Development of an e-Catalog Evaluation Model Using Analytic Hierarchical Process

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AHP를 이용한 전자카타로그 평가 모형 개발에 관한 연구

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Abstract

고객이 요구하는 정보를 효율적으로 제공하기 위한 전자 카탈로그를 구축하는 것은 e-business의 성공의 핵심적 요소이다. 우수한 상품 판매 기술을 이용하여 고객의 판매 결정을 촉진하는 전자 카탈로그가 있는 반면, 그렇지 않은 경우는 사업적 손실과 법적인 분쟁까지 초래하기도 한다.

전자 카탈로그가 전자 상거래 사이트의 중심 요소임에도 불구하고 이제까지 학문적, 실용적 분야에서 전자 카탈로그의 평가 방법에 관한 연구는 찾아 보기 힘든 상황이다.

따라서 이 연구에서는 우선 효과적인 전자 카탈로그 구축을 위한 요구사항을 도출해 내고 그것을 전자 카탈로그 평가 기준으로 적용하여, AHP(계층적 분석 방법)를 사용해서 평가 기준간의 상대적 중요도를 개발해 내는데 목적이 있다.

그 평가 기준의 상대적 중요도는 기업이 전자 카탈로그를 구축할 때 중점을 두어야 할 사항을 결정하는데 기준을 제시해 줄것이다.

이 연구의 결과는 평가는 물론 효율적인 전자 카탈로그의 개발을 위한 지침을 마련해 줄 것이다

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1. Introduction

The electronic catalogs (e-catalogs) are defined as the reference for product selection and description of terms and conditions [Kelly, 1997]. In contrast to the paper-based catalogs, e-catalogs can carry almost unlimited volume of the product related information. For instance, the e-catalog of a leading communication equipment commerce site that authors of this study visited had the following information about the router: product name, image, price, characteristics, advantages compared to other brands, technical specification, electronic compatibility information, the names of countries in which router can be used, installation instruction, multimedia demonstration for the installation, after-service information, product evaluation by customers and so on. The e-catalog plays a role of the information portal in which customers obtain various information about products and services and complete the purchasing transactions.

Companies perceive that there is a competitive advantage on how they organize their catalog data. By intuitively matching the right products to the right people, the e-catalog can increase sales and create loyal customers who keep coming back for more [Verity, 2001]. On the other hand, flaws in the e-catalog could result in business losses and legal suits. For example, lack of integration between check-out mechanism of e-catalog and the fulfillment back-end results in 1999 Christmas' chaos [Scheraga, 2000]. Many on-line retailers relied on data entry clerks to key orders from the storefront into the fulfillment system. This was slow and error-prone activity that eventually fails retailers to ship customer orders by the promised date. Companies are learning that simply putting their catalogs up on the web isn't enough. They must also wrap workflow process and business applications [Mullich, 2000].

Many companies view their Internet presence to be vital to remain competitive. The reasons are to increase revenues, reduce costs, keep pace with the competition, and better satisfy customers. Setting up an effective e-catalog that enables the company to deliver the information and capabilities that customers need, is critical to the success of the e-business initiatives. However, there has been no comprehensive research that provides criteria and guidelines for an effective e-catalog development and evaluation. The purpose of this research is (1) to identify requirements of the successful e-catalog and then (2) to derive prioritized criteria for e-catalog evaluation. Using Analytic Hierarchical Process (AHP) methodology, this study develops a hierarchical structure of e-catalog evaluation criteria and their relative importance. AHP (Analytical Hierarchy Process) methodology is

suitable for complicated decision that involves trade-off among multiple criteria [Saaty, 1995]. When it comes to the e-catalog development, there are various resource constraints such as economic and time constraints under which developers have to make trade-off decisions. The relative importance of the evaluation criteria allows the developers to focus on more important features of the e-catalog.
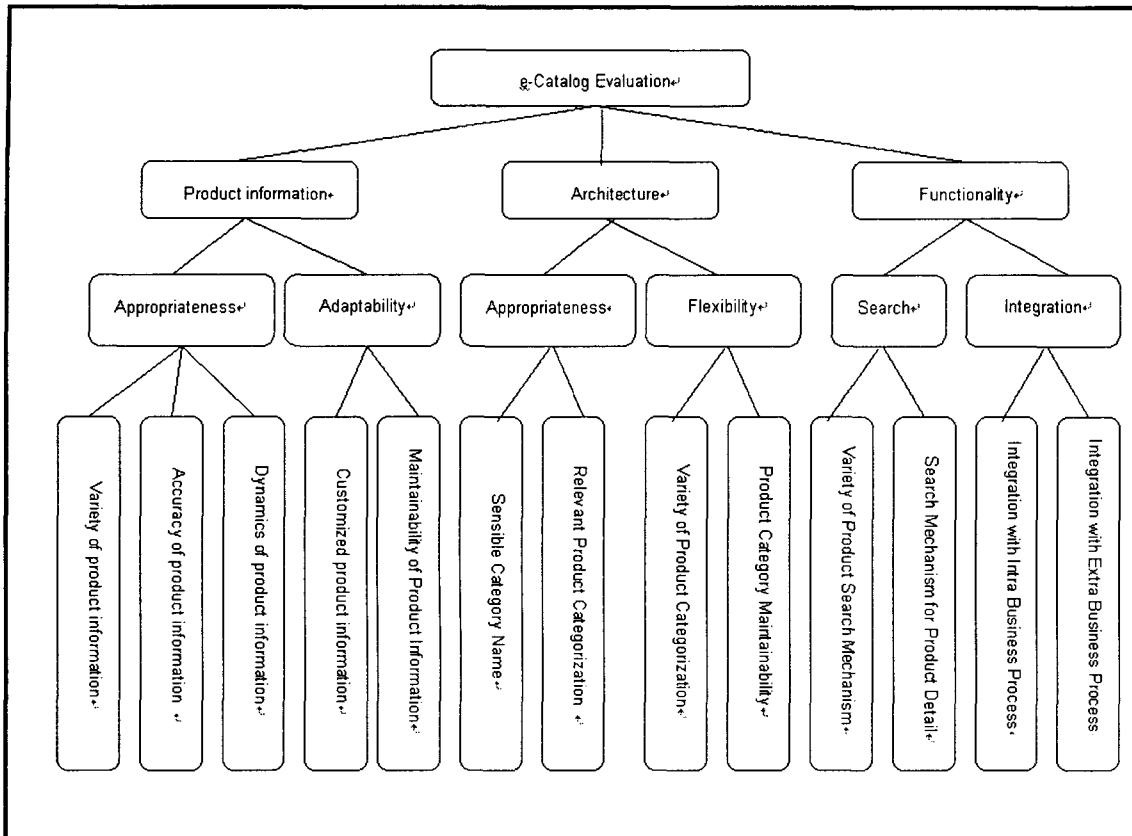
2. E-Catalog Evaluation Model

AHP (Analytical Hierarchy Process) methodology constructs hierarchical and multi-criteria knowledge map of decision makers. The constructed knowledge map demonstrates the hierarchical structure of the decision criteria that decision makers use to solve the decision problem. For the development of a hierarchy, the first step is to identify the objective of the decision and the first-level decision criteria that decision makers need to consider to accomplish the objective. For each first-level criterion, second-level sub-criteria are developed. Similar decomposition can be made iteratively down to the next level. Once the hierarchy is developed, the next step is to compare the criteria at the

same level in pairs to identify weights showing the relative importance of alternative criteria. This methodology is proven to be effective to support decision making of the complicated problem where trade-offs among multiple criteria are required [Satty, 1995].

This study initially constructed a decision hierarchy based on the relevant literature on the e-catalog. Then, the hierarchy was examined by e-catalog experts for verification and then revised according to their opinion. Figure 1 illustrates hierarchical structure of e-catalog evaluation criteria after verification. The relative importance of each criterion is obtained from the survey of domain experts on e-catalog. The e-catalog is evaluated in terms of architecture, product information and functionality. The description of each node in the hierarchy is as follows.

2.1. Architectural Criteria.

One study found that 38 % of e-commerce sites being studied have poor information architecture [Schwartz, 2001]. Another study reports that 80% of problems on a site relate to users' inability to locate a product [Riedman, 2000]. Since e-catalog includes thousands of products, proper organization of the

<Figure 1> Hierarchical Structure of Electronic Catalog Evaluation Criteria

products is key to sales. If they are not organized properly, people will just leave [Wonnacott, 2001]. Proper organization of the products requires (1) having sensible category name and (2) placement of the products under the right category. The former requirement involves that the category name by which the product is classified must be able to tell what kinds of products are included in the category. The latter requirement is related to the product being placed under the right category.

Since each customer can have different search path for a product, single product categorization can cause inefficiencies in the product search [Chung et al., 1998]. Figure 2 shows a network architecture of the product categorization, which illustrates various product categorizations.

Each oval in the network represents a product category. Each category at the higher-level network can have sub-categories showing at the next level. The sub-category's memberships in
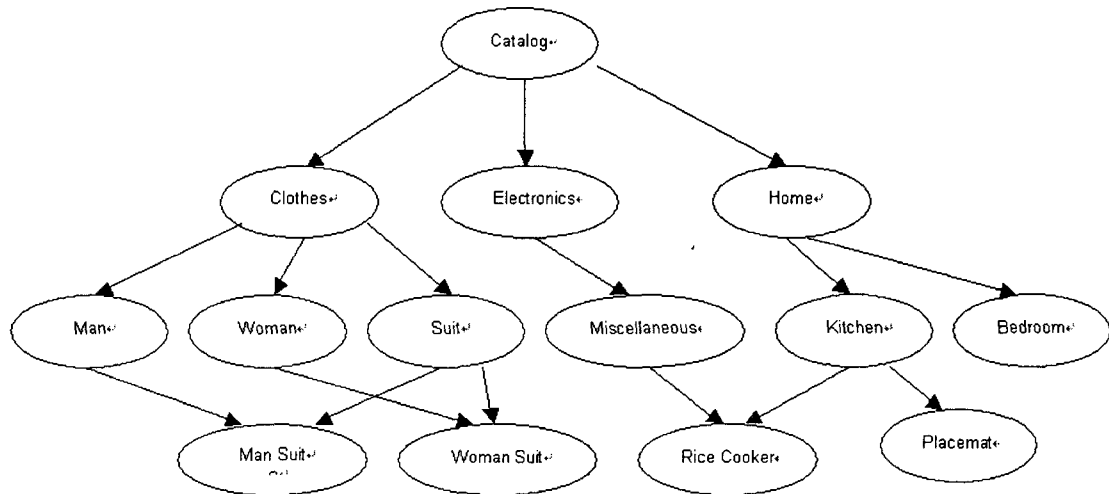
<Figure 2> Product Categorization [Adapted from Chung et al., 1998]

the higher-level categories are epresented with arrows. In figure 2, "man suit" is categorized in two different ways:

(1)clothes → man → man suit

(2)clothes → suit → man suit

Therefore, the product being included in various sensible categories is important requirement for an effective e-catalog.

As the industry advances, existing products are terminated and new products are introduced into the market. At the same token, existing categories are eliminated or modified; and new categories are emerged. Therefore, the product categorization model that the catalog is based on, must support category addition, deletion, merge and division [Chung et al., 1998].

Thus, the architectural aspect of the e-catalog is evaluated in terms of (1) appropriateness of the category and (2) flexibility of the category. Appropriateness is examined by ①sensible category name and ② relevant product categorization. The former relates to the case where the category name itself tells what kinds of products are included in the category. The latter is associated with the case where the product is placed under right categories.

Flexibility of the e-catalog is evaluated in terms of ① variety of product categorizations and ② product category maintainability. While the former relates to the product being included in various sensible categories, the latter refers to the easiness of the category addition, deletion, merge and division.

2.2. Criteria for Product

Information

In contrast to the paper-based catalogs, e-catalogs can carry almost unlimited volume of product related information -- product name, image, price and characteristics, advantages compared to other brands, technical specification, installation instruction, multimedia demonstration for the installation, after-service information, product evaluation by customers and so on. To help customers understand the usage of the products, it is required for the catalog to include various value-added information.

In addition to a variety of product related information, dynamics of the product information is considered to be crucial feature for e-catalog [Verity, 2001]. Based on product characteristics, the product data can be enhanced with images and motion pictures.

The variety and dynamics of the product information should not be provided at a cost of the accuracy. The accuracy of the product information affects the customer satisfaction. Inaccurate inventory quantity is one of the most frequent cited flaws of e-commerce sites. The site that claimed specific items were out of stock but later found to be in stock, is no longer trustworthy. Completeness and consistency of the information affect the accuracy of the product information.

The ability of providing customized product information is important yet challenging feature of the e-catalog. By intuitively matching the right products to the right people, e-catalog can increase sales and create loyal customers who keep coming back for more [Verity, 2001]. However, delivering customized catalog data with a different pricing and product assortment to a variety of buyers is a great challenge [Gilbert, 2000, Macleod, 2000, Karpinski, 1999].

Since the product information of e-catalog is volatile, e-catalog maintainability is an important feature of the e-catalog. The product information maintainability refers to the easy updates of product information due to changes in product specification or prices. About 75 percent of the time devoted to supporting an online catalog is spent creating and maintaining the data [Rogers, 1999]. In order to keep the product information maintainable, the catalog data needs to be populated from the database in which data are entered once and data inconsistency are minimized. The product information maintainability also affects the accuracy of the product information.

Thus, the product information of the e-catalog is evaluated by (1) appropriateness of the product information and (2) adaptability of product information. Appropriateness criterion is examined by ① variety, ② accuracy and ③dynamics of the product information.

The first criterion, variety refers to the product information of the catalog

including not only basic product information but also additional value-added information to help customers understand the usage of the products. The second criterion, product information accuracy refers to the accuracy of product data such as performance, delivery and after-service. The third criterion, dynamics of the product information refers to the product information having dynamic features such as images and motion pictures.

Adaptability criterion is used to evaluate the capability of the e-catalog being adaptable to the changing environments. The adaptability is examined by ① customization and ② maintainability of the product information. The product information customization refers to the ability of e-catalog delivering customized catalog data to a variety of buyers. The maintainability refers to the easy updates of the product information due to product changes, prices changes, or other supplier updates.

2.3. Functionality Criteria.

As mentioned in the previous section, 80% of problems on a site relate to users' inability to locate a product [Riedman, 2000]. As an alternative way to solve this problem, e-catalog needs to provide more than a single way to navigate the site (e.g. search by category or designer). A variety of search mechanisms for different search context includes key word search, attribute-based field search, directory search, and comparison search. The keyword search allows customers to search products by keyword that describes the products. The attribute-based field search allows customers to search the products by brand name, price and other criteria representing product characteristics. When customers have specific items that they want to buy, the key word and the attribute-based field search would be sufficient [Chung et al., 1998]. However, in other cases where customers do not have specific ideas about the products, the directory search through which customers can be guided to the products is more efficient. For efficient purchase, finding products is only half the battle. Using comparison search, customers need to fully evaluate all of the possible alternatives to ensure the selection of the right product, from the right supplier, at the right price.

When it comes to the product purchase, customers wish to search products at a detail level. For example, customers search products by manufacturers (Samsung, GE, Zippel etc.) and then by product types. For the next level, customers search products by price. Therefore, it is considered to be important to provide customers with the search mechanism that allows customers to search products at a detail level.

The integration of the e-catalog with various business processes is required for efficient processing of the

customer orders [Mullich, 2000]. The integration of the e-catalog comes in two different ways (1) intra business process and (2) extra business process. For inventory management and accounting purposes, the e-catalog needs to be integrated with the internal business processes [Baron et al., 2000]. A popular integration option for the e-catalog is integration with ERP (Enterprise Resource Planning) Systems. For the delivery of the products and electronic payments, e-catalog is integrated with the business process of external business partners through extranet. During Christmas' chaos of 1999, many on-line retailers relied on data-entry clerks to key orders form the storefront into the fulfillment system of the (fulfillment) service provider [Scheraga, 2000]. The lack of integration leads to delays and errors in order delivery.

Thus, the functionality of the e-catalog is assessed in terms of (1) search and (2) integration mechanisms. The search mechanisms of the e-catalog are evaluated in terms of ① a variety of the product search mechanisms and ② search mechanism for product details. While the former relates to the provision of a variety of search mechanisms for different search contexts, the latter is associated with the search mechanism to search products at detail level.

The integration criterion is evaluated in terms of the integration with ① intra business process and ②extra business process. While the former relates to the integration of the e-catalog with intra business process, the latter relates to the integration of the e-catalog with the business process of external business partners through extranet.

3. Survey Design and Data Analysis

Table 1 shows weights that indicate the relative importance of the criteria in the hierarchy along with brief explanations on each criterion.

The relative importance was obtained through the survey conducted with e-catalog experts. Each question in the survey consists of pairwise comparison of two elements from the same parent node at the same level of hierarchy. For example, the sample question shown in Figure 3, was formulated to ask the relative importance of architecture, product information and functionality aspects of the e-catalog.

Fifty-five e-catalog experts that include e-catalog developers and e-commerce site managers, participated in the survey. While 64% of the experts participated in the survey has less than or equal to two years of the e-catalog related experiences, the rest of them has more than two years of the e-catalog

<Table1 1> Evaluation Criteria and Weights for e-catalog

Level 1 (High) Criteria	Level 2 (Sub) criteria	Level 3 (Leaf) Criteria	Explanation
Architecture (0.333)	Appropriateness (0.213)	Sensible Category Name (0.116)	Category names are sensible.
		Relevant Product Categorization (0.097)	The product is placed under relevant categories.
	Flexibility (0.120)	Variety of Product Categorization (0.062)	Various categorizations for the product are available.
		Product Category Maintainability (0.058)	Addition of a new category and deletion of existing categories are supported.
Product Information (0.411)	Appropriateness (0.269)	Variety of Product Information (0.057)	Various value-added information for the product is included.
		Accuracy of Product Information (0.173)	The product information is accurate.
		Dynamics of Product Information (0.039)	The product information is dynamic based on the product characteristics.
	Adaptability (0.142)	Customized Product Information (0.074)	The product information is customized according to the buyers.
		Maintainability of Product Information (0.067)	The product information of the catalog is easily maintained.
Functionality (0.256)	Search (0.152)	Variety of Product Search Mechanism (0.091)	Various types of search mechanisms are available.
		Search Mechanism for Product Degree (0.061)	Search mechanisms for product detail are available.
	Integration (0.104)	Integration with Intra Business Process (0.047)	The catalog is integrated with various internal business process.
		Integration with Extra Business Process (0.057)	The catalog is integrated with various external business process.

Level 1: Comparisons between architectural, product information and functional criteria. Among evaluation criteria, A and B, which one is more important than the other?

A	Absolutely More Important	Significantly More Important	More Important	Slightly More Important	Equally Important	Slightly More Important	More Important	Significantly More Important	Absolutely More Important	B
Architecture										Product Information
Architecture										Functionality
Product Information										Functionality

<Figure 3> Sample Question

related experiences. Since e-catalog is relatively an infant stage of the development, a group of the experts is relatively a small size compared to the other areas of the information systems. The organizations where e-catalog experts were drawn include B2B marketplaces, government supply agents and shopping malls. After being explained about criteria in the hierarchy, the experts were asked to indicate their opinion about the relative importance of the criteria.

Based on the relative importance given by individual participants, the mean values of the relative importance of the criteria were computed. For the consistency of the results, the consistency ratio was measured as the ratio of the consistency index and the random index. Consistency ratio of less than 0.2 is considered to have an acceptable level of consistency while consistency ratio of greater than 0.2 is to have a lack of consistency, resulting in additional test of the consistency. Furthermore, consistency ratio of less than 0.1 is regarded as a reasonable level of consistency [Satty, 1990]. In this study, therefore, the survey with consistency index grater than 0.2 was excluded from the analyses. Only 27 surveys were determined to be consistent with overall consistency index 0.01, which represents a good consistency.

According to the analyses results, the product information aspect of e-catalog was perceived to be the most

important criterion with 41% weight followed by 33.3% of architecture and 25.6% of functionality. At the second-level criteria, appropriateness criteria of both architecture and product information were perceived to be more important than the other compared criteria, namely flexibility and adaptability. This can be attributed to the fact that e-catalog is relatively at the beginning stage where developers perceive the basic criterion, appropriateness being more important than flexibility and adaptability.

While accuracy of the product information (17.3 %) was perceived to be the most important among the product information appropriateness criteria, sensible category name (11.6%) was perceived the most important among the architectural appropriateness criteria. The former can be attributed to that accuracy of the information was perceived to be the fundamental feature compared to the value-added features of variety and dynamics.

Overall, category maintainability (5.8%), variety of product information (5.7%), dynamics of product informations (3.9%), intra business process (4.7%) and extra business process (5.7%) were perceived to be the least important criteria. Among these, product information variety, intra business process and extra business process are closer to the business side than technical side of the company operation. Since experts participated in the survey were e-catalog

developers with technical background, they might have placed a less importance on business aspects of the e-catalog.

4. Conclusion

Although there have been a few studies on standardization of technical format and product classification for the e-catalog, there has been no previous study on overall evaluation criteria for the e-catalog. The evaluation model developed in this study is comprehensive in that it includes a wide range of e-catalog features. The evaluation model not only provides the criteria to evaluate the e-catalog but also suggests guidelines to develop the e-catalog. When it comes to the system development, there are various resource constraints such as economic and time constraints under which developers have to make trade-off decisions. The relative importance of the criteria developed in this study allows the developers to focus on more important features of the e-catalog. Although the e-catalog is a central and forefront component of e-commerce sites, there has been little research on how to develop the effective e-catalog in either academic or practical domain. Since there has been no systematic research on e-catalog, authors had difficulties on deriving evaluation criteria. The criteria derived in this study are general however it can be further developed for specific industries as future research. A separate survey could be conducted by the type of industry and

thus specific industry evaluation model can be derived.

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