proposed model.

2. Cloud-based Analytics for SMEs

In today's competitive environment, many SMEs started exploiting innovative BI solutions based cloud computing in order to gain competitive advantage [17]. Cloud BI, aka Software as a Services (SaaS) BI or BI services on-demand, provides IT supporting infrastructure and analytical abilities with excellent scalability, large scale storage, and high performance [18]. NIST (National Institute of Standards and Technology) defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction" [19].

The related literature presents essential characteristics of cloud computing as followings [17], [19]:

- On-demand self-service (platform with minimal management or self-management),
- Broad network access (accessible via internet from any device),
- Resource pooling (shared, configurable, flexible, dynamic resources),
- Rapid elasticity (virtual, dynamic, scalable and massive infrastructure),
- Measured services (charging based on consumption).

Considering the above-mentioned attributes of cloud computing, it can be argued that cloud technology could be of potential use for SMEs in accessing cheaper analytical solutions. Several operational and financial benefits can be obtained through the use of cloud-based BI for SMEs some of which are [17], [20]:

- Time saving with speed of implementation and deployment
- Lower Total Cost of Ownership
- Elasticity / Flexibility / Agility
- Expertise support
- Focus on core strength
- Standardization of business models
- Quick access and On-demand availability
- Scalability

Although recent studies indicated that most of the organizations would consider cloud computing as a realistic technological option for future, current state of use of cloud-based solutions are in fact limited [17]. The main reason behind that is due to some potential risks or challenges associated with cloud computing which as follows [17], [20], [21] :

- Moving data to the cloud
- Data security and Privacy
- Speed of data access
- Integration with on premise data
- Lack of control
- Vendor maturity
- Reliability of service
- Internet resilience and bandwidth

Existing literature on analytics provide some discussions regarding the architectural and technological infrastructure required for and as well as concrete conceptual frameworks on web- or cloud-based analytics solutions for SMEs. Grabova et al. (2010) [16] made thorough discussions related to limitations of four main BI technologies and presented an architecture which includes relational on-line analytical processing (ROLAP) with java-based ETL. Xu et al. (2009) [18] suggested three layer cloud architecture (business application layer, big cloud-based parallel data mining layer, platform interface layer) for BI applications in telecommunications industry. Liyang et al. (2011) [22] provided more conventional approach to cloud-based BI architecture. Their SaaS BI architecture includes five layers, namely Infrastructure Layer, Data Service Layer, Business Service Layer, User Interface Service Layer, and Operational Service Layer. Wu et al. (2007) [23] also suggested five layer web-based BI architecture which is called Service Oriented Architecture for IT Performance Analytic (SOA-ITPA). The framework consists of data source layer, ETL layer, physical layer, logical layer and analytic application layer.

3. Assessment of Current Analytics Solutions From SMEs' Perspectives

The business analytics software market can be considered as an aggregation of several software tools. Table 1 provides a snapshot of the business analytics software market which has three primary segments: performance management and analytic applications, business intelligence and analytic tools, and data warehouse platform software [24]

Table 1. Business Analytics Market (Source: (Vesset et al., 2012)[24])

<table>
<tr><th colspan="2">PERFORMANCE MANAGEMENT AND ANALYTICS APPLICATIONS</th><th>BUSINESS INTELLIGENCE TOOLS</th></tr>
<tr><td>Financial performance, strategy management, and GRC applications
(Budgeting and planning, consolidation, profitability, and cross-functional GRC)</td><td>CRM analytic applications
(Sales, customer service, contact centre, marketing, web site analytics, and price optimization)</td><td>Query, reporting, and analysis tools
(Dashboards, production reporting, OLAP, and ad hoc query)</td></tr>
<tr><td>Supply chain analytic applications
(procurement, logistics, and manufacturing)</td><td>Service operations analytic applications
(Financial services, education, government, healthcare, communication services etc.)</td><td>Advanced analytics tools
(Data mining and statistics)</td></tr>
<tr><td rowspan="2">Workforce analytic applications</td><td rowspan="2">Production planning analytic applications
(Demand, supply, and production planning)</td><td>Content analysis tools</td></tr>
<tr><td>Spatial information analytics tools</td></tr>
<tr><th colspan="3">DATAWAREHOUSE MANAGEMENT PLATFORM</th></tr>
<tr><td colspan="3">Data warehouse management</td></tr>
<tr><td colspan="3">Data warehouse generation
(Data extraction, transformation, loading; data quality)</td></tr>
</table>

The business analytics market is comprised of more than 100 companies and their associated products. Some of these service providers offer a single application, while some others provide software that spans multiple market segments (12 different market segments). In addition to that, there is a range of business models (e.g., commercial software and open source software) and deployment options (e.g., on-premise and public and private cloud) among these vendors. Though the top 5 business analytics vendors account for approximately 62% of the software revenue, the remaining 38% of the market can be considered as large enough piece of the cake for the small players in this area as shown in Table 2 [24], [25].

Table 2. Worldwide Business Analytics Software Revenue by Leading Vendor, 2009–2011 (Source: (Vesset et al., 2012)[24])

	Revenue ($M)			Share (%)			Growth (%)	
	2009	**2010**	**2011**	**2009**	**2010**	**2011**	**2009-2010**	**2010-2011**
Oracle	4,563.5	5,194.9	6,117.4	18.3	18.7	19.3	13.8	17.8
SAP	3,472.4	3,990.5	4,600.6	14.0	14.4	14.5	14.9	15.3
IBM	3,458.2	3,826.6	4,369.3	13.9	13.8	13.8	10.7	14.2
Microsoft	1,870.7	2,110.6	2,349.7	7.5	7.6	7.4	12.8	11.3
SAS	1,898.2	2,007.5	2,263.2	7.6	7.2	7.1	5.8	12.7
Other	9,624.3	10,655.1	12,002.2	38.7	38.3	37.9	10.7	12.6

Total	24,887.3	27,785.2	31,702.4	100.0	100.0	100.0	11.6	14.1

Recently, organizations with less business analytics experience, particularly SMEs, have become interested in analytics solutions. The majority of SMEs perform their business decisions through the managers' gut feelings and based on a combination of static historical reports generated via spreadsheets [11]. As companies continue to grow or face fierce competition, the necessity of making decisions that are based on meaningful information has become an imperative [26]. However, penetration of analytic applications into SMEs market is low because of the following reasons [2], [5], [10], [26], [27], [28], [29], [30]:

- SMEs are being reluctant on giving up spreadsheets
- Leaders are not fully familiar-with/convinced-about the return on investment (ROI)
- Leaders are aware of ROI, but end-users are not familiar with right tools or end-users are unable to interpret the recommendations from the analytics and translate them into business decisions.
- Tight ICT budgets, high prices and Time implementation consideration
- Lack of sophistication (limited ICT expertise), personnel and infrastructure
- Low flexibility and limited number of solutions available

Due to the reasons stated above an external help to SMEs is certainly needed. But, the majority of the vendors and their solution partners usually use a time-and-materials approach to deploy analytics solutions to SMEs. This could be affordable and suitable for large enterprises but it does not fit SMEs with smaller budgets. Also, equally important is the fact that the buyers of analytics solutions are mainly less tech-savvy managers and they are looking for simpler, less technology-centred solutions. Pre-built solutions delivered by the players in the market via the traditional service-oriented approach could be considered an alternative for SMEs. However, such an approach is too expensive for SMEs and it is neither scalable nor repeatable [29]. For an SME, successful business analytics implementation relies on four basic stages: information/data; technology; intelligence; and implementation and communication [26]:

1. With regards to information/data, one could argue that the smaller the size of the company the less data is available. Compared to the data available in an ERP system, SMEs possess a basic entry-level accounting program that stores substantially less information. Most SMEs usually manage their key business data in spreadsheets, contact manager databases, payroll systems, and other home-grown databases.
2. In terms of the technology aspect, the software solutions that can deliver analytics applications are beyond the financial reach of SMEs. Therefore, they usually tend to go for very cheap and simple solutions in the form of spreadsheets. Ubiquitous spreadsheet packages like Excel are undoubtedly valuable and powerful tools, but this approach possesses some limitations and dangers (dependency, inflexibility, insecurity, complexity) [10]. Another technological solution for SMEs is the packaged solutions provided via cloud computing. Although some of the products delivered via the software-as-a-service model could be considered as an alternative solution to SMEs, but much cheaper versions of such technology should be made available to SMEs.
3. As far as the intelligence aspect is concerned, SMEs face exactly the same problem as large companies do in determining the relevant data and metrics. Being overwhelmed by the data and having difficulty to focus on what is truly important are also unavoidable for SMEs mainly due to the amount of available data in the operational data stores and not having the relevant trained staff. Therefore, an external help is needed in defining critical success factors and the data/metrics for a typical SME.
4. In the majority of analytics applications, the crucial element frequently missing is the communication aspect (explaining to the users what the analytics mean, how to interpret them, and what actions to take). Therefore, a decision support system platform could be of potential use in an analytics solutions tailored to SMEs.

The discussion above highlights that having such analytics applications accessible to SMEs should be within their financial capacity and horizon, while also the solutions provided should overcome the difficulties of adapting the analytics pertaining to SMEs by taking into account the following critical factors, including aligning business and IT, time concern, ease of use, reducing total ownership cost, flexibility and adaptability [5]. In conclusion, it is believed that the business analytics market is still dominated by traditional on-premises solutions, therefore, utilizing key forces like cloud computing in an adaptive and cheaper way will play a key role in increased adoption of the analytics for SMEs.

4. Proposed Conceptual Model

While in-house business analytics solutions are common in Western and Northern Europe, the situation is totally different, if one takes a look at the South East end of Europe. Economies in that area of Europe are largely SME-based but a sizeable percentage of these SMEs have a limited capability of exploiting business analytics in

order to improve their business performance. Part of the explanation for this phenomenon is attributed to cultural and historical reasons. Another important reason is the lack of effective funding; SMEs either decide to invest elsewhere or operate on very low margins, thus being unable to afford an ICT back-office in general (despite the generous funding from European Union sources). This situation is evidently a very serious obstacle for growth with respect to SMEs and SME-based economies in this region. The proposed model addresses this problem by moving the business analytics infrastructure out of the SME environment and into the cloud. This removes the requirement for dedicated hardware / software and combined with an affordable pricing scheme, significantly lowers the barrier of entry for medium-sized/small players. The model will provide SMEs with business analytics (sales, marketing and customer analytics) and reporting/knowledge extraction components for medium and long term business strategies. The model will be compatible with several business data formats and sources (e.g. MS Office files, XML-formatted files, ERP systems etc.) and will be equipped with the appropriate software tools in order for SME-derived data to be seamlessly loaded onto the platform for further processing.

The architectural design of the model is based on a complete data life cycle that starts with the acquisition of raw data and ends with business analytics reporting as depicted in Figure 1. In terms of system architecture, the model will implement, to the furthest extent possible, a modular architecture consisting of loosely coupled, self-contained software components. This approach guarantees portability, ease of integration and modification of the platform. The main components of the model are presented as the following:

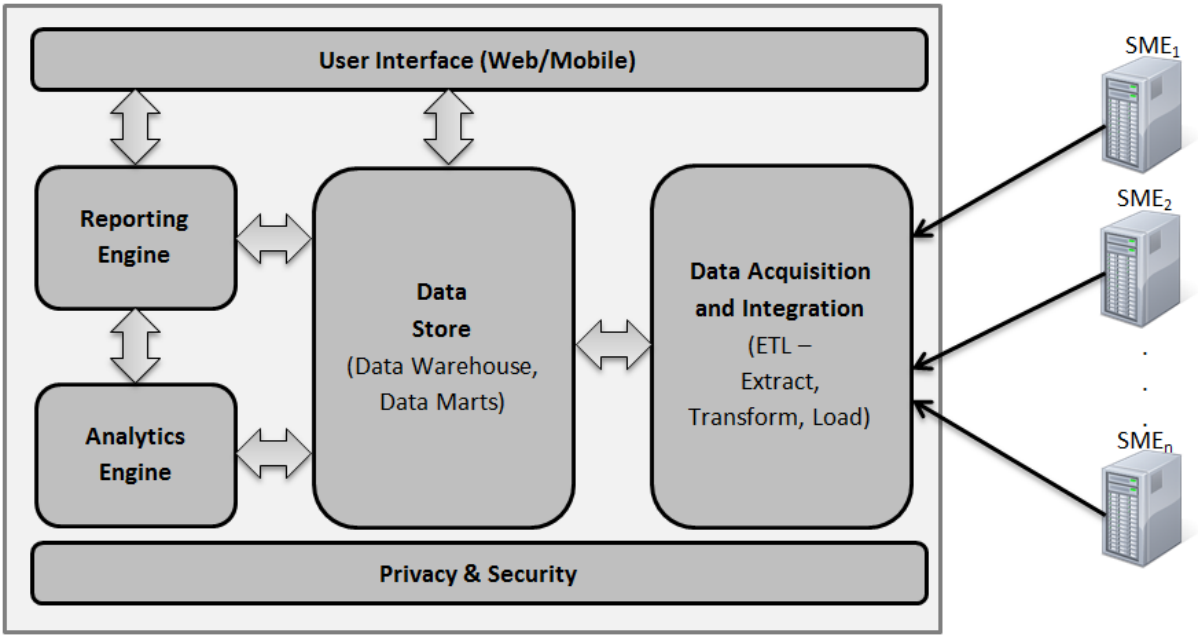

Figure 1. Architectural Design of the Proposed Model

Data Acquisition and Integration: These are services that would be used for the acquisition of input data from the retail SMEs business systems. As such, they are tailored to the interfaces of each external business system e.g. XML, ERPs, Office files etc. Evidently, original input data exists in several formats, depending on the originating business system, and its structure resides in several languages, depending on the country/countries the retail SME resides in. This component is supplied with input data from the various business connectors and transforms it, incorporating also semantic mediation techniques, to a common data schema that can be used for further processing.

Data Store: This component is responsible for the persistence of input, intermediate and output data. The exact nature of the data store (SQL, NoSQL, OWL, RDFS, etc.) must be decided based on requirements analysis.

Analytics Engine: This is the component that is responsible for processing the input data and producing analytics information and knowledge such as e.g. sales and market analysis, segmentation. The analytical component of the model includes the following specific modules.

Sales Performance Analytics Module: To be able to construct this module the followings must be identified: the common sales performance metrics, the target data set which includes the necessary data fields required for these metrics, some pre-processing activities (validation, aggregation, reduction, transformation, consolidation, and etc.) and their logical principles, the mathematical calculations needed to come up these metrics, determination of programming needs and procedures.

Some data pre-processing technologies, tools and principles regarding data preparation as well as potential data exploration methods based on mathematical and statistical models (eg., univariate and multi-variate analyses, linear and logistics regression) must also be utilized within this module.

Market/Sales Intelligence Module: This module includes several forecasting models for the aim of extracting marketing and sales intelligence information/knowledge. Therefore, after determining the types of information to be extracted, the necessary variables associated with each type of knowledge-domain must be specified. Through the identification of dependent and independent variables for each knowledge-domain several forecasting and econometric models can be employed.

Market Basket Analysis Module: In order to create this module some pre-processing activities on the consolidated data mart to make the data ready for market basket analysis must be carried out. The module also utilizes a robust and commonly used data mining based association rules technique (the Apriori algorithm) in order to carry out market basket analysis. Therefore, a user-defined flexible rule extraction design must be accomplished via taking into account different parameters (eg., confidence and support levels of the rules) of the algorithm.

Customer Analytics Module: The activities regarding this module have two folds. The first group of activities would ensure the most flexible and comprehensive target data selection process for conducting the analyses particularly customer segmentation, customer lifetime value calculation and customer churn modeling. Therefore, potential data preparation and exploration technologies, tools and principles within the context of data mining and knowledge discovery can be utilized. The second category of activities include the followings: (1) identification of segmentation, lifetime value and churn models and the variables (or the bases) required to perform each type of segmentation, lifetime value, and churn model; (2) determination and design/programming procedures of data mining based clustering, classification and prediction algorithms (including k-means, fuzzy c-means, self-organizing maps, back-propagation, logistic regression) needed to carry out the selected segmentation and churn models; (3) design/programming procedures of logical principles and the mathematical calculations of each selected lifetime value model; (4) determination of the criteria required for the evaluation and validity assessment of the selected segmentation, lifetime value and churn models and design their mathematical calculations.

Reporting Engine: This component properly combines the derived knowledge from the SME originated business data in order to produce custom reports that concern long term strategic decisions for SMEs (i.e. What will be the sales projections? Which sales channels have better performance? Which customers are more profitable or valuable? What are the main customer segments? What are the profiles of each segments? Should I tailor a pricing model for each segment? etc.).

User Interface (UI): The model will feature a web-based front-end based on responsive design principles in order to be compatible with desktop and mobile terminals. The main role of UI is to allow SMEs to benefit the business analytics reports.

Privacy and Security Component: One of the major issues concerning the platform is how to convince SMEs that it would be safe to send their business data to an external platform for further processing. There are open issues concerning data theft, data corruption, as well as trade secrets. A minimum set of requirements would most certainly have to offer secure authentication / authorization, secure connections, encrypted databases, as well as, an anonymization process that would make it very difficult for a 3rd party to associate a set of data with a specific SME.

5. Conclusions and Discussions

The proposed model aims to provide retail SMEs with a cloud-based open platform for customer data analytics by contributing them in acquiring the access to competences and resources that they need to develop innovative content and data analytics services. The model connects with numerous apps already employed at SMEs, acquire customer data and then perform analysis processes in order to produce a rich set of customer analytics reports. Considering the fact that most cloud computing-based BI tools may not be suitable for every organization, the proposed model provides a customized solution for retail SMEs within context of analytical processing and reporting regarding customer management.

The suggested technological architecture and business model will enable the sustainability and wider use of the model outcomes. The cloud model, for instance can provide a pay per use option for SMEs who can become register and as a member benefit from the provided services for a low and affordable price. The related bodies such as retailers, associations and development agencies can be contacted for ensuring the outreach and sustainability of the model outcomes. The sustainability of the model depends on the assumption that either a financially affordable pay per use business model will be facilitated to SMEs or an external fund is to be obtained from the related governmental institutions, retail/SME associations and unions.

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