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Using Ontology-Based Patent Informatics to Describe the Intellectual Property Portfolio of an E-Commerce Order Fulfillment Process

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Abstract. Electronic commerce (EC) is the process of selling and buying goods or services through an online platform used for conducting the necessary business communications and transactions for sellers and buyers over the Internet. EC companies sell products online with an emphasis on running the entire supply chain process efficiently. The business processes, that enterprises use to conduct e-commerce business, are quite valuable and can be treated as intellectual properties (IPs). Business method patents provide inventors and enterprises with protection for the unique business process. The United States provides business method patent owners an exclusive IP right for 20 years. A good quality business method patent is considered a powerful and effective tool to generate revenue and bar potential competitors from duplicating the practices. Patent analysis can assist companies in evaluating their business strategies or redesign their business processes. Grouping patent documents and defining a domain ontology helps companies describe technology trends and innovations. This research uses Amazon's business processes as a case example to conduct business method patent analysis, particularly considering order fulfillment as a key method to manage inventory and purchase orders. An EC ontology schema is constructed based on the key EC business processes and key-phrase extraction from the patents. Understanding Amazon's patents and their relationships to the business process, other EC enterprises can examine their own patents' strategic strengths and weaknesses. In addition, they can prevent their business processes not to infringe upon existing EC patents.

Keywords. patent, ontology, business method, e-commerce

1. Introduction

The Internet has offered a wealth of new business opportunities. One of the greatest opportunities is electronic commerce (EC) application. E-commerce is the process of selling and buying goods or services through an online platform for the necessary business communications and transactions between sellers and buyers over the Internet. According to the Internet Retailer [1], as shown in Figure 1, the largest U.S online retailer in 2013 is Amazon.com, which is $49.6 billion larger than the second-largest

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online retailer, Apple. Successful EC companies sell products while emphasizing their supply chain process efficiency. Order fulfillment is a core step of the EC process. Consumer-direct e-commerce is compelling to customers for the online shopping experience, on-time delivery, fewer fulfillment errors, extra services, and convenience. These are services that provide values to customers [2]. Therefore, the processes that enterprises use for building e-commerce business is valuable, especially the patented business methods. Business method patents issued in the United States provide an e-commerce firm with exclusive right for 20 years. A high quality business method patent is a powerful and effective asset used to generate revenue and stay competitive. In view of the proliferation of Internet business method patents, e-commerce enterprises need continuously evaluate and implement their patent strategy [3].

Figure 1. Top 10 largest U.S. online retailers in 2013.

This research uses Amazon.com as a case to analyze business method patents and construct the ontology of key business processes. The scope the research focuses on EC order fulfillment, including inventory management and outbound processes.

2. Literature review

This section introduces the definition of business method patents and the existing approaches in patent analysis and key phrase extraction.

2.1. Business method patent

Business methods were developed and provide inventors and companies with protection for their new products, new software or new business processes. However, business methods are abstract descriptions of how companies input their resources and transform these inputs to value-added outputs. According to the United States Patent and Trademark Office (USPTO), the Current US classification of business method patents is Class 705, which definition is defined as "Data Processing: financial, business practice, management, or cost and price determination." Meurer [4] classified business methods into two categories: administrative methods and customer service methods. Administrative methods are back-office methods that increase productivity or reduce organizational or production costs in a firm. Customer service methods yield services that are consumed by customers or methods related to pricing, advertising, or other marketing concerns. Chang et al. [5], using cluster analysis, divided basic

business method patents into 3 groups: Marketing, Data Security and second generation Data Security. The market group contains the most important technology for marketing business methods, such as coupons, promotion programs, POS, reservations, check-in and booking. Data Security protects transaction security and increases the customer's trust in e-commerce. Second generation Data Security is a continuation to accommodate new technologies. In conclusion, no matter how business methods are categorized, they are all classified in Class 705. Therefore, this research collects business method patents under Class 705 from the USPTO database and analyzes the case of Amazon.com.

2.2. Patent analysis

Patent analysis is a tool to assist companies in determining their business strategies or redesign their business processes. Patent trend analysis indicates the growth pattern of a technology, the technological shifts that are occurring, investment opportunities in acquisitions and divestitures and R&D planning for new product development [6]. According to Tseng et al. [7], a typical patent analysis scenario has 7 processes: Defining the scope of the analysis task, searching, segmenting and normalizing structured and unstructured parts, abstracting and extracting the key phrases, clustering the patents based on extracted attributes, visualizing the results, and making a suggestion. Each process has its own application and the outcome of the patent analysis can be visualized and interpreted in different ways. For example, clustering methods group patent documents by identifying key phrases and define a domain ontology which help to describe technology trends, processes and innovations [8]. Jun et al. [9] used text mining and K-medoids to cluster patent documents for technology forecasting. In this research, the patent analysis focuses on order fulfillment process and corresponding Amazon patents, visualizes the patent distribution by constructing an ontology of its process and draws a conclusion based on the contribution of key processes.

2.3. Key phrase extraction for ontology schema

Key phrase extraction is considered as an important step prior to the patent ontology construction. Patent documents are usually described in a lengthy written explanation and hard to understand the knowledge or innovative contribution in short period of time. In addition, text mining methodology has been applied to extract key phrases from patent documents. Term frequency (TF) and inverse document frequency (IDF) are two major factors used in text collection and information retrieval. TF measures the occurrence frequency of a specific term in a document [10]. IDF presents the rarity of the term in a set of documents [11]. Salton and Buckley suggested that using TF-IDF method can find out the representative terms in a document based on how frequently they appear across a collection of documents [12]. However, TF factor does not take account of the length of documents. The normalized TF (NTF) approach considering document length and word counts is adopted in this research [8].

3. Methodology

The methodology of this research consists of four steps. First, define the order fulfillment process and identify the key operations. Second, search for the business method patents related to the process from USPTO database (patents searched on 2014/12/08). Third, use text mining approach to calculate NTF term values from the abstract and claims of the searched patent documents, and extract key phrases associated with order fulfillment operations from the ranked NTF. The last, group the patents and construct the ontology. The ontology will show an overview of Amazon's its core patent strategy and logistics innovations.

3.1. Business processes for Amazon.com

Amazon.com is the first company to operate a long-scale e-commerce book retailer, which quickly diversified its range of products. Amazon.com has three major products suppliers: the marketplace, direct vendors, and Amazon.com itself. The Amazon marketplace enables sellers to draw on the e-commerce services and tools to present their products alongside Amazon.com on the same product page and allowing customers to compare between suppliers [13]. This research, using Amazon.com as a case example, uses Income software to provide a holistic view of the Amazon.com business processes. Figure 2 is the Amazon.com business process overall view. When the customer places an order, Amazon starts its outbound processes supported by inventory management. After the order items are packed, the package is delivered to customer's delivery address by a third-party logistics company. Figure 3 shows the detailed processes and sub-processes. The detailed descriptions of each stage of the process follow Bragg's analysis [14].

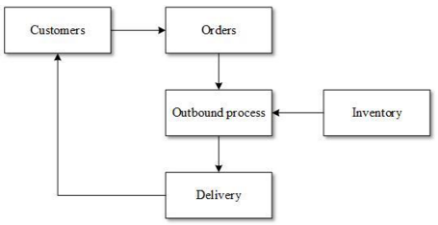

Figure 2. Amazon.com business process overview.

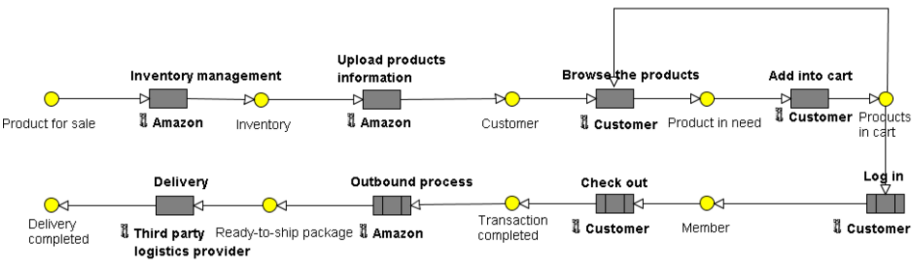

Figure 3. Amazon.com detailed business processes.

Step 1: Inventory management

The products for sale are sent to Amazon's fulfillment centers through the inbound processes for cataloging and storage as ready-to-ship inventory. After receiving, scanning, and recording the inventory, Amazon continues monitoring the inventory level and handling the disposition operations, such as inventory replenishment.

Step 2: Upload product information

Amazon will upload or update product information on Amazon.com for the next ordering process cycle.

Step 3: Ordering

When customers want to buy something on Amazon.com, they browse the products on the website and add items to the shopping cart. Before check out, Amazon.com requires the customer to login or register as new member (Figure 4). Then the customer places the products into the shopping cart, and Amazon.com requests members to enter the shopping and billing address and method for order fulfillment (Figure 5).

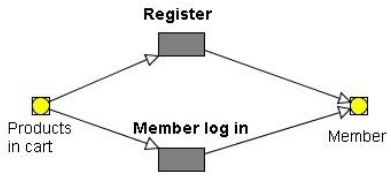

Figure 4. The drill-down log in activity.

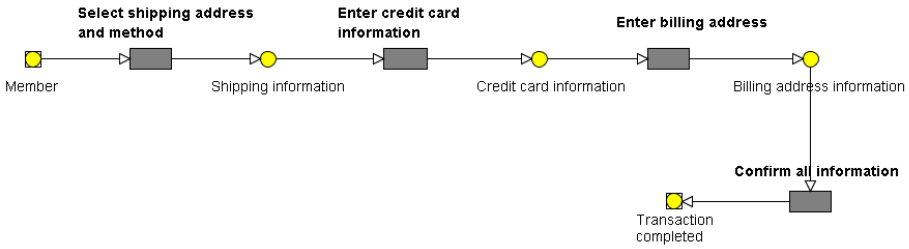

Figure 5. The drill-down check out activity.

Step 4: Outbound processes

After receiving an order, Amazon checks the inventory level and assigns orders to one of the domestic fulfillment centers which has the least shipping cost to fulfill this order. Once receiving an assigned order, the fulfillment center begins to pick and sort items and combine all of the different items into one package. In this process, fulfillment center workers use radio-frequency scanners to fill the picking cart, sort the picking batch into the individual customer orders, and pack into a package. Amazon also sorts different orders into different shipping method operations and shipping plans for customer delivery (Figure 6).

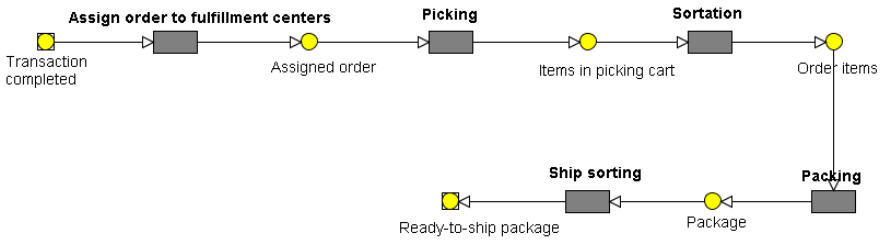

Figure 6. The drill-down outbound process activity.

Step 5: Delivery

The third-party logistics company outsourced by Amazon is responsible to deliver the package to customers based on Amazon's shipping plan. After describing the business processes of Amazon.com, the logistics related technologies and methods are clear appearances. In the next section, this research focuses on the patents related to order fulfillment including inventory management and outbound processes.

3.2. Order fulfillment ontology and corresponding Amazon patents

Amazon.com is a consolidation center adding value by combining different items into one single order for shipment to the customer's front door in a few days. Amazon's success depends on the fulfillment center which is key to handling inventory and orders efficiently. Therefore, the related patents are used construct an ontology by identify the key phrases of order fulfillment process. The patent documents are searched from USPTO database. The key phrases are all associated with methods or technologies in logistics and inventory management, such as the phrases "disposition," "fulfillment," "delivery," "pick path." And by text mining methodology, the innovative logistics practices, technologies and methods derived from patents are considered as the key phrases. The order fulfillment process ontology with Amazon corresponding patents is shown in Figure 7.

In the Figure 7, the order fulfillment has two sub-processes: inventory management and outbound processes. Inventory management processes are divided into two sub-processes. The inbound sub-process focuses on inbound inventory positioning and data collection for optimal performance of inventory management, and this sub-process has one sub-domain: defect. The defect is to detect the incoming shipment through a cataloging system and generate the defect rate, enabling material handling facilities to operate the corrective actions. The disposition sub-process is used to handle the stored inventory. In this sub-process, there are three sub-domains: determine is to set the target inventory related levels or identify the identifier contents, dimensionally-constrained patents related to automatically estimate the dimensions of items to facilitate operations and optimize space utilization, and replenishment is the planning for replenishment strategy for the risk of inventory shortage. The determine sub-domain has three sub-subdomains: healthy is to determine a healthy inventory level of the item and initiate an appropriate action such as disposition of unhealthy inventory, exhaustion is a method analyzing order trends and calculating the expected item depletion time from inventory model and identifier increases the chance of accurate recognizing of the products or presents the position information by communication devices for agents.

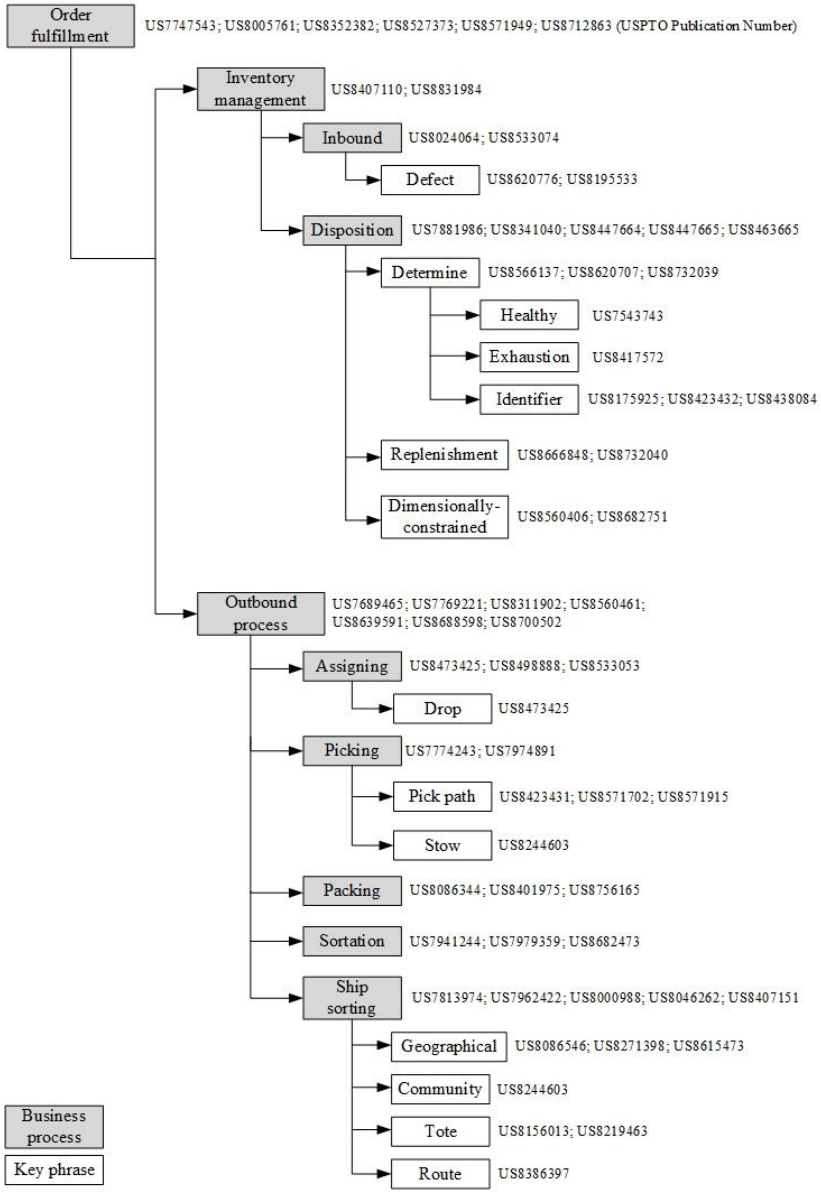

Figure 7. Order fulfillment ontology with Amazon patents (searched on 2014/12/08).

Outbound processes contain five sub-processes and the assigning and picking sub-processes also have their sub-domains. The drop sub-domain of assigning sub-process is a method predicting and identifying which certain items can be directly fulfilled from merchant without stocking items in fulfillment centers. The picking sub-process has two sub-domains: the pick path patents are related to optimizing the picking path or direct the movement of the agents towards to targeted location within less time, and stow integrates picking and stowing operations within a single picking travel so as to decrease the quantity of labor time utilized to perform given quantity of work. The ship sorting sub-process focuses on the delivery plans and the delivery methods, such as its

sub-domains tote and community delivery methods which help Amazon.com to save on package costs and lower shipping costs. The geographical sub-domain of shipping sorting anticipates the customers' ordering activity and ships the items to geographical area without completely specifying the delivery address, and the route sub-domain is used to improve the real time planning of vehicle routes.

4. Conclusions

This research uses text mining to extract Amazon's business method patents' key phrases and constructs an ontology. The results demonstrates that inventory management and ship sorting contain the largest number of patents (Figure 7). In other words, these two processes are strategic elements of Amazon's order fulfillment process. Inventory management is an important for allocating ready-to-ship inventory and for enhancing follow-up operations more efficiently while handling inventory levels and status. Ship sorting focuses on optimizing shipping routes and offering a variety of shipping methods for customers. From competing e-commerce enterprises' perspective, Amazon uses these two processes to represent their core patent strategy. Furthermore, an ontology of Amazon's order fulfillment process provides other enterprises with an overview. Other enterprises can examine their own patent strategies' strengths and weaknesses comparing to Amazon's patented distribution processes and logistics innovations, and proceed to improve their related business processes. Besides, by understanding Amazon's patented distribution processes, they can also insure their patent claims do not infringe upon the existing EC patents when associated patents are filed.

5. Acknowledgement

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