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minib25

marketing of scientific
and research organizations

no. 3(25)/2017



research
for future

eISSN 2353-8414

pISSN 2353-8503

september 2017



CLOUD COMPUTING APPLICATION FOR ROMANIAN SMES

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DOI: 10.14611/minib.25.09.2017.15



Summary

The article studies the current economical state of Romanian SMEs and the utility of cloud computing technologies in the process of sustainable open innovation. The study is based on a supply chain adapted for SMEs, on a model of innovation within a network business environment and on a decision tree dedicated for SMEs when starting a new project. Taking into account the statements of the article, a new framework of cloud computing economics can be developed.

Keywords: cloud computing, SMEs, AngularJS, JSON, model of innovation, supply chain, decision tree

Current Economic State of Romanian SMEs

Romanian economic indicators are not very encouraging and the development in our country is slower than economic growth. Although GDP has increase 4 times in the past 15 years, the human development index increased by only 12.2%: [Georgescu, 2016]

- because of the quality of relatively weak growth (structural problems in the real economy, the main force to create GDP), deficiencies in the distribution of GDP, as the effect of financial indiscipline and illegalities in society;
- report distribution of income among working (40%) and capital (60%) is in Romania as opposed to the developed countries;
- the economic activity and financial results of the past 15 years, companies have increased the capital with 5 billion (6% of the total amount that was capitalized Romania in the last 15 years). The difference (94%) of investment in Romania was generated by new capital contribution of shareholders, especially those new entrants, mostly foreigners;
- examining the behavior of investment-disinvestment of shareholders, many companies are targeting the short term interests and are not applying development strategy in the medium and long term because: 1) they record large losses, 2) the shareholders grant substantial loans for their preferential economic agents causing losses, 3) precisely amounts "taken out" of the company by "financial engineers", representing inflated production costs;
- many shareholders used the insolvency procedure as a legal method "to exit from the scene", at considerable cost for creditors (budget banks, suppliers etc.);
- disproportionate ratio between wages and profits in favor of the profits;
- the costs of the crisis were shifted to the employees and by reducing social programs;
- rapid income polarization determine social disparities. Although GDP growth during 2007-2014 was 20%, the share of poverty only decreased by 14 percent;

These phenomena and behaviors show structural weaknesses or low technological level, low paid jobs, reduced processing products, processes simple repetitive operations.

In the literature review SMEs are considered the engine of the economy. In Europe, SME's are responsible for a big percentage of private sector jobs and produce more than 50% of the total value-added created by companies [Rocha, 2016]. In this economical situation Romanian SMEs could be the beneficiary Blue Ocean Strategy adapted to their necessities (Fig.3), taking the advantages of cloud computing technologies and trying to mitigate the economic-financial risks.

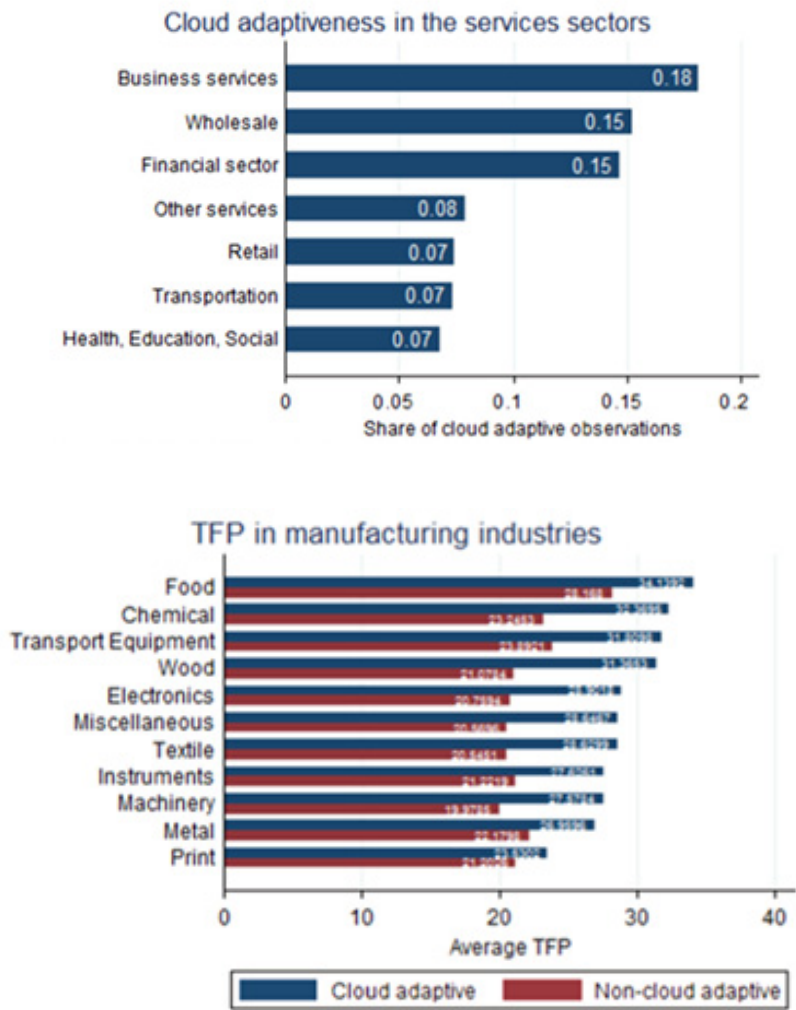
Cloud Computing for SMEs

Based on survey panel data from European firms the authors [Candel, 2016] shows that cloud adoption and adaptiveness differ widely across industry sectors and is correlated to a firm's position in the supply chain. Thus the type of output it produces differs in accordance with the market in which it operates. Their study show that small business has a very similar trend with large companies, being very adaptable to the new technology, in contrast with medium sized firms, that show a delay in the process of adaptation. Cloud computing involves pooling IT resources such as storage or processing in a virtual system serving multiple users. Resource pooling allows for specialization and the realization of economies of scale on the provider side. Capacities are assigned dynamically according to demand; users therefore cannot locate their data in a certain geographic area. Importantly, cloud users often can purchase computing resources without any human interaction and at short notice (on-demand self-service).

The authors substantiated that service sector is more cloud adaptive than the manufacturing sector and that it is especially business services and the financial and wholesale sectors that are most cloud adaptive. In the manufacturing sector there are a lot of cloud adaptive firms in food, chemical, transport equipment, wood and electronics fields. In wood

fields the prevalence of cloud adaptive firms is bigger in contrast with non-adaptive firms. Cloud computing adoption varies based on a firm's position in the supply chain and thus suggests a linkage of cloud adaptiveness and the firm's type of output or its market power in addition to its industry (Fig. 1).

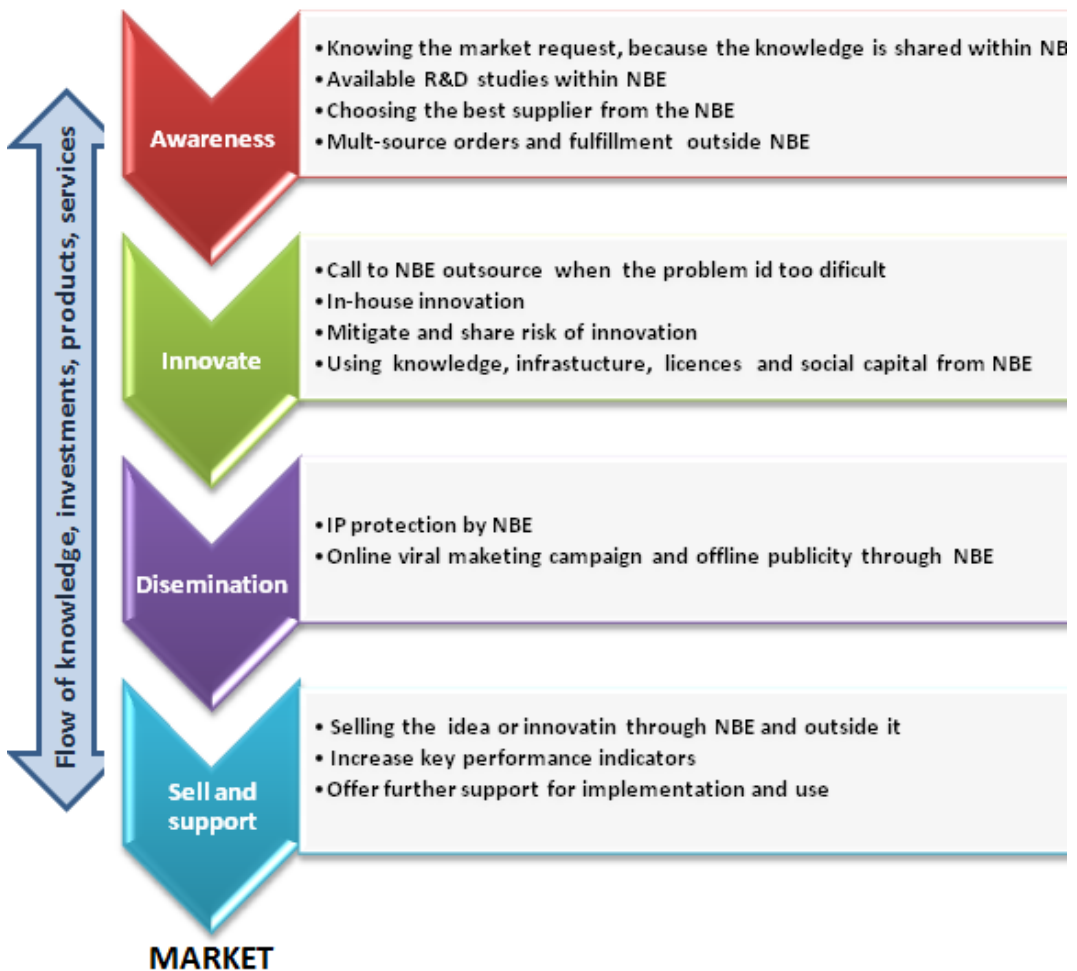
Figure 1. Cloud Adaptiveness in the Service Sectors and Total Factor Productivity (TFP) in Manufacturing Industries



Source: [Candel, 2016].

SMEs activating in a Network Business Environment (NBE), using cloud technologies, have special outlined supply chain for sustainable open innovation, as is presented in the Fig. 2. The chain start with the awareness feature, that is very high for SMEs operating in a NBE, because they have access of marketing studies, R&D studies, investments in social capital, etc.

Figure 2. Supply Chain for Sustainable Open Innovation within
a Net Business Environment



Source: Own conception.

A SME connected with other SMEs through cloud technologies will call to NBE outsourcing services when the problem is too difficult and proceed to in-house innovation. Having the cloud protection the SME will mitigate and share the risks of innovation, using knowledge, infrastructure, licenses and social capital from NBE. Dissemination is free of charge or cheaper within NBE using cloud technologies, which offers security and IP protection. The selling, further services and support associated to the idea/innovation are facilitated by SMEs.

Cloud computing often provides Business intelligence (BI) solutions. BI during times of crisis have been analyzed by [Antoniadis & co., 2015] in a case study on 37 SMEs. The capabilities considered by SMEs as being the most important are: the aggregated results tools, importing/ exporting data, optimization techniques, economic management/ accounting tools, OLAP Possibilities (multi dimensional analysis), dynamic user interface (dashboard). Tools capabilities that are considered very closed to the first category are cloud applications systems (web-based), simulation/risk assessment, property management tools and investment analysis tools [Antoniadis, 2015].

Cloud Computing offer for SMEs tools comprised of three main streams: Computer-aided engineering (CAE) software packages, a Product Life Cycle (PLM) tool, and an Open Innovation (OI) platform, through the CloudPyme2 project (CPP2). It is providing innovation tools for product development and manufacturing processes to SMEs in a sustainable business [Rocha, 2016].

The cost of ICT technologies is high enough as SMEs not to be able to support it. 90% of European SMEs with less than ten employees, often face greater obstacles than bigger companies in terms of skills, costs of resources, funding or access to markets [Rocha 2016].

It has been observed that many companies in the information and communication technology (ICT) industry have been faced with the same phenomenon in which 80% of their budget was spent on maintaining existing ICT services and infrastructures, while only 20% on their core business functions. As a result, a limited amount of computing resources and capital can be used to improve the core competences of small- and medium-sized manufacturers (SMMs),

including the development of new products and the improvement of existing products [Dazhong, 2015].

As a consequence many companies adopt outsourcing services. In this context has developed cloud computing that offers both computing technologies and outsourcing services advantages, as a new paradigm and framework, able to solve computing problems, fostering internal and external communication, productivity, firms and regional economic growth. Cloud computing seems to be dedicated to SMEs, offering a supporting business environment for sustainable open innovation at low costs [Tonis, 2016].

Cloud computing allows SMEs to innovate into a network after a model based on three pilings: open-innovation, eco-innovation and Blue Ocean Strategy [Tonis, 2016].

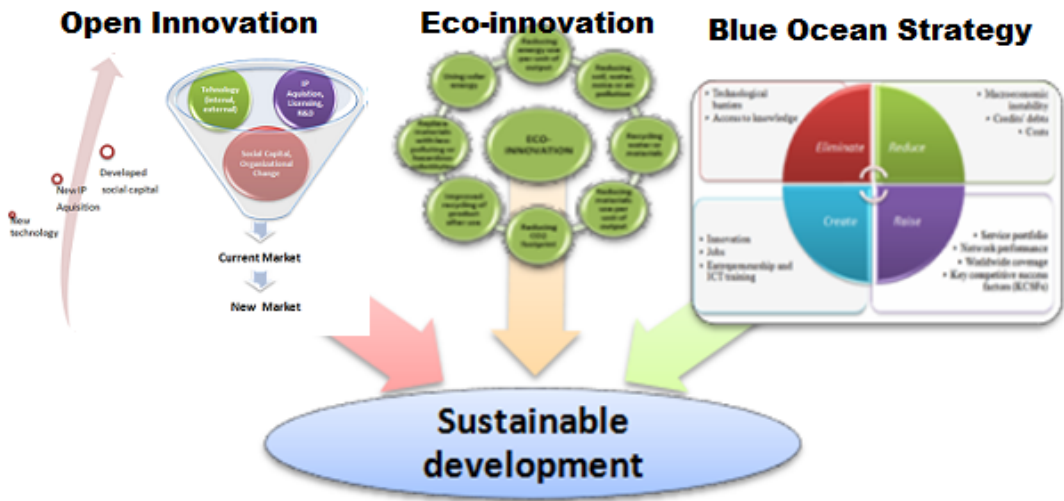
Open innovation is a dynamic process, whose inputs are external technology in-sourcing, Intellectual Property acquisition, licensing, R&D, social capital and organizational change, each of these being in a continuous evolution, in anticipation of future market evolution. Social capital is based on social networks interaction, trust and reciprocity between counterparties and shared norms and values in the business process.

Through eco-innovation firms can improve their profitability reducing waste disposal and raw materials cost and increase product value due to enhanced reputation of the company. Customers demand for environmental-friendly products or services is increasing and take into account the regulations for protecting the environment. Eco-innovation improves competitiveness and overall business success and brings the sense of feeling good when protecting the environment. Eco-innovation is easier to be implemented in the network than open innovation is.

SMEs can be the beneficiary of open and eco-innovation if they try to conduct their business in accordance with Blue Ocean Strategy, based on ERRC (Eliminate- Reduce-Raise-Create) pattern. For SMEs the strategy has the aim to eliminate technological barriers and the lack of access to knowledge. It has to reduce macroeconomic instability, credits' debts and costs. In contrast has to raise service portfolio, network performance,

worldwide coverage and key competitive success factors (KCSFs). The adapted ERRC pattern also aims to create inexperienced activities until now, such as innovation, new jobs, and new methods of entrepreneurship and ICT training (Fig. 3).

Figure 3. Model for SMEs Open Innovation in a Network Business Environment

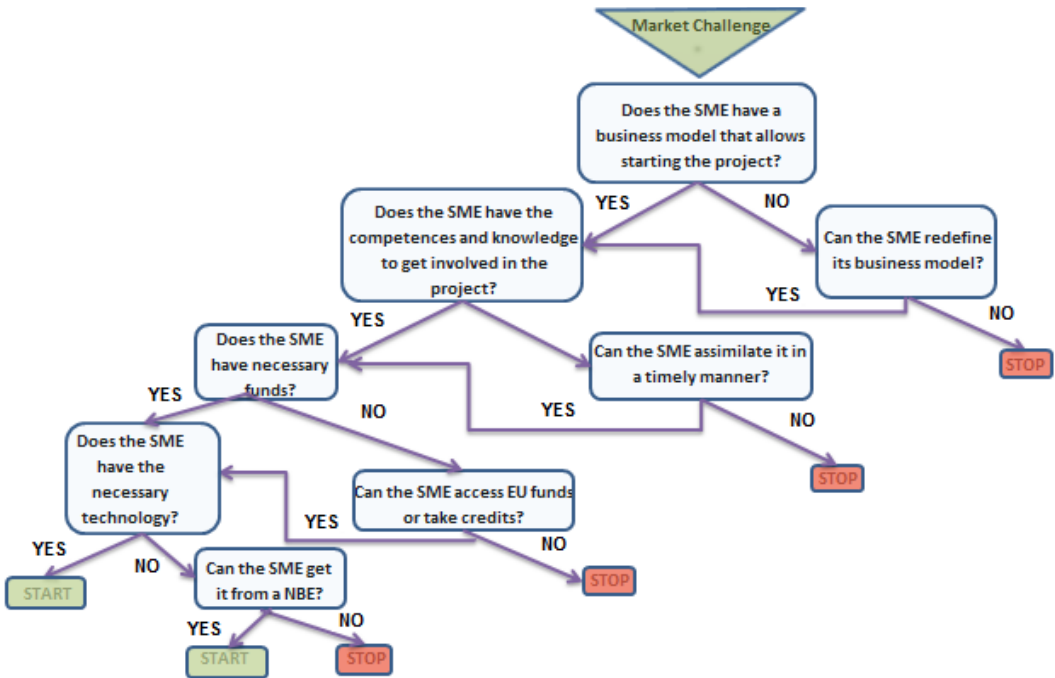


Source: Own conception.

When SMEs get a market challenge has to decide if it can face it or not. In this regard, a decision tree would be useful for managers to evaluate the factors that can lead the company to profit or loss. These factors are as presented in Fig. 4 Main factors that can influence the decision of starting a new project are the answers to the following questions:

- Does the SME have a business model that allows starting the project? If not, can SMEs redefine its business model? The SMEs should base their activity on the sustainable model presented above and ask for supplementary consultancy to be sure that the project is feasible.
- Does the SME have the competences and knowledge to get involved in the project? If not, can SMEs assimilate it in a timely manner? SMEs should look for knowledge and support in their NBE.

Figure 4. Decision Tree for Starting a New Project



Source: Own conception.

- Does the SME have necessary funds? If not, can SME access EU funds or take credits? SMEs should take into account the financial consultancy that can be obtained from the NBE.
- Does the SME have the necessary technology? If not, can SME get it from a NBE? SMEs start the project only if the technology is in accordance with the eco-innovation principles.

This tree shows that sustainable activities of SMEs require a long term planning and change, and is associated with a wide range of collaboration types. It also implies a deeper understanding of managerial process. Facing alone the market challenges is not a solution for competitive SMEs.

Having in mind the statements above it can be easier to understand the cloud computing benefits to economic field and develop a cloud computing framework and platform for SMEs, adapted especially at the firm and industry level.

Case study

Below is an example of cloud computing technology applied in economic field. It is a simulation of a network business environment using Qlik Sense Cloud for SMEs than can easy find a viable business partner. The application offer a dynamic dashboard regarding Romanian SMEs contact data and economic-financial data, as presented in the figure 5.

The application comprises other dynamic dashboards, presenting key performance indicators, such as economic, financial and commercial profitability. Applng the financial leverage on these KPI one can be sure of making business with a solvable SMEs. These dynamic boards can be shared with all the network members.

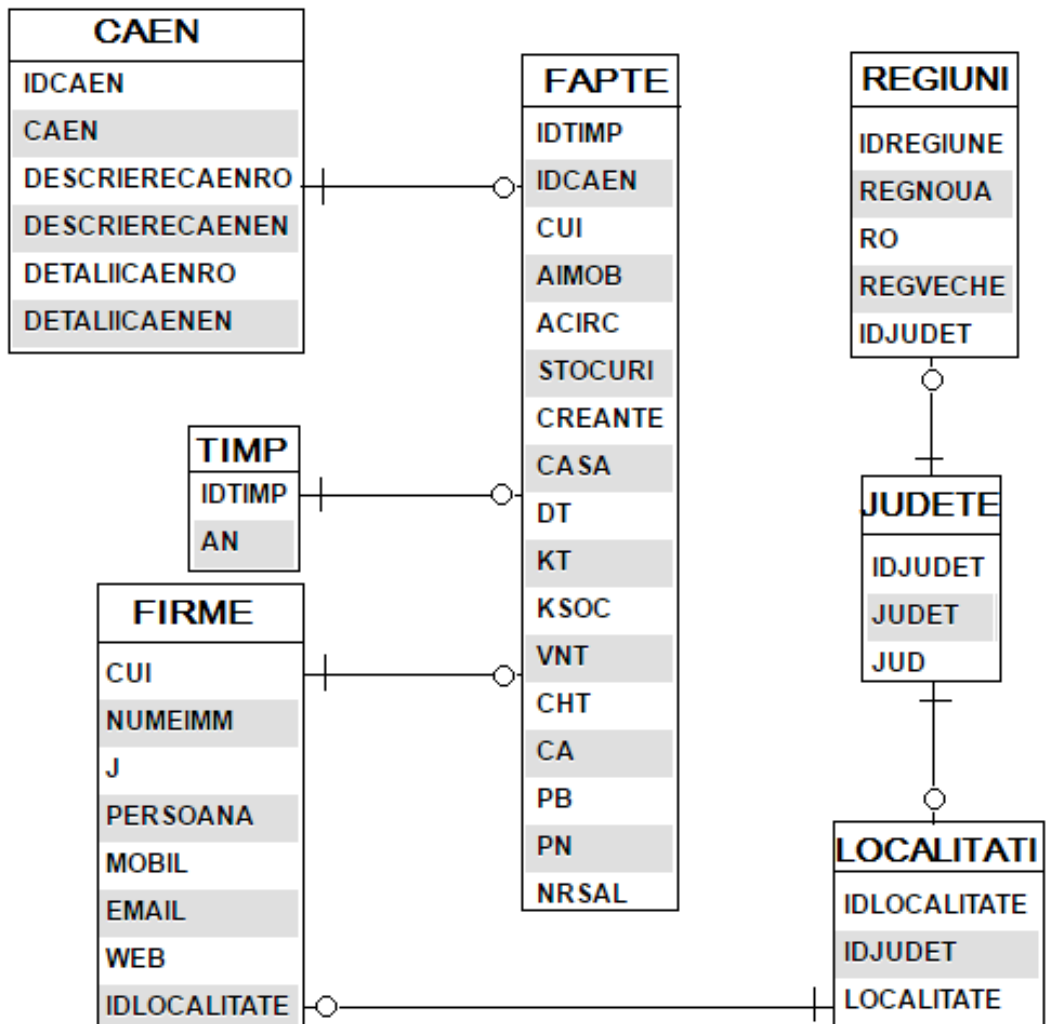
For the data presented in the previous dashboard, the Entity Relationship Diagram is presented below (see fig 6).

Figure 5. Dynamic Dashboard Regarding Romanian SMEs Economic-Financial Data

NUMEIMM SEARCH		ADRESA		TIMP	
?NGER P2ZITOR SRL		JUDET	REGNOUA	AN	
A WIEW SRL		ALBA	C	2006	
AB STAR TRANSPORT SRL		ALBA	C	2007	
ABOULEMENT SRL		ALBA	C	2008	
IMM				2009	
CUI	J	NUMEIMM	PERSOANA	MOBIL	
35572	J40/12631/199;	PROMSID SRL	CALOTA EMILIA	021-233.90.27	2010
37298	J40/11445/199]	JUNIOR TRADING UNIVERSAI	BOARIU VASILICA	-	2011
42502	J40/20122/199;	MARICON SRL	POP VIRGIL EMIL	021-242.14.09	2012
DATE FINANCIARE					
ACIRC	AIMOB	CA	CHT	VNT	PN
41335	0	63681	25166	63789	37028
41423	43918	187844	204675	188301	-16374
41481	62345	59500	63362	59800	-7081
41509	50403	34711	52424	34711	-19363
41509	50403	34711	52424	34711	-19363
CAEN					
CAEN	DESCRIERECAENRO				
1	Agricultura, vanatoare si servicii anexe				

Source: Own conception.

Figure 6. ER diagram for SMEs Warehouse



Source: Own conception.

The data is retrieved using a SQL query inside a PHP script:

```
// Query the database:      $result = mysqli_query($connection, $sql) or
die("Error in Selecting " . mysqli_error($connection));
// Utwórz tabelę wyników zapytania:
$emparray = array();
while($row =mysqli_fetch_assoc($result))
{
    $emparray[] = $row;
}
//Return a JSON for a given array:
echo json_encode($emparray);
The resulted data is encoded to JSON:
```

```
[{"CUI":"16676328","NUMEIMM":"HALAT
SRL","AIMOB":"2934585","ACIRC":"2837798","STOCURI":"1917206","CRE
ANTE":"797065","CASA":"123527","CH_AVANS":"0","DT":"2074533","VN_A
VANS":"0","PROVIZIOANE":"0","KT":"3697850","KSOC":"200","VNT":"4433
410","CHT":"4365264","CA":"4919551","PB":"68146","PN":"49505","NRSAL":
"21","AN":"2013"},
{ " C U I " : " 1 6 6 7 8 2 6 4 " , " N U M E I M M " : " D A N I
SRL","AIMOB":"722","ACIRC":"43564","STOCURI":"27000","CREANTE":"1
5186","CASA":"1378","CH_AVANS":"0","DT":"39413","VN_AVANS":"0","PR
OVIZIOANE":"0","KT":"4873","KSOC":"200","VNT":"1710","CHT":"29205","
CA":"13740","PB":"30915","PN":"30915","NRSAL":"0","AN":"2012"},
{"CUI":"17420076","NUMEIMM":"GIKY          IMPEX
SRL","AIMOB":"0","ACIRC":"24790","STOCURI":"10301","CREANTE":"860
0","CASA":"5889","CH_AVANS":"0","DT":"53372","VN_AVANS":"0","PROVI
ZIOANE":"0","KT":"28582","KSOC":"200","VNT":"21070","CHT":"20547","C
A":"21070","PB":"523","PN":"109","NRSAL":"1","AN":"2012"},...
```

The user sees the result filtered in AngularJS and formatted in HTML by using browser (<http://www.smesonline.eu/firme.html>), as may be seen in fig. 7:

```
<!-- Defining Angular application and controller name: -->
<div class="container" ng-app="myApp" ng-controller="customersCtrl">
<!-- Defining model component for dynamic data filtering: -->
<label>Search: <input ng-model="searchText"> </label>
<table class="table table-striped">
```

```

<thead>
<tr
class="info"> <th>CUI</th> <th>Nume</th> <th>AIMOB</th> <th>
ACIRC</th> <th>STOCURI</th> <th>CREANTE</th> <th>CASA</t
h> <th>CH_AVANS</th> <th>DT</th> <th>VN_AVANS</th> <th>
PROVIZIOANE</th> <th>KT</th> <th>KSOC</th> <th>VNT</th>
<th>CHT</th> <th>Cifra_afaceri</th> <th>Profit_brut</th> <th>Pr
ofit_net</th> <th>Nrsal</th> <th>An</th> </tr>
</thead>
<tbody>
<!-- Querying & filtering data from controller: -->
<tr ng-repeat="x in myData | filter:searchText">
<!--Binding data from response data: -->
<td>{{x.CUI}}</td> <td>{{x.NUMEIMM}}</td> <td>{{x.AIMOB}}</
td> <td>{{x.ACIRC}}</td> <td>{{x.STOCURI}}</td> <td>{{x.CREA
NTE}}</td> <td>{{x.CASA}}</td> <td>{{x.CH_AVANS}}</td> <td>
{{x.DT}}</td> <td>{{x.VN_AVANS}}</td> <td>{{x.PROVIZIOANE}}
</td> <td>{{x.KT}}</td> <td>{{x.KSOC}}</td> <td>{{x.VNT}}</td>
<td>{{x.CHT}}</td> <td>{{x.CA}}</td> <td>{{x.PB}}</td> <td>{{
x.PN}}</td> <td>{{x.NRSAL}}</td> <td>{{x.AN}}</td>
</tr>
</tbody>
</table>
</div>
<script>
var app = angular.module('myApp', []);
app.controller('customersCtrl', function($scope, $http) {
//Get data from PHP script:
$http.get("http://www.smesonline.eu/firme.php").then(function (response)
{
    $scope.myData = response.data;
});
});
</script>

```

The user can filter dynamically all the fields bound in AngularJS:

Figure 7. Demo Interface for Romanian SMEs Data Info

CUI	Nume	AIMOB	ACIRC	VNT	CHT	Cifra_afaceri	Profit_brut	Profit_net	Nrsa
16676328	HALAT SRL	2934585	2837798	4433410	4365264	4919551	68146	49505	21
17420076	GIKY IMPEX SRL	0	14205	21107	23949	21107	2842	3475	1
17617117	DORA LACT SRL	42538	127707	221612	134798	163284	86814	81814	0
19013770	INCA TEX SRL	60175	398200	1512549	1335825	1433982	176724	149343	37
20985658	GINI STYLE SRL	74996	312130	720629	629376	718617	91253	74514	31

Source: Own conception.

Conclusions

In the context of very fast developing technology and globalization, cloud computing proved to be a viable solution for SMEs. SMEs can gather into a NBE using cloud technologies, such as Qlik Sense as we demonstrate. Thus they can share information, learn ethical behavior, acquire new knowledge and technologies in their activity field and fair collaborate with other counterparties. In order to innovate SMEs have to open collaborate with other SMEs, big enterprises, research laboratories, academic institution, consultancy and marketing agency, governmental institutions within a hub.

Acknowledgments

This work is supported by the Romania's Operational Program for Human Resource Development (POS DRU), financed from the European Social Fund and the Romanian Government under the contract number POS DRU/159/ 1.5/S/134398.

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