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Review Article

INTRODUCING WEB GEOGRAPHIC INFORMATION SYSTEM IN AGRICULTURE – ANALYSIS OF TWO START-UP SOLUTIONS IN SERBIA

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Abstract: Start-up could be considered as a solution that is innovative and leads to opening new business opportunities, as well as a type of company that is new and growing, starting to promote new products and services, based on innovations. Aim of this paper is to present innovative solutions and activities in the field of establishing web based geographic information system in the agriculture. Special part is dedicated to the analysis of related research in this field.

Particular aim is to analyze the start-up solutions of web-based geographical information systems that are applied in Serbian agriculture sector. Two leading software solutions (First solution is www.agrosense.rs developed by Biosense Institute; Second solution is www.knjigapolja.rs developed by company Yuteam Software) are analyzed from the functionality aspect. These solutions are analyzed from the aspect of market establishing methods, existing results and opportunities, i.e. methods and results in establishing the solution to be used by as-many-as-possible software users.

This case study shows many functional similarities in the developed software solutions. Companies performed the solutions marketing via specially designed web pages and presenting solution at conferences and publications. Particularly important part of marketing is linking with other related business companies, scientific and government-based institutions. Existing results show high potential of using such software solutions in agriculture regions, such as Vojvodina (north part of Serbia).

Keywords: Agriculture, web, geographic information system, start-up, case study, market, Serbia

Introduction: One of the main powers of modern society development is in the hands of innovative people, whose vision of problem solving is often materialized in new methods, products and services. Being proactive with problems and open-minded to diversity of solutions leads to endless perspectives for creativity. To be innovative and unique at market opens many business opportunities. This

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approach could be found as the main characteristics of a start–up. Start-up could be defined as an endeavor of creating innovative solution ("the act or an instance of setting in operation or motion" - Merriam-Webster), the innovative solution itself or a new enterprise which is offering innovative solutions to market ("a fledgling business enterprise" - Merriam-Webster).

The business domain of agriculture becomes more attractive in recent years, since the increasing human population and the need for food supply to the growing needs. Therefore, food production is one of the most important areas of human activities, which leads to promising business perspectives. Large spaces are used for crops, fruit and vegetable planting and agronomical processing in periods of time. The data about the plants position, conditions and activities performed are needed to be collected, stored and visualized, for the operative and strategic planning purpose. This leads to the using geographical information system (GIS), which could be defined as "a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. GIS can show many different kinds of data on one map, such as streets, buildings, and vegetation. This enables people to more easily see, analyze, and understand patterns and relationships " (National geographic).

In the field of applying GIS in agriculture, research results are directed towards addressing diversity of problems, such as: plant diseases detection and care (Nelson *et al*, 1999), water quality and supply of fields in agriculture (He *et al*, 1993), groundwater management based on remote sensing and GIS (Jha *et al*, 2007), soil quality management (White *et al*, 1997) and pollution issues (Udoyara&Jolly, 1993).

This paper describes experiences from Vojvodina, the north part of Serbia (which is considered as an agriculture part of the country). Many start-up ideas are encouraged from the Ministry and regional municipality initiatives, supported by financial grants and organizational forms, such as business incubators (one example is Business incubator BIZ in Zrenjanin). Some start-up ideas are related to information technology (IT) applications in many business areas, such as agriculture. This paper aim is to analyze two start-up solutions that were developed in Serbia – related to application of GIS in agriculture. Software start-up solutions will be analyzed as well as marketing activities related to promotion of the developed product and production process itself. This way, this paper will describe two examples of successful start-ups, which established good position at Serbian market, which could be encouraging for other start-ups in similar business fields.

Two Start-Up Solutions in Serbia: In this section two start-up solutions in applying GIS in agriculture are compared. These two solutions that will be analyzed were developed by Biosense Institute and Yuteam Software Company.

Biosense Institute (http://biosens.rs) is a scientific institute (more than 35 full-time scientific and professional employees) expanded from the scientific center within School of technical Sciences University of Novi Sad, located in Novi Sad, Vojvodina region, Serbia. Organizational chart of this institute has been presented at fig 1. Development of the integrated software and hardware solution is performed with on-going processes by research groups: Nano and Microelectronics group, Communication and signal processing group, remote sensing and GIS group, Knowledge technologies group, Robotics and mechatronics Group, Group for Biosystems research. This institute develops the science-based web-oriented GIS software solution (accessible at www.agrosense.rs) integrated with robotics, remote sensing devices etc. within scientific international projects in category FP7, Horizon2020 and others, such as project "ANTARES". The results are presented within scientific publications (books, journal articles,

conference proceedings). The product website is named in English, but it has multi-lingual support for users.

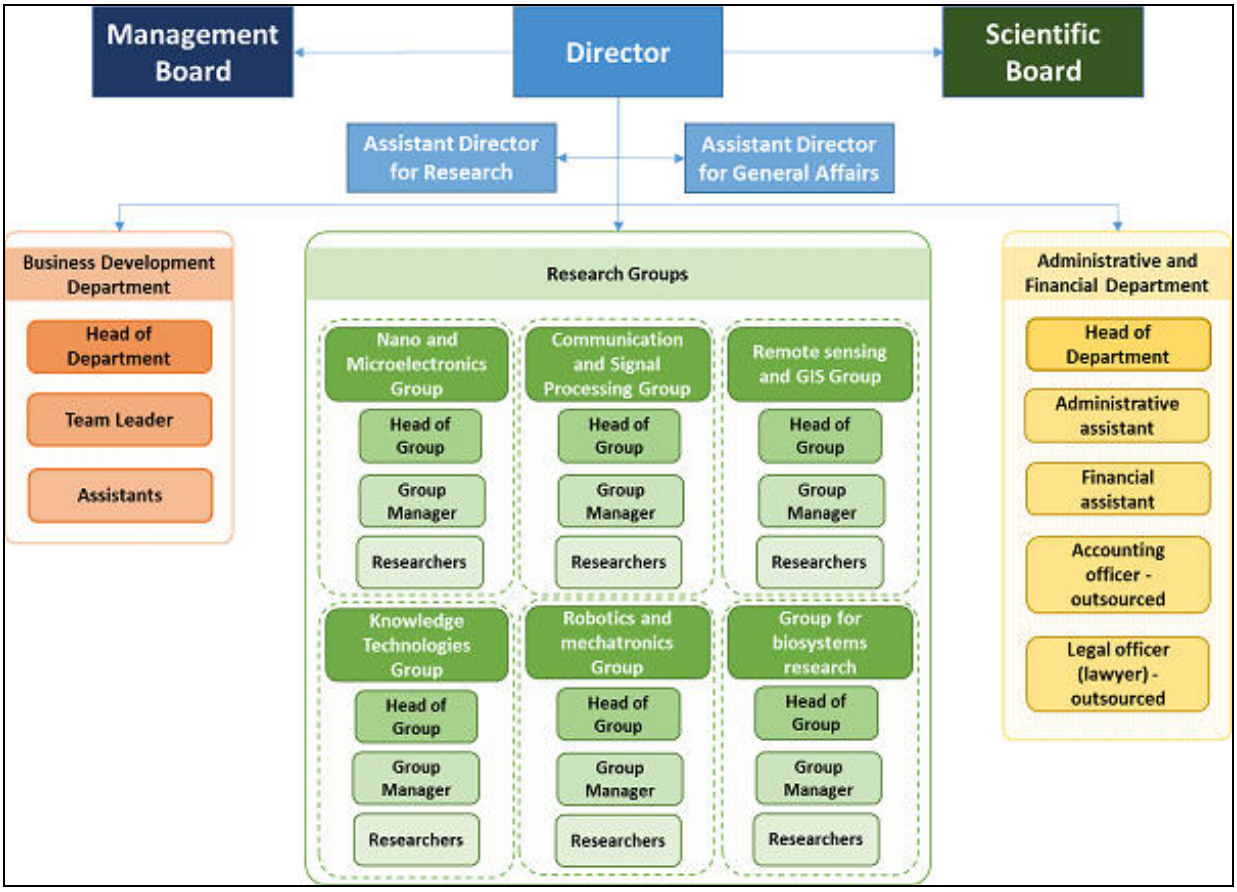


Fig. 1. Biosense institute organizational chart (source: www.biosens.rs)

Yuteam Software (http://yuteam.co.rs/) is a small software company (9 full-time employees, i.e. software developers) located in the city of Zrenjanin, Vojvodina region, which closely cooperates in development and applying scientific-based technical solutions (mainly related to the improvements of general software development methodology and tools) with (most frequently) University of Novi Sad, School of Technical sciences "Mihajlo Pupin", Zrenjanin. This company independently developed the commercial-oriented solution of web-GIS agriculture support software (accesible at www.knjigapolja.rs). This solution was developed upon requests and specifications from their agriculture-oriented clients (that previously used their accounting software) and based on the analysis of similar solutions worldwide. The product website is named in Serbian language (KNJIGA POLJA means the BOOK OF FIELDS), which primarily focused the product towards Serbian market users. In recent period, under the same web domain, the company enhanced the Serbian version of web application with English version for the international users.

The comparative analysis of these two solutions will be performed from the functional aspect and from the marketing activities aspect, based on available public data.

Short Description of Solutions: Biosense Institute develops not only Web-based GIS software solution to be applied in agriculture, but the integrated solution including electronic

devices for remote sensing and control and robots, creating first Digital Farm in Serbia. The BIOSENSE vision of future is demonstrated at Fig 2. With technologies (such as Big Data, Internet of Things, Remote sensing, Satellite Imaging, Nano and Micro-electronics, Robotics) integrated within the agriculture processes.

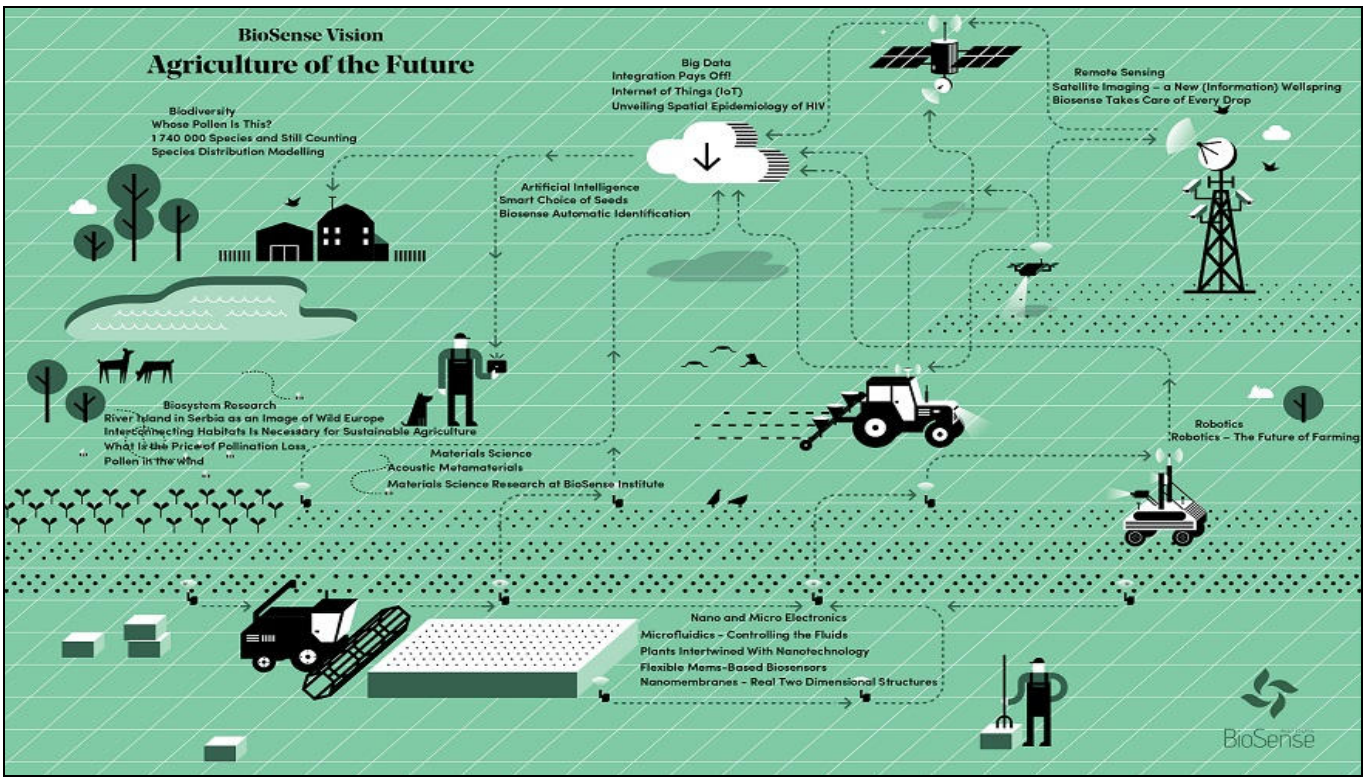
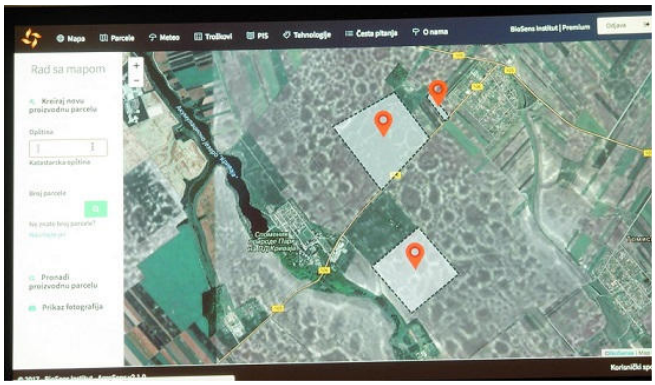
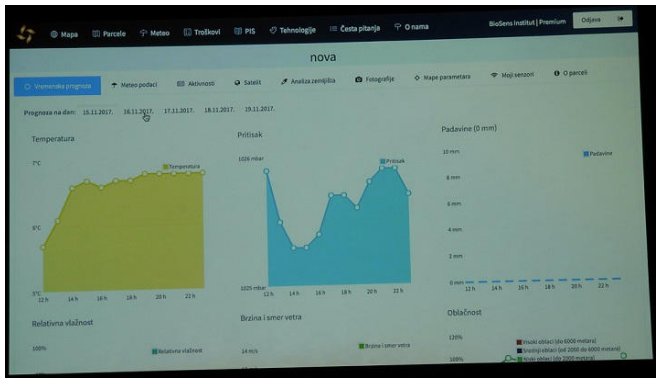


Fig.2. Biosense vision of future of agriculture, with integrated technologies (source: www.biosens.rs)

Software solution (www.agrosense.rs) is a solution oriented towards remote sensing and automated image processing, in aim to enable decision support to agriculture production process. Some of the most important features include: Map, Parcel (location), Meteorology (Weather related data), Costs, Technologies, Activities, Satellite, Soil analysis, Photos (attached to parcel-location), Parameters, Sensors.





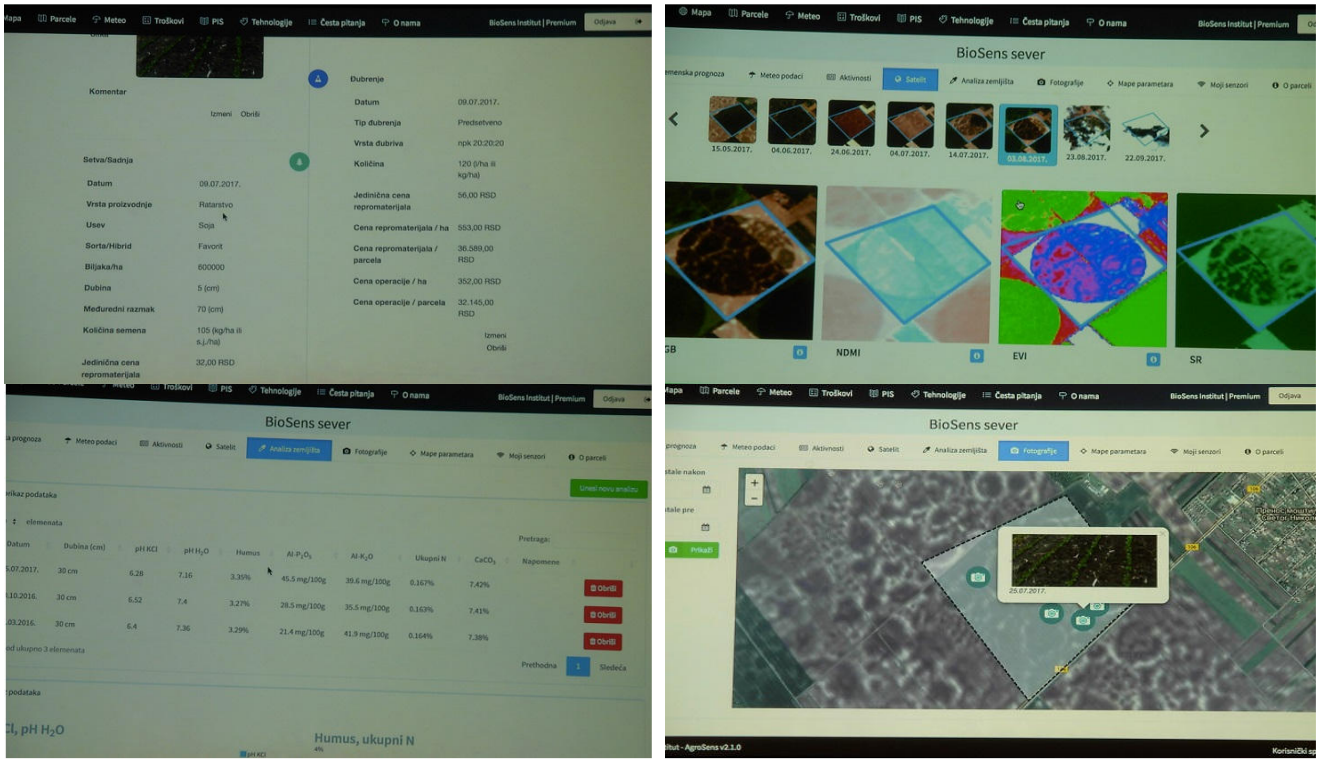


Fig. 3. Screen shots from www.agrosense.rs taken at GIS DAY 2017, Serbia

Yuteam Software solution (www.knjigapolja.rs) is developed as a software solution that is oriented towards support to production process in agriculture with automated calculations within accounting module (costs, income) and document administration (production plan, calculations, reports, daily reports) support. The solution is developed to aid agriculture production with decision-support related to appropriate activities, machines, plant types and materials to be used for soil and plants processing (at some location) during the production process. The software consults predefined calendar of activities and reminds of future needed activities related to the location.

Fig. 4. Presentation of diversity of software functions of YUTEAM SOFTWARE solution, run at desktop, laptop, tablet and mobile (source: www.knjigapolja.rs)

Web application Knjiga POLJA is designed as a tool for planning and monitoring everyday activities in agricultural production. The system is completely graphically oriented. All parcels and production boards are monitored on a digital map that forms the basis of the main application screen, thus visually providing assistance in planning, recording and analyzing production activities.

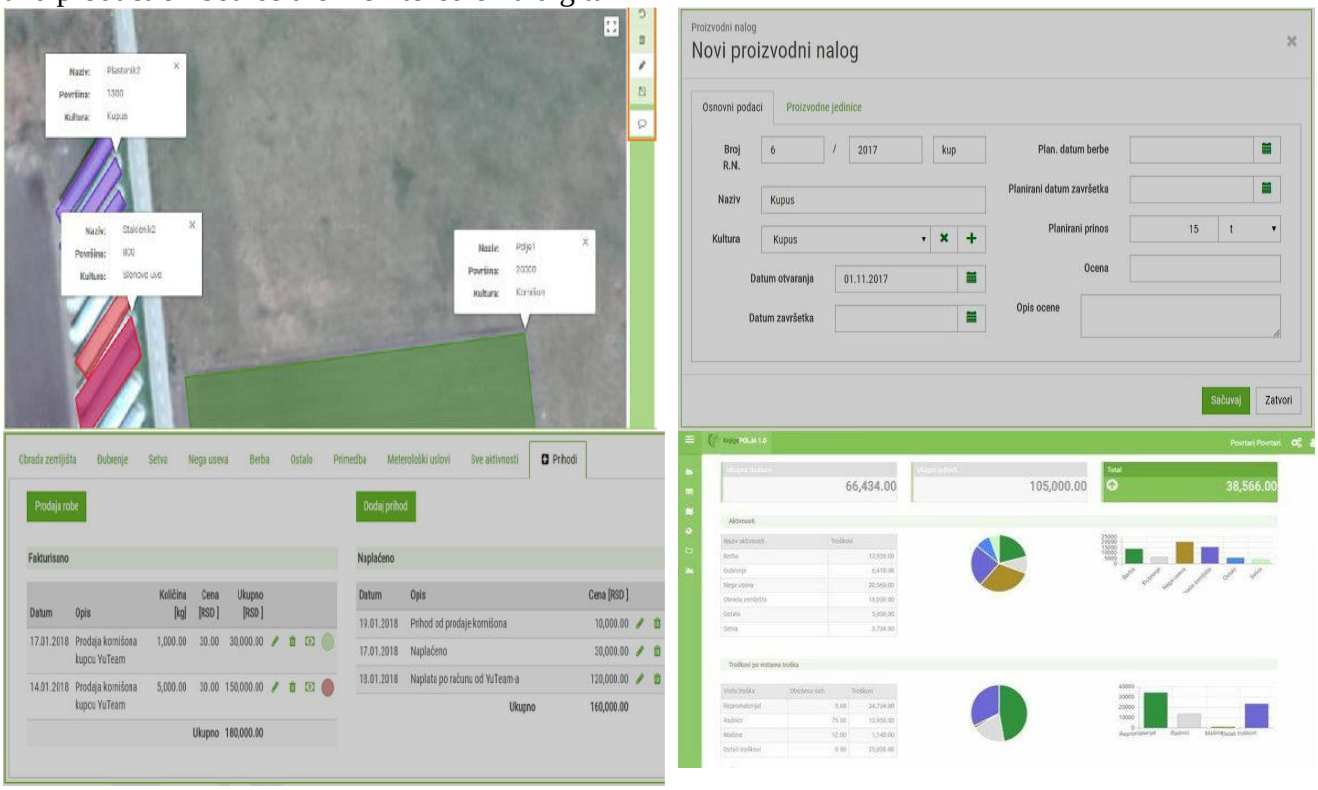


Fig. 5. Screen shots from www.knjigapolja.rs taken from PDF promotional brochure

The main segments of the application include data on Soil treatment, Fertilization, Sowing (seed dispersing), Plant care, Harvesting, Meteorology conditions, Activities, Incomes, Costs. The KnjigaPOLJA represents assistance in the planning of plant production, because it enables simple analysis of production activities and monitoring of the achieved results and costs. It enables the calculation of the cost of the finished product. Main features include: precise planning and analysis of production activities, optimized organization of work, an overview of all production activities, consumed materials, working hours of people and machines, remarks and observations, land analysis, comparative analysis of data from previous years and thus more efficient sowing plan, graphic and tabular yield overview over the years, graphical environment – digital map, assistance in the introduction of ISO and GLobalGAP standards, necessary records for organic production, database needed for advisory activities, availability of data on all devices that have an internet connection. (source: www.knjigapolja.rs)

Comparation of Marketing Activities and Market Results: The Table 1. gives a short presentation of some marketing activities that are used for the promotion of the product, i.e. web-based geographic information system. Some of the data presented in the table are not available (N/A) in the time of writing this paper and requires more research effort to be informed about the data for noted section.

Table 1. Marketing activities of the two analyzed solutions

Marketing method / tool	**Institution/ Company**	
	Biosense Institute	**Yuteam Software Company**
Company Website – link to product website	not easily found for institute website visitors	accessible from the first page of company website
PRODUCT WEBSITE	www.agrosense.rs	www.knjigapolja.rs
Linked at Other Related Websites	N/A	www.poljosfera.rs
Social Networks (Facebook, Twitter) Profile	Facebook profile biosense institute Twitter @BioSenseRS	Facebook profile Knjiga Polja
Conferences, Workshops	Many scientific and professional conferences and workshops with business, IT and agriculture professionals, with presentation of developed solutions such as: • "GIS DAY conference" • "Science for business fair" • Workshop on agriculture advisors in Vojvodina region	Few professional conferences with business, IT and agriculture professionals such as: • Regional forum on e-agriculture for Central and Eastern Europe • Workshop on agriculture advisors in Vojvodina region • Forum on business cooperation of Serbia and BIH
Publications	• Books • Journal articles • Conference proceedings	N/A
Local news website	Many local news companies such as: novosti.rs, rtv, politika, panonrtv, vojvodina world, 02, N1, dnevnik...	Few, such as: Ilovezrenjanin.com

The market results, i.e. clients' satisfaction with the new product could be presented with the list of users of the new solution. The promotion of results of the application of new product (i.e. web-based GIS in agriculture) with clients list is insufficient in both examples:

- BIOSENSE institute does not have the reference list, i.e. the list of users of their solutions at their company website or product website. Information about the testing the solution with large number of users was promoted with the news (Tweets) section at institute website and at conferences.
- YUTEAM SOFTWARE company has explicitly presented reference list (list of clients) within the company website (http://yuteam.co.rs/referentna-lista/), but it is only the list of clients that are categorized roughly according to their business area, without the details on which software is installed at these clients. There is no list of users of the new product, i.e. KNJIGA POLJA. Product website (www.knjigapolja.rs) offers description of cooperation with two clients that use the software and that were included in the process of the software development. The news section presents new contract with the third user (public institution Agriculture professional service - "Poljoprivredna stručna služba Novi Sad"), which will use this software as a regular tool in everyday work in advisory and educational activities,

as well as production aid activities of the service at the whole region of Vojvodina.

Conclusion: This paper presented two start-up solutions in the field of applying geographic information system in agriculture in Serbia. The two start-up solutions presented in this paper were analyzed from functional aspects and from the aspect of marketing activities related to promotion of the products.

First of the presented solutions is created as science-based solution from scientific institute developed as integration of many research results within internationally recognized projects. The first presented solution is strongly related to Internet of Things, remote sensing, satellite communication and graphical analysis of the visual representation of soil and plants. The second solution is developed by a small software company, based on the commercial needs of agriculture companies, which lead to focusing the solution towards automated financial calculations and documentation and advisory support during the production process.

From the functional point of view, both solutions have similar core functions, such as graphical representation of soil parts and locations with attached alphanumerical data, agriculture processing workflow support (records on activities at land segments), statistics and calculations.

From the marketing point of view, both solutions apply on-line marketing with website, social networks and both solutions provide information in local and regional news websites. First solution expressed very intensive live demonstrations at conferences, workshops and present results during development of the solution in many scientific publications, while second solution has modest appearance in news and public presentations. Both solutions do not provide the list of users of their new solutions at their company website, only second solution gives few references and testimonials at the product website.

Based on previously presented examples, it is evident that developing start-up solution faces with many challenges – technology "follow-up", continuous development process and product features improvement, competition, quality of product, quality of service related to product, marketing promotion etc. Development and continuous improvements of start-up solutions should be based on real-world problems solving innovations, which emerge from the close cooperation of business companies with research institutions. Particularly important segment of establishing start-up solutions is linking with the public institutions and business companies that are closely related to the business domain of the start-up solution.

The results presented in this paper could be encouragement for further improvements particularly in the marketing segment for the analyzed two start-ups. The results presented in this paper could be an encouragement for new initiatives and new products and services development at Serbian market and worldwide.

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