

# **An Intelligent Tool for All-to-All Sales on the Internet**

## ***Platform for Compilation of Commercial Offers and Requests for Companies and Customers***

Radoslav Fasuga, Pavel Stoklasa and Martin Němec

*Department of Computer Science, VŠB Technical University of Ostrava, 17.listpadu 15, Ostrava-Poruba, Czech Republic*

**Keywords:** Offer Portal, Intelligent Search Engine, Parametric Search, Electronic Commerce, E-Shop, Second Hand, Offers, Requests, Exchange, Multilingual Implementation, Multimedia System, Product Catalogue.

**Abstract:** This paper deals with the issues of building an intelligent sales portal. The portal features include a price comparator, entering of individual offerings and requests for concrete and specific products and services. Product offers can be entered by choosing from predefined product options and specifications, or as new specifications. The paper describes matching of sales for new products, services and used goods. The design philosophy combines the features of product aggregators, advertising and second-hand sale systems and auctions with so-called fair direct offers in both public and anonymous offer and request proceedings. The implementation is designed for both companies presenting their products, services and requests, and ordinary customers and their individual offers and requests. The core system component is the intelligent search and offer/request matching process. The identical product-to-product matching model and searching based on product similarity is described. A model ideal product and most similar offer can be defined. The paper includes a discussion of the issue of working with a large quantity of highly structured data, their pre-processing and effective visualisation. The conclusion outlines the project ambitions in the area of building a European offer and request platform among business and customer clients.

## **1 INTRODUCTION**

Monitoring of offers and requests on the Internet plays an increasingly significant role today. Customers including individuals, households, small, medium, large and multinational companies require a high degree of customisation of supply and demand, seeking new business opportunities and consolidation of existing sales and business relations.

The objective is to minimise the time required for compiling a sales offer or request and effective acquisition of a relevant response leading to an actual sale. The paper discusses existing solutions and compares their advantages and drawbacks. It reflects user knowledge of products or services offered and requested. It outlines customer decision-making models, their preferences, functional and general requirements, the importance of pricing, (regional or global) availability, delivery method, warranty conditions, servicing and extra services (Wang and Zhang, 2012).

This paper deals with the issue of effective presentation of products and services, definition of sales offers and requests, collection of the relevant response, evaluation and support of the actual sales process. In addition, it describes methods of evaluation of relevance and credibility of trade partners for further decision-making (Fasuga et al., 2014).

It discusses both matching algorithms and technical resources necessary for implementation of such an extensive portal with finely structured data and a high degree of diversity of product offers. It describes methods of minimal, partial and complete pre-processing of sales offers and requests with reference to additional advanced searching and matching methods.

Moreover, the article describes concrete implementation of a real-world portal dealing with the issues at hand. It discusses opportunities for further expansion and establishment of a European all-to-all (A2A) sales and offering platform (All = businesses, customers, governments) (Figure 1).

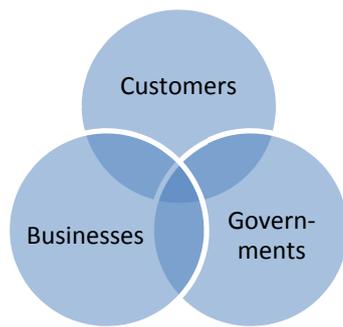


Figure 1: All-to-All diagram for subject interaction.

## 2 INSPIRATION DRAWN FROM EXISTING SOLUTIONS

Existing sales methods on the Internet are based on established models of supply and responding demand. The aim is to elicit the buyer's interest in the product, or to boost their decision in our favour. Companies or individuals offer their products and services on their own websites, product aggregators, paid advertising campaigns, social networks, auction portals, and one-to-one communication with registered users and previous users. Customers usually wait for dealers' offerings, based on which they then make decisions.



Figure 2: Sales concepts integrated into single system.

However, there are also different sales models, which are equally effective, reduce costs of promotion and only collect relevant customer (buyer) requirements. These are advertisement and second-hand portals, goods or service exchange solutions, and requesting systems for (typically large) contracts. In addition to conventional offering, these also feature an equal counterpart in the form of more or less specific requests. The advantage is the cost minimisation on the part of the entrant (buyer or seller), who only specifies their requirements and

waits for relevant replies and offers from trade partners (Figure 2) (Cai et al., 2013).

### 2.1 Product Price Comparators

Active (knowledgeable = decided) users search for specific products and services in price comparators increasingly often (example: Google Merchant Products). Companies place their offers in these systems and update them on a regular basis. They offer concrete (matched) products at a declared price and availability. Full-text search methods are then used for other products.

The disadvantage of this design is that the offering company does not have direct information about specific requirements and price expectations of specific customers. It can therefore only respond to competing offers, not to customer requirements.

Customers can comment on products, their own experience and satisfaction with them, as well as with companies offering the products. There may be official reviews, detailed descriptions and classified properties of the products. Classified properties are used for detailed searches. The user may specify technical parameters of a product and the most similar products are found.

### 2.2 Auction Systems

Auction portals (eBay, Aukro, etc.) represent a large portion of the direct online sales market. These portals were originally focused on selling used goods, worse quality goods, clearance sales and closing sales. Today, they are used as a secondary market for conventional e-shops and sales portals, or as a primary market for small sellers. Again, the sales are only oriented at offering specific products or services. Potential buyers bid up on each product and it is then sold to the highest bidder (Fasuga et al., 2010).

The auction environment is a fast alternative to conventional sales. Its chief benefit is the seeking of potential customers and interest groups without any additional costs. The drawbacks for the seller are the limitation to selling to the highest bidder only, long periods in between sales, and the impossibility to respond to other, lower bids.

For the buyer, there is a single winner in a bidding auction (unless it concerns a sale of multiple items). The drawback is the impossibility to respond to competing offers and the sale end time being set by the seller, not the buyer. It is therefore more like a game with a random winner than a real-world auction process respecting both sellers and buyers.

## 2.3 Discount Portals

Discount portals are another segment of the market supporting sales of individual products. Here, companies offer selected bargains in limited quantities under advantageous conditions. There are many discount portals and even discount offer aggregators exist today. Companies can thus make offers of only limited quantities of products on offer or generic discount vouchers for their entire product range, but then they lose control over which products will be marked down in the end.

Customers are then limited by specific offers or purchases of inexpedient (unnecessary) product and service combinations (Fasuga et al., 2011).

## 2.4 Advertising and Second-Hand Portals

Advertising newspapers, magazines and second-hand offers are still popular chiefly for private offers and requests. Most companies have shifted from print periodicals to the Internet and they now offer portal solutions, which collect general offers and requests.

Users select their area of interest, then specify their requirements in a textual form, which they can complement with multimedia information (photos, videos and more). The offers are so general that it is difficult to match the ads with searchers' requirements. Reading and sifting through large quantities of ads is time-consuming and, ultimately, inefficient. There are no templates for typical products and services in the category and no precisely defined sets of monitored properties. The focus of the second-hand solutions is mostly on used goods, worse quality goods, goods in use or goods in private ownership. There are also clearance sales, with the attribute reducing the value and quality of the goods in the buyer's eyes.

## 3 SALES OFFER AND REQUEST PRESENTATION FORMAT

It is based on usual product categorisation and so-called generic design for creating sets of descriptive attributes (Nguyen et al., 2011) (Figure 3).

The system has to be divided into categories (supertypes) and subcategories (subtypes). Subtypes are specialisations of supertypes; they specify and divide their properties and services. A list of general, shared properties for each product class is assigned to each supertype. Other specific properties that can be

filled in are then added by defining the subtype hierarchy. Properties are divided into mandatory and optional (additional). Mandatory properties always have to be filled in; they are typically basic classifications and divisions of offers. The generic design structure (Diagram 1) is suitable for the implementation; it allows dynamic addition of other properties and their values as needed.

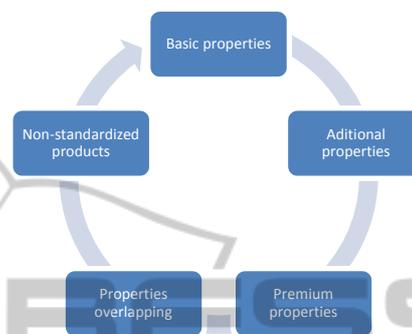


Figure 3: Define product properties and overlap.

### 3.1 Definition of Basic Properties

Moreover, there is a list of properties. Property specifications include their name, data type, value, unit and comments. The name of a property describes the content stored; the same property can be stored for multiple products of different types (e.g., screen definition for: TV sets, monitors, tablets, notebooks, mobile phones, cameras, etc.).

In this case, the data type specifies whether the parameter value is entered manually, whether it is text or a number, whether there is a choice from more options of values.

Having these values categorised is an unquestionable advantage. Therefore, you have a list of permissible options when defining a product, and only choose one or more of them. This eliminates typing and other undesirable errors; there may be a problem with new products and technologies, as brand new products may have new properties, capacity, output, etc., that are outside the normal ranges (Kołaczkowski and Gawrysiak, 2011).

Another inseparable part of a property is its unit. An explanatory comment, which helps clarify the meaning of the property, can be attached to each property. You can also comment on other variations of the property, highlight its advantages and shortcomings.

### 3.2 Premium and Additional Properties

Some products may have so-called premium properties, which are not typical. Alternatively, they may occur as new properties for the given product (expansion of standard product features). It is therefore necessary to include the property in the system to make the products findable by it.

Additional properties are not directly related to a product but its distribution, storage, transport, price, availability, etc.

These properties are set case by case for each seller. Their setting may depend on the product type, dimension, weight, manufacturer, supplier, etc. The properties have to be clearly separable from the suppliers' official specifications.

### 3.3 Property Overlap

In private sales and sales of used goods in particular, official properties may overlap, meaning a modification of the catalogue specification (e.g., a computer memory upgrade or hard drive replacement, incomplete product accessories, transfer of a holiday vacancy, etc.).

In such cases, the official description parameters have to be replaced with new values. No new parameters are added; only the existing specification is modified (Kotha and Basu 2011).

The advantage of this approach is the unification and comparability of products, efficient searching based on defined parameters and their values.

### 3.4 Definition of Own Non-Standardised Product

It is obvious that the system will not contain specifications of all (older versions of) products and their alternatives. It is therefore possible to insert in the system a general offer or request, which will respect the structure and parameters of a given category and will be integrated into the detailed search.

Alternatively, it can be described only briefly, as an advertisement in the form of running text. This then allows full-text searching only (Lahaie, 2006).

The goal of the project is to minimise the proportion of non-standard offers and present relevant results only.

## 4 DATABASE IMPLEMENTATION

Such an extensive project requires efficient database implementation and choice of technologies to use. The implementation itself was preceded by database server performance tests with identical hardware configurations. The SQL (Structured Query Language) test compared Microsoft SQL Server 2008, Oracle 11g, PostgreSQL, and MySQL. MySQL, with adequate performance and acceptable operating costs, was then selected for the implementation. The Java language has been chosen for the system module and crawler implementation; the PHP technology with a suitable framework has been chosen for the back office and the front-end web. Intensive testing of available frameworks (Laravel, Phalcon, Symfony 2, CodeIgniter, Zend 2, Nette) is currently in progress.

### 4.1 Listed Product Catalogue

During the test operation and acquisition of information from the XML (Extensible Markup Language) feeds that e-shops publish in price comparators (Heureka.cz, Zboží.cz, HyperInzerce.cz are the product aggregators in the Czech Republic), approximately 10,000,000 different active products were identified. Each product has approximately 14 comparable properties, a long description of 2,500 characters on average, and graphic information in the form of multimedia files with images and support graphics with 4 images per product at 150 kBytes on average. Approximately 6,000,000 of the products include a link to the manufacturer's or distributor's official website (Table 1) (Kannan et al., 2011).

Table 1: The total size of the product and property database comprises.

Basic product information	4.50 GBytes
Detailed properties and parameters	1.40 GBytes
Indexes for search engines	2.20 GBytes
Full-text indexation (approx.)	8.00 GBytes
Images and multimedia information	6.00 TBytes

The estimated proportion of individual products and changes of parameters in catalogue products is approx. 15-20%.

Additional technologies to be used are 360-degree rotation, panoramic pictures, product videos and virtual tours at an estimated size of 10 MB per product. The estimated number of products presented in this way is 20-40%; the required data storage size is then 30 TBytes.

Selling prices, comments and reviews are registered and periodically updated for each catalogue product. Each product has 34 price offer available on average, and the estimate is that 1-2 requests on average will be stored for each product. Moreover, it is estimated that 5 comments at 1 kBytes each on average will be stored for each product (Table 2).

Table 2: The expected increase in the database size.

For current product prices	5.44 GBytes
For requests	1.02 GBytes
For comments	50.00 GBytes

To reduce the requirements over the database, we chose the method of caching (pre-generation) of final pages with product information previews at an average size of 200 kBytes of HTML (HyperText Markup Language) code per product, as well as search results for typical keywords and phrases at up to 200 kBytes of resulting data per product.

The pre-generation of product and price information:

- If the description changes (immediately)
- If a product description or comment is added (immediately)
- If the seller changes the selling price (within approx. 2-5 hours depending on previous frequency of changes)
- If a request is added, request matching (immediately upon entry).

The database engine used within MySQL. Three engines were used for real operation, namely InnoDB for structured data storage. MyISAM for storage of the presentation layer and the full-text search, and the Memory type for fast parametric searches.

The database storage facility was fitted with fast SSD (Solid-state drive) discs and, for the multimedia information, high-capacity 6 TBytes RAID (Redundant Array of Inexpensive/Independent Disks) Edition or Enterprise Edition discs. The RAID 6 + Spare technology was chosen for the RAID discs, with an EXT 4 fourth extended file system for Linux. The system was set up with periodic weekly backups and incremental backups of critical database components in the meantimes.

Migration to Google Cloud is planned for the future.

## 4.2 System Block Diagram

The system is divided into several basic modules. The first is an XML Feed Eshop Crawler (FEC). This system is implemented as a multi-thread console

application in Java with a shared memory and single data storage in the working product database. This is followed by an intelligent product matching module, based on EAN (European Article Number since year 2009 International Article Number) or GTIN (Global Trade Item Number) codes, keywords in product names, numerical identifiers, and dynamically changing intervals of acceptable prices. The system also tries to identify products in clearance sales and, increasingly often, products on offer that have been returned to the seller, and pre-orders for products not dispatched yet (Figure 4).

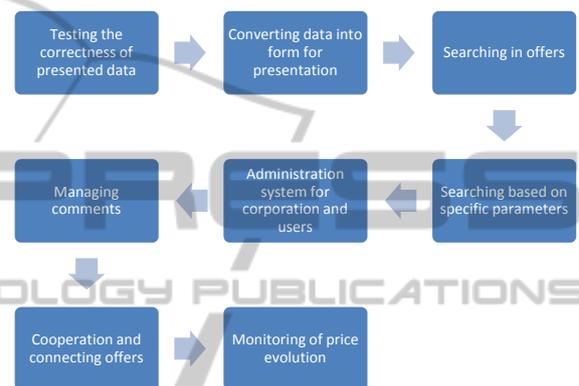


Figure 4: List of system implementation modules.

There is also a module testing the correctness of presented data (TCPD). Based on a specific algorithm, it crawls through the different e-shops, and tries to identify the prices and the availability declared in the feed in comparison with the real offer on the seller's website. If the number of discrepancies between prices and availability is increasing, other products are scanned as well and when a limit tolerance is exceeded, the system is penalised and excluded from further searching.

Another tool is a system for converting obtained data into a form convenient for presentation (COD-FCP) to ordinary users. Another test of dishonest conduct is a tool monitoring manipulation with keywords, i.e., descriptions of offers that are related to other products or brands and deliberately include names of other products in their descriptions so that they are shown when searched for. This conduct is again regarded as unethical, therefore penalised by blocking off the presented content.

This is followed by a module for searching in offers (SO), both matched products and full-text searches. Results of matched products are preferred to full-text.

Then there is a tool for searching based on specific parameters (SBSP), which generates detailed

templates for querying; results are not pre-processed and all queries are handled individually.

There is a user profile administration system for both corporate clientele and ordinary users (AS-CO). This involves management of identities and registration information with identity authentication.

A system for managing comments (CM), reviews and evaluations. It enables evaluation of companies, sellers, buyers, as well as products or services offered.

A system for cooperation and connecting offers (CCO) monitoring options for interlinking various offers, such as a product seller and a servicing organisation. The interlinking can be defined as authorised, unauthorised, undesirable, and banned (blocked).

Monitoring of price evolution (MPE) for a commodity or an entire market, with monitoring of competing offers. Thus, the user can see not only their products and offers but also the matched offers of competitors. Based on that, they can respond and adjust the price or selling terms and conditions.

### 4.3 Additional System Features in Preparation

A general tool for importing complex data structures such as specifications of cars, real estate, holidays, etc. The tool will both respect inherent standards for description of these objects and allow importation from various data structures CSV (Comma-separated values), XLS (Microsoft Office Excel), XML, JSON (JavaScript Object Notation) and more. After that, external data structures will be paired over internal specifications of the sales portal.

Development of an application version for mobile devices. The precondition is the integration of responsive application design based on the Twitter Bootstrap CSS (Cascading Style Sheets) Framework.

In the second phase, generation of information sources respecting requirements of mobile devices, particularly reduction to the amount of data transferred, and last but not least, purely mobile applications for the three major platforms - Android, iOS and Windows Phone. Expansion to gaming consoles and smart televisions is being considered. Although the responsive design is sufficient for the primary launch.

## 5 REQUEST AND OFFER MATCHING METHODS

The primary feature is the module for matching offers and requests (or conversely, requests and offers) (Figure 5) (Ayanso and Karimi, 2015).



Figure 5: Offers lifecycle.

### 5.1 Offer Entry

We will describe the steps in entering an offer. The entrant/company imports a list of products offered into the system as per the XML Feed standard (Google Merchant Feed). For fewer products or a private offer, they enter products by selecting from a product catalogue. Alternatively, they can modify product parameters or create a new product, or enter their request only as a text ad available in full-text search results only.

Company imports are subject to authorisation, and the form and content of input data are checked before including the content in the system, along with a data verification authentication.

Only the entrant's identity is verified for private offers (Ong, 2011).

### 5.2 Offer Search

The system allows searching for offers by browsing the product catalogue. Products are labelled as company and private offers (requests). Another search option is definition of specific parameters. First choose a product and set the desired properties, then suitable products are selected; parameters can be further specified until a product matching your idea is found (Overby and Forman, 2015).

If no identical products are found, you can choose a so-called approximate search, where you define the degree of tolerance and deviation direction for each parameter. For example, you can tolerate a higher product price, different delivery terms, or higher capacity. Importance for parameters can also be changed for the search. This means whether you care more about the price or the properties of the product or service (Zou et al., 2014).

Finally, there is the full-text search. You can run this search if you have not found your requested product; the search is made in indexed texts and

descriptions and, most importantly, in products outside the catalogue.

If you are using the system as a registered user, you can save all your search settings as templates for repeated future use..

### 5.3 Request and Cross-Offer Entry

If you find a product you request, you can enter negotiation with selected sellers. You can enter a cross-offer for the product, define your requirements for a better (lower) price, number of units required, delivery terms, servicing terms, etc. The company can thus respond to your specific individual request and accept your requirements or refuse them. Requests also specify whether the price is fixed and the selling parameters final (fixed) or whether everything is open to negotiation (Bauner, 2015).

If you cannot agree with any seller, you can enter your specification as a request and wait if you are addressed by a seller who would like to accept your request.

Likewise, you can use this monitoring as a form of watchdog, which can see how sellers' offers change over time (discount, availability, etc.).

### 5.4 Public and Non-Public Offer Proceedings

Mutual communication among offering and selling entities may proceed in a public, anonymous or secret mode. The offer (request) entrant always decides about the degree of visibility of the communication. The other party always has to accept the user's settings. In the public mode, specific requests to your offer and the whole communication (prices, discussions, evaluations) are visible. In anonymous communication, the dialogues are not visible; only the price offers and numbers of units requested are seen. Other customers can thus respond to visible parameters and adjust their counter-offers. In secret communication, none of the seller-buyer interaction can be seen publicly (Pham et al., 2015).

Experience with the system operation has shown that the anonymous communication setting is the most effective; it makes the results of communication visible without any comments or specific contacts.

## 6 PILOT SYSTEM OPERATION

The system has been integrated into the portal kartoteka.cz. It had been developed since 2000 as a platform for company offers, information about

companies and their products. In 2009, the project was transformed into a price comparator with the addition of an innovative possibility to request products besides offering them. The implementation of the new portal, as described in this paper, was launched in 2012, and the project will be put into full operation by the end of 2015 at the latest.

Today, the system is used by users mainly as a product price comparator. The markets approached by this project are auction systems, sellers of cars, real estate, holidays and more.

## 7 FURTHER SYSTEM DEVELOPMENT PLAN AND COOPERATION OPTIONS

The project has a powerful developer base combining the university environment with the real-world commercial sphere.

The objective is to become established on the Central European market (Czech Republic, Slovakia, Poland, Hungary) with further expansion across Europe and possibly world-wide.

For these purposes, partners in the regions are sought in order to make the project viable with a functional technical and administrative background.

The project has received positive ratings in several competitions and comparisons; the aim is to ensure stable project financing by means of subsidies and community financing.

A precise business model has to be set up, with a definition of paid system services. With sufficient financing from public sources, the services could be offered entirely free of charge for both corporate clients and the general public.

## 8 CONCLUSIONS

The paper deals with designing and implementing a global portal for collecting offers and requests for specific and special products and services. The portal works across various products disciplines and enables connecting cooperation among products and services.

The paper describes an innovative approach to entering offers and other connected steps. In addition, it outlines options for cooperation with other partners and possible expansion options.

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## REFERENCES

- Ayanso, A., Karimi, A. 2015, The moderating effects of keyword competition on the determinants of ad position in sponsored search advertising, *Decision Support Systems*, vol. 70, pp. 42-59.
- Bauner, C. 2015, Mechanism choice and the buy-it-now auction: A structural model of competing buyers and sellers, *International Journal of Industrial Organization*, vol. 38, pp. 19-31.
- Cai, Y., Mahdian, M., Mehta, A., Waggoner, B. 2013, Designing markets for daily deals.
- Fasuga, R., Drabek, T., Toporkova, G., Holub, L. 2010, Expert system for data identification in auction system along with market trends analysis, *Proceedings - IEEE International Conference on E-Business Engineering, ICEBE 2010*, pp. 36.
- Fasuga, R., Stoklasa, P., Němec, M. 2014, The method of automated monitoring of product prices and market position determination in relation to competition quotes: Monitoring of product prices and marketability development with continuous assessment of market position in on-line sales, *ICE-B 2014 - Proceedings of the 11th International Conference on e-Business, Part of ICETE 2014 - 11th International Joint Conference on e-Business and Telecommunications*, pp. 5.
- Fasuga, R., Toporkova, G., Paluch, M. 2011, Advanced market trends analysis in electronic auction systems, *Proceedings - UKSim 5th European Modelling Symposium on Computer Modelling and Simulation, EMS 2011*, pp. 231.
- Kannan, A., Talukdar, P.P., Rasiwasia, N., Ke, Q. 2011, Improving product classification using images, *Proceedings - IEEE International Conference on Data Mining, ICDM*, pp. 310.
- Kończakowski, P., Gawrysiak, P. 2011, Extracting product descriptions from polish e-commerce websites using classification and clustering.
- Kotha, S., Basu, S. 2011, Amazon and eBay: Online Retailers as Market Makers.
- Lahaie, S. 2006, An analysis of alternative slot auction designs for sponsored search, *Proceedings of the ACM Conference on Electronic Commerce*, pp. 218.
- Nguyen, H., Fuxman, A., Paparizos, S., Freire, J., Agrawal, R. 2011, Synthesizing products for online catalogs, *Proceedings of the VLDB Endowment*, vol. 4, no. 7, pp. 409-418.
- Ong, B. S. 2011, Online shoppers' perceptions and use of comparison-shopping sites: An exploratory study, *Journal of Promotion Management*, vol. 17, no. 2, pp. 207-227.
- Overby, E., Forman, C. 2015, The effect of electronic commerce on geographic purchasing patterns and price dispersion, *Management Science*, vol. 61, no. 2, pp. 431-453.
- Pham, L., Teich, J., Wallenius, H., Wallenius, J. 2015, Multi-attribute online reverse auctions: Recent research trends, *European Journal of Operational Research*, vol. 242, no. 1, pp. 1-9.
- Aggarwal, G., Goel, A. & Motwani, R. 2006, "Truthful auctions for pricing search keywords", *Proceedings of the ACM Conference on Electronic Commerce*, pp. 1.
- Wang, C., Zhang, P. 2012, The evolution of social commerce: The people, management, technology, and information dimensions, *Communications of the Association for Information Systems*, vol. 31, no. 1, pp. 105-127.
- Zou, P. J., Cheng, Y., Xu, Y. Y., Fang, Z. 2014, Boost keywords conversion of search engine.