Summary

The dynamic of e-commerce development in Poland is constantly increasing. One of the segments are on-line shops which support mainly B2C e-business sector. For the last 3 years the number of on-line shops increases app. 30% annually and in 2010 is expected to reach 10 000 active e-commerce initiatives. That means that several times some kind of e-commerce solutions were chosen and applied by new Internet entrepreneurs with sometimes not complete knowledge about specific software. The goal of this article is a prototype ontology of e-commerce solution taking into consideration main identified e-commerce dimensions: types, application’s platforms, software licenses and application functionality. The further development of this ontology would become the bases of an expert system supporting an entrepreneur decision in described matter.

Keywords: Application ontology, e-commerce ontology, e-business

1. Introduction

The last decade of previous century, when anyone must have noticed dynamic Internet and IT development (both applied in business solutions), has changed the way that companies were run. The phenomenon of e-business appeared and became very competitive and tempting alternative to traditional market. One part of e-business is e-commerce defined as electronic trade concerning four main business processes:

1. marketing and promotion,
2. orders,
3. payments
4. deliveries (of course only digital goods).1

Research done on Polish Internet initiatives shows that the number of new e-commerce services is increasing almost 30% annually – reports presented by Sklepy24.pl show that in 2010 we have 9.6 thousands on-line shops. What is more, information popularized by IAI S.A. points that there can be even 20 thousands. Polish electronic market reached almost 2% of total national retail trade (comparing to 1.6% in 2007).2

Concerning so many e-commerce initiatives there appears a question how new entrepreneurs proceeded from idea to specific on-line shop. Most of them are not e-business specialists but still they had to make a decision, which e-commerce software and platform should they use. The problem in that case is the number of open source and commercial application offered by many ven-

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dors, various payment solutions for software license or available e-commerce models. Final decision is a combination of listed features in a form of specific software. Due to the work and finance engagement the entrepreneur choice should be based in full information about available solutions. There are some professional and free websites or publication which can be helpful but there is no tool which would enable experienced users to share their knowledge in a form structured information. Semantic character of the problem and indispensable classification flexibility points ontology as suitable description concept of e-commerce domain.

The article presents short report about proceedings in ontology prototype building of e-commerce on-line shop.

2. Features of e-commerce solutions

E-commerce is the process of buying and selling of various products and services by businesses through the Internet. It deals various kind of business concern, from retail site of the consumer, which includes auction. The main focus is to concentrate on business substitutes involving goods and services between various corporations. There are identified four main types of e-commerce:

- **Business to Consumer (B2C)** is the model taking businesses and consumers interaction. Online business sells to individuals. The most common example is on-line shop offering standard or digital goods to private customer.

- **Business to Business (B2B)** consists of largest form of Ecommerce. This model defines that Buyer and seller are two different entities. It is similar to manufacturer issuing goods to the retailer or wholesaler. Those solution can be also based on online shops however the access to the trade platform is usually restricted.

- **Consumer to Consumer (C2C)** helps the online dealing of goods or services among individuals. The pure example of such a trade can be announcement website concerning some “second-hand” goods which can be sold and bought by private persons. An exception are website services like eBay or Allegro – their model can be called C2B2C because in the middle we can find very well prospering company (taking commission from every transaction made by individuals)

- **M-commerce** deals with conducting the transactions with the help of mobile. The mobile device consumers can interact each other and can lead the business. This can concern relation between individuals and companies (so mobile B2C) or just companies (B2B). In that case Internet solutions must be optimized to the resolution of screens of mobile devices.

Running e-commerce business requires suitable software. The proper choice can be a huge problem for someone who starts “Internet based” business. The e-commerce software market is very competitive what causes extremely high number of possible solutions. They can be classified cause of their license type and platform ownership:

- open source project based on free license (e.g. OSCommerce or ZenCart),
- typical, commercial license which is purchased once (e.g. SOTE, KQS),
- ASP model (payment for application usage):
  - based on Internet traffic,

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Each model has its advantages and disadvantages which can be crucial for proper choice. Of course there is the most expensive option to have the application implemented as unique software designed only for one customer. However, each time the decision is made one has to consider a lot of options in many criteria. There is a price (of license, installation, configuration, template design and maintenance), safety and security matters (database protection, transfer encryption, backup copies etc.), technology and of course functionality of specific software.

For some businesses, e-commerce is a natural fit. Retailers of small consumer items – clothes, gifts, books, electronics, packaged foods – are a perfect example. The products are easy to choose, commonly sold online, and inexpensive to ship. However each entrepreneur must ask him/herself several questions concerning logistic, products, customers, promotion or shop administration matters. The range of those areas can change and for specific business different area can be the most important. In logistic the e.g. warehouse issue is important: how many product would be hold in own storage and how many would be ordered for special customer order; what customer delivery options would be or how the returned product procedure would be organized. Product area causes questions about product presentation (how detailed description, photos, movies) or product navigation in case of huge assortment. Customer issue matter can focus on customer profile (what features would be important to collect) or customer type: retailers or only individual customers (what would be price policy – discount options: manual or automatic rules). Marketing or promotion branch must cover issues like unique e-shop graphical layout, e-commerce passages integration or simply the sale statistics for campaign planning. From the administration (back-end panel) the automation seems to be the most important – questions like: how long customer order service takes to or how much time I need to input/update product’s catalogue. Those are only exemplary questions – to choose proper e-commerce application the entrepreneur must ask much more and get specific and certain answer.

Functionality features, comparing different e-commerce solution, can be identified optional in both types: available/non-available or more complex collection of settings e.g. area of marketing management.

Most professional e-commerce systems calculate appropriate taxes and shipping costs, but owner may have to do some setup work: entering shipping costs for each item in your store, for example. One common complication is items that have multiple options: colors, sizes, and the like. The simplest version has just one option per item; slightly more complex systems can handle items with two or three options; much more robust systems can handle pricing that changes based on the options or certain combinations of options that aren't available. Any worthwhile e-commerce system should connect to specified merchant account to accept credit cards for payment. Other popular features include automated emails to customers, coupons or discount codes, and "related items" links.

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4 http://www.webdesignecommerceguide.com/
Comparing a set of e-commerce applications we can classify functionalities into basic and advanced. The basic ones are:

- **Product catalogue and basket** – the customer can collect products from different categories and afterwards decide to put the order. The order process in simplest form is just an e-mail to shop owner with a list of ordered products and customer data. However nowadays standard in that matter is a guided process with an order status change and automatic customer notification.

- **Specific product promotion** in a form of crossed previous price and the new, lower just next to it. It can be also new product’s module, bestseller box or recommendation “Customers, who bought this product bought also …”.

- **Catalogue navigation (breadcrump) and searching** (simple/advanced).

- **Payment and delivery options**.

Advanced functionalities are offered by more complex script. There are features like:

- **Electronic payment option** from money transfer to credit cards service.

- **Product comparison module** – useful for the customer when shop offers almost similar products.

- **Price and discounts management** (order amount or items number rules; discount coupons etc.).

- **Newsletter and mailing**.

- **Some accountancy tasks** e.g. invoice printing or just direct integration with specified accountancy system.

- **Loyalty program**.

- **Partnership program**.

- **etc. …**

The above classification is just an example – if we consider real decision we must get really deeper into each of presented points. For inexperienced entrepreneur there is no way to check hundreds of e-commerce applications across all presented dimensions: license, platform, type and functionality. The most common solution for them is to base their choice on expert opinion given usually in Internet as an article e.g. 15 Open Source eCommerce Platforms presenting most popular platforms, breaking each one down into its respective pros and cons. Most share a basic set of functions, but offer a couple of unique features on top. Another example is portal presenting four e-commerce platform in a form of table comparison. In case of further questions and doubts new e-commerce entrepreneurs check Internet forums which are full of posts titled “Which e-commerce shop shall I choose?” (e.g. http://www.biznesforum.pl/ or http://www.bankier.pl/forum/).

As we can see the problem exists cause there is huge number of e-commerce solution which can be bought, installed and owned in several ways. However when someone has to spend some or much money for specific one, he would like to be somehow advised. For inexperienced users the best would be naming condition in almost natural language to pick a platform suitable for his

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needs. According to multidimensional character of the problem prototype of ontology of e-commerce application is proposed.

3. Ontology as complex description method

According to W3C Recommendation (10 February 2004) an ontology defines the terms used to describe and represent an area of knowledge. Ontologies are used by people, databases, and applications that need to share domain information. Ontologies include computer-usable definitions of basic concepts in the domain and the relationships among them (note that here and throughout this document, definition is not used in the technical sense understood by logicians).\(^\text{10}\) They encode knowledge in a domain and also knowledge that spans domains. In this way, they make that knowledge reusable. The word ontology has been used to describe artifacts with different degrees of structure. These range from simple taxonomies, through metadata schemes to logical theories. The Semantic Web needs ontologies with a significant degree of structure. These need to specify descriptions for the following kinds of concepts:

- Classes (general things) in the many domains of interest.
- The relationships that can exist among things.
- The properties (or attributes) those things may have.\(^\text{11}\)

Universal character and flexibility of reflecting real world issues made ontologies very popular. Several languages (from RDF, XML to OWL) and universal ontologies and editors were adopted or developed and are constantly improved. The list of application which can help in building an ontology divided into subcategories is presented on Michael Bergman website.\(^\text{12}\)

An ontology defines a common vocabulary for researchers who need to share information in a domain. It includes machine-interpretable definitions of basic concepts in the domain and relations among them. The main reasons of developing an ontology are:

- to share common understanding of the structure of information among people or software agents,
- to enable reuse of domain knowledge,
- to make domain assumptions explicit,
- to separate domain knowledge from the operational knowledge,
- to analyze domain knowledge.\(^\text{13}\)

Due to international researches concerning domains like gene, geography etc. some methodologies of ontology building were identified. The most popular are:

- On-To-Knowledge,
- MENTHONTOLOGY,
- Uschold and King’s,
- CYC,
- Gruninger and Fox’s,

\(^\text{10}\) http://www.w3.org/TR/webont-req/#onto-def.
However some researches shows that in almost 60% of cases when an ontology is built no methodology is used. All the process is based on expert knowledge of analyzed domain, his intuition and several prototypes of prepared ontology. The usual steps of creating new ontology are: identification of ontology scope, capture phase, encoding phase, ontology integration, ontology evaluation and finally ontology documentation. They are built for specific applications like problem solving methods, domain-independent applications or software agents.

There must be pointed that ontology development process is never finished – the results must be evaluated, revised and usually extend (cause of domain broaden or just constant changes in described matter) (Fig.1)

This article is a trial of analysis and classification of knowledge concerning e-commerce application in domain of their types, platforms, licenses and specified functionality (based on real examples of software) and is development of previous project which focused only on software functionality.

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4. Ontological description of e-commerce application

The research work started with identification of suitable ontology editors. There were checked and tried several option (open source and commercial) and the final set, which was examined more carefully was: OntoStudio, Swoop, Protégé from 3.1 to 4.1 beta version. According to trial ontologies building the most friendly solution was OntoStudio however the 3 month evaluation period was not enough to complete planned research. Cause of the financial reasons Protégé platform in chosen. There were checked various versions of Protégé (from 3.4 to 4.2) and finally (cause of stability matter) the 4.1 Alpha was chosen. For the consistency check there were installed and tried several reasoners like HermiT, Fact ++, Pellet which current versions are compatible with chosen Protégé platform.

Next step was identification of e-commerce solutions dimensions (presented in the article) which were classified in hierarchical lists of possible options. That stage was based on literature studies, several e-commerce platforms trial and author's experience.

Finally the lists was implemented in Protégé platform as set of classes and sub-classes in domain of e-commerce application functionality with defined object properties. The reasoned confirmed ontology consistency. An example code in RDF/XML is presented below.

```
<!--http://www.owl-ontologies.com/ecommerce_functionality.owl#AssortmentManagementOptions -->
<Class rdf:about="&ecommerce_functionality;AssortmentManagementOptions">
  <rdfs:subClassOf rdf:resource="&ecommerce_functionality;EcommerceFunctionalityOptions"/>
</Class>

<!-- http://www.owl-ontologies.com/ecommerce_functionality.owl#B2BType -->
<Class rdf:about="&ecommerce_functionality;B2BType">
  <rdfs:subClassOf rdf:resource="&ecommerce_functionality;EcommerceTypes"/>
</Class>

<!-- http://www.owl-ontologies.com/ecommerce_functionality.owl#B2CType -->
<Class rdf:about="&ecommerce_functionality;B2CType">
  <rdfs:subClassOf rdf:resource="&ecommerce_functionality;EcommerceTypes"/>
</Class>

<!--http://www.owl-ontologies.com/ecommerce_functionality.owl#BespokeSoftwareType--> 
<Class rdf:about="&ecommerce_functionality;BespokeSoftwareType">
  <rdfs:subClassOf rdf:resource="&ecommerce_functionality;EcommerceApplicationLicenceTypes"/>
  <disjointWith rdf:resource="&ecommerce_functionality;CommercialLicenceType"/>
</Class>
```

Next step was creation of a set of e-commerce types, available licenses and platforms. Due to performed tests for future usage in SPARQL applications all the options were implemented as classes with specified individuals. For the ontology testing there was chosen two open source platforms: OsCommerce and QuickCart. A part of OsCommerce definition is presented below.
For the testing reasons some defined classes were implemented to check the ability of ontology in “cross-dimension” definitions.

```xml
<!--http://www.owl-ontologies.com/ecommerce_functionality.owl#WideRangeOfElectronicPaymentsOptions-->
<Class rdf:about="&ecommerce_functionality;WideRangeOfElectronicPaymentsOptions">
  <equivalentClass>
    <Class>
      <intersectionOf rdf:parseType="Collection">
        <rdf:Description rdf:about="&ecommerce_functionality;EcommerceApplication"/>
        <Restriction>
          <onProperty rdf:resource="&ecommerce_functionality;hasElectronicPayment"/>
          <minCardinality rdf:datatype="&xsd;nonNegativeInteger">3</minCardinality>
        </Restriction>
      </intersectionOf>
      <rdfs:subClassOf rdf:resource="&ecommerce_functionality;EcommerceApplication"/>
    </Class>
  </equivalentClass>
</Class>
```

The final shape of designed ontology is presented on Fig. 2. The number of classes and subclasses was limited for the purpose of this article giving just a prototype of final solution. During the analysis and ontology implementation phases it appeared that one more main class creates a list of sub-classes, which considered further where beginning of another sub-class. However, according to theory of ontological attitude, author realizes that the number will never be finished. Each day new e-commerce solutions can appear and that will require presented solution to be updated.

During implementation process some problems with chosen software platform appeared. The main inconvenience was met during data type restriction defining – there was a problem with numeric type recognition and it must be solved before project is continued.
Figure 2. Designed Ontology of e-commerce application

Source: Self study.
5. Concluding remarks

The goal of this article was to check usability of ontology as a domain codification tool for e-commerce solutions, which can become a knowledge base for future expert system. The most complex tool, which helps the user to choose proper e-commerce platform was found on http://www.ecommerceknowhow.com/. The eCommerce Know-How Solution Finder shortens your research time in finding solutions that fit your needs. Create a short list of solution options based by filtering on key criteria that are important or relevant to your business.\(^{15}\) Once a shorter list is created, drill down to detailed information including key capabilities, proof points and pricing.\(^{16}\) However, there is no query language available and no way to develop the data set by anyone else accept the website owner.

The goal and future of information exchange is to give the user possibility to add knowledge, experience or opinion to existing domain knowledge base and share it without any borders (open access solutions). Application independence of ontology enables such a operation keeping still the knowledge- and database consistent.

The conclusion from the ontology implementation phase based on Protégé platform is consistent with general opinion about open source platform. They give huge functionality (huge number of plugins, tools etc.) and support planned research but in case of problems the time spent to solve it makes the project schedule extremely longer. From the list of tried commercial ontology editors OntoStudio is considered to be the most suitable and friendly. Project continuation assumes the purchase of commercial license and migration to that platform with further ontology development.

Bibliography


ONTOLOGIA APLIKACJI HANDLU ELEKTRONICZNEGO

Streszczenie

Dynamika rozwoju handlu elektronicznego w Polsce utrzymuje się na bardzo wysokim poziomie. Jedną z gałęzi e-commerce są sklepy internetowe działające w ramach modelu B2C. W ciągu ostatnich 3 lat ich liczba rosła rocznie i, jak pokazują badania, w roku 2010 powinna osiągnąć 10 000 aktywnie działających sklepów online. Oznacza to, że za każdym razem podjęta została decyzja o wyborze i wdrożeniu konkretnej aplikacji e-commerce – często bez kompletnie wiedzy decydenta (przedsiębiorcy) o danym rozwiązaniu. Celem artykułu jest prezentacja badań nad budową prototypu ontologii rozwiązań e-commerce, zawierającej w sobie główne charakterystyki tego tych aplikacji: typ, charakterystykę platformy, rodzaj licencji oraz cechy funkcjonalności. W dalszym etapie badań zbudowana ontologia posłuży jako baza wiedzy dla systemu ekspertowego, wspierającego decydenta w procesie wyboru systemu handlu elektronicznego.

Słowa kluczowe: ontologia aplikacji, ontologia handlu elektronicznego, e-biznes

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