EnviroInfo 2004 (Geneva)
Sh@ring – EnviroInfo 2004
 ISBN: 28 29 30 275-3

Process Models and Software Components for Electronic Marketplaces of Used Products

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Abstract

Electronic marketplaces play an increasingly role in buying and selling products. Their importance can also be observed in the case of used products (Fichter 2003). Designing electronic marketplaces for used products in comparison to new products leads to some important additional requirements and problems that have to be considered. For instance, their specifications are often incomplete and inaccurate. This makes the search for products more difficult. In this paper, we first discuss these problems in more detail. Moreover, we describe algorithms, software components, and business processes for electronic marketplaces taking into account the special requirements of used products.

1. Introduction

Electronic marketplaces based on internet technology are a special kind of electronic commerce that offer a place where buyers and sellers can meet, directly communicate with each other, search for products and negotiate prices for those products. They simplify business processes and reduce transaction costs. Due to their global accessibility, they support a worldwide exchange of products.

Some electronic marketplaces also support the trade in used products. For instance, eBay is a giant C2C electronic marketplace that allows people to sell their (used) products directly to other consumers. Obviously, successful sales of used products extend their life cycle and intensify the product usage. Therefore, besides the economic benefits for buyers and sellers we can also establish ecological benefits because extending the product life cycles is one of the best ways to decrease their environmental impact.

In this paper we focus on B2B electronic markets for used industrial machines, e.g. saws, drilling machines, grinding machines, construction machines etc. In contrast to the specification of products like books, these machines require more com-

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plex classification systems. In addition, to automate business processes standardized classification system like eClass (Institut der deutschen Wirtschaft 2004) or UNSPSC (ECCMA 2002) and XML business documents for B2B e-commerce, e.g. BMEcat (Bundesverband Materialwirtschaft 2004), openTRANS (openTRANS-Initiative 2004), or xCBL (Commerce One 2004) have to be considered.

One main objective of our work is to analyze and to provide methods and components that simplify implementation and maintenance of electronic marketplaces for used products. In section 2, we analyze several electronic marketplaces in respect of functionalities and classification systems. Based on this analysis the requirements for classifying used products are determined. We show that standardized classification systems must be extended to specify used products because non-standard information must be stored, for example about machine condition, construction year, operating time, etc.

Besides the support of the communication processes between the trading partners, the product search is another important functionality of electronic marketplaces. Currently, most electronic marketplaces only offer very simple search functionalities. But in the case of complex products like used industrial machines, it is obvious that a feature-based search procedure is necessary which also determines the relevance of the result. To cope with this, in section 3 we propose the integration of a fuzzy-based search algorithm as described in (Naumann et al. 2003). In section 4, we present some methods that support the communication between trading partners and the electronic marketplace. The last section gives a summary of our work and an agenda for further research issues.

2. Classification Systems

Classification systems are designed to categorize products that have common characteristics. In our approach, we assume that a classification system consists of

1. *product groups*, which are hierarchically organized in a product group tree,
2. *features of products*, which are assigned to the product groups, and
3. *possible values and ranges*, which can be assigned to the features.

The characteristics of a product are described by feature/value pairs. Typical features are identification number, price, weight, description, picture, etc. An electronic *product catalogue* consists of several products, which are assigned to product groups. Usually sellers provide electronic marketplaces with product catalogues containing the relevant product data.

In a first step we analyzed several electronic marketplaces trading in used industrial machines in respect of classification systems and product catalogues. Tab. 1 shows some of the electronic marketplaces considered.

Electronic Marketplace	Trading Partners (seller:buyer)
www.gebraucht-maschinen-markt.de	m:n
www.stiens.de	1:n
www.maschinenboerse.de	m:n
www.surplex.de	m:n
www.machinestock.com	m:n

Table 2
Electronic marketplaces for used machines.

The result can be summarized as follows:

1. Different non-standard classification systems and product catalogues are in use.
2. Compared to new products a detailed product specification needs additional features and attributes (e.g. condition/state, energy efficiency).

The missing of standard classification systems (e.g. eClass) can be explained by the fact that they are not as flexible as necessary and do not provide enough features to specify these products sufficiently or to support a search process.

Attribute	Value		
Identification	XXX003003		
Name	Condition		
Synonym	State		
Definition	Assessment of the current condition of the machine		
Values	Good	Medium	Bad
Value description	Regular maintenance, directly serviceable	No regular maintenance, principally serviceable	Evident defects, repair is necessary
Value scale	Nominal		
Similarity function	Correlation matrix		

Table 3
Detailed specification of the feature “condition”.

On the other hand standardized product classification systems and catalogues simplify the import, the export and the automatic processing of product data. Therefore, in order to solve the problems listed above, we propose the adaptation of a standard classification system (e.g. eClass) instead of using a proprietary classifica-

tion system that has no relation to any standard. For example, Tab. 2 shows the specification of the feature “condition” as an extension of a standardized classification system.

3. Fuzzy-based Product Search

Searching products is a core functionality of electronic marketplaces. It has to support the buyers in gathering information concerning products (e.g. availability, prices, descriptions, etc.). The analysis of the marketplaces listed in Tab. 1 has shown the following:

1. Detailed descriptions and data sheets of the manufacturer for the products are often not available.
2. Non-ambiguous identification numbers like EAN-Codes and original article numbers are often absent.
3. The products are often not described completely. The specification consists of some major features or is even a non-structural textual description.

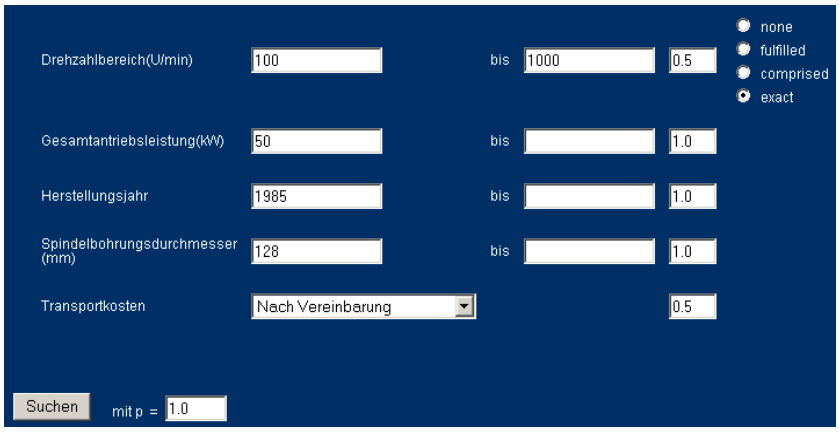

Figure 4
User interface to describe features, values,
and feature weights of a searched product.

Therefore, searching for used products is a difficult process. Usually it is based on product features. For example if a buyer is interested in used drilling machines, he does not usually ask for a concrete machine, but rather for features like construction year, condition, energy efficiency etc. Mostly, common electronic marketplaces

only provide search methods within a product group structure or make the search results available without any ranking of the relevance of the result.

To improve the search process for used and complex products, we propose a strategy as described in (Naumann et al. 2003). Thereby we exploit knowledge of the application domain and the structure of classification systems. The process consists of the following steps:

1. Formulation of a query, e.g. with a web-based form as shown by Fig. 1. A query consists of several feature/value pairs that can be combined by Boolean operators. Moreover, the buyer can assign a weight to each feature/value pair in order to express preferences. The specification of lower and upper bounds is also possible.
2. To optimize the response time, first a pre-selection of appropriate product groups and products is determined. For pre-selected products, a numerical relevance will be computed.

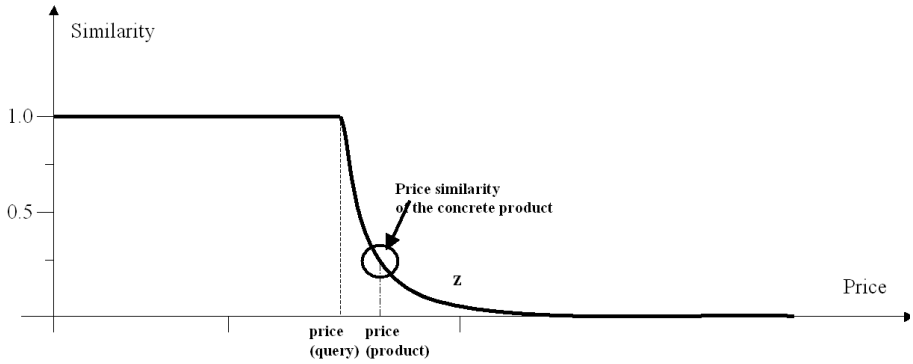

Figure 2
Similarity function of the feature „price“

3. In order to determine the relevance of a product, for every product feature the similarity between the query value and the product value is determined. The computation is based on feature-related similarity functions and takes the meaning of the feature into account. E.g. a feature “price” is evaluated as follows: A product price less than required by the query has similarity “1”. As shown in Fig. 2 if the product price is higher than required, the similarity decreases down to zero depending on the price difference and the function assigned to the feature. In order to determine the similarity of features which are described by nominal scaled values, a correlation matrix (Ogawa et al. 1991) has to be defined, which describes the similarity between discrete values. To set an example, Tab. 3

shows the correlation matrix of the feature "condition". If a buyer searches for a product whose condition is good but a seller can only offer a product whose condition is medium, the resulting relevance is 0,3 regarding this feature.

Product value Query value	Good	Medium	Bad
Good	1	0,3	0
Medium	0,7	1	0,3
Bad	0,3	0,7	1

Table 4
Correlation matrix for the similarities
between the values of the feature condition

4. For every product, the similarities of the features are summarized. In doing so weights added by buyer (see Fig. 1) have to be considered. To compute this overall similarity between a product and a query we adapted the extended Boolean model (Salton et al. 1983).
5. After computation the web front-end shows the products sorted by their relevance.

4. Business Process Automation

The integration of the electronic marketplace and the application systems of buyers and sellers supports business process automation and reduces costs by reducing errors and the manual effort to publish and maintain product information. Therefore, during the last years a lot of work has been invested in the development of XML – based business document standards supporting the B2B data exchange, e.g. BMEcat with openTRANS or xCBL. Taking this into account we discuss two business processes:

(1) Exchange of Product Catalogues: In order to simplify the exchange of product catalogues between marketplaces and trading partners we developed an interface, which can handle different proprietary formats of classification systems and product catalogues. Thereby, an XML-based document defines the mapping between the product catalogues formats of sellers or buyers and catalogue and classification structures of the electronic marketplace (Krieger et al. 2002). This solution takes into account that in the case of used products usually proprietary classification systems and product catalogues are in use. The mapping document reduces integration

costs in many cases. In particular, it supports the import and the export of standardized XML-based product catalogues (like BMEcat, xCBL).

```
<QUERY>
        <FEATURE_EXPRESSION>
                <F_AND_EXPR weight="1.0">
                        <F_LITERAL feature_id="124" weight="1.0">
                                <FEATURE_NAME>
                                        Drehzahlbereich(U/min)
                                </FEATURE_NAME>
                                <FEATURE_VALUE>
                                        <LOWER_BOUND>1000</LOWER_BOUND>
                                        <UPPER_BOUND>5000</UPPER_BOUND>
                                </FEATURE_VALUE>
                        </F_LITERAL>

        ...

                        <F_LITERAL feature_id="290" weight="1.0">
                                <FEATURE_NAME>
                                        Preis
                                </FEATURE_NAME>
                                <FEATURE_VALUE>
                                        <LOWER_BOUND>40000</LOWER_BOUND>
                                </FEATURE_VALUE>
                        </F_LITERAL>
                </F_AND_EXPR>
        </FEATURE_EXPRESSION>
</QUERY>
```

Figure 3
A Boolean search query represented in XML.

Product Search: Before starting the search the product specification has to be transformed into a query that consists of weighted feature/value pairs that can be combined by Boolean operators as described in section 3. Sometimes this transformation is a complex and time-consuming task that is done by the buyer in cooperation with technical experts. Therefore, as alternative to the web-based form as shown in Fig. 1 we developed an XML schema for the query. Fig. 3 shows an example of a corresponding XML-based query document. It can be sent to the electronic marketplace as input to the search process. The result can be exported as a standardized XML-based product catalogue (like BMEcat, xCBL).

5. Conclusion

In this papers we have analyzed some key issues in the area of electronic marketplaces for used products. We have presented several methods and models that can improve their functionality, efficiency and acceptance. Especially, we described a method for searching products that supports a fuzzified feature-oriented search process and delivers a weighted result set. This method seems to be a good concept that supports buyers in gathering product information.

Nevertheless, our solutions are not limited to this application area. They are also very promising in the case of new products having complex specifications. It can improve search in general if the items of the search space are classified by feature/value pairs. Therefore, the adaptation and evaluation of our search strategy in other application areas will be subject of further research.

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