Establishment of Low Energy Building materials and Equipment Database Based on Property Information

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Abstract. The purpose of this study is to provide reliable service of materials information portal through the establishment of public big data by collecting and integrating scattered low energy building materials and equipment data. There were few cases of low energy building materials database in Korea have provided material properties as factors influencing material pricing. The framework of the database was defined referred with Korea On-line E-procurement system. More than 45,000 data were gathered by the specification of entities and with the gathered data, price prediction models for chillers were suggested. To improve the usability of the prediction model, detailed properties should be analysed for each item.

1. Introduction

The commercial websites for purchasing goods or comparing the prices of similar goods in Korea mainly focused on household items such as clothing and home appliances, however, the items which are handled in commercial websites are getting diverse so that the information of real estate are provided through the websites recently [1]. The services provided by those websites are usually the properties of the items, price comparison, consumers’ review information and so on, allowing users of the websites to obtain information of the items. As the users of the websites increase, the manufacturers have to provide more information to the websites, and compete the price and quality of the product with similar manufacturers in the same field. When consumers purchase a product, they can obtain information regarding the product promptly through the websites for comparing the prices and purchase the same product at a low price. Due to such advantage, 51% of consumers purchased a product after price comparison through the websites for comparing the prices, and 45.4% among them considered product reviews when deciding whether or not to purchase the product [2].

The low energy building materials and equipment information portal in this study is established at national level with quasi-governmental agencies including Korea Energy Agency and Korea Appraisal Board. The portal is designed to integrate scattered database and provide reliable contents related to government systems and policies in order to allow portal service users to select a desired product rationally. Also, this portal leads healthy competitions between manufacturers and sellers through the product price and properties comparison so that reasonable prices can be established in the market. This paper suggests the methodology for gathering the data and the processed information from the gathered data

2. Low energy building materials and equipment database

2.1. Code system of low energy building materials and equipment database

The data framework is necessary to gather enormous data for building materials and equipment database.
Korea On-line E-procurement system (www.g2b.go.kr) was established in 2002 to secure the transparency of public contract between the government, public institutes and private companies. The On-line E-procurement system has officially certified code system for gather the information of products which is supplied to the government or public institutes [3-5]. For operation and management of building materials and equipment database the code system of the Online E-procurement system was used in the building materials and equipment database after modified to expand the number of items for building materials and equipment database. The classification code of the database was same with Online E-procurement system up to sub-class, and the code for sub sub-class was recomposed according to the range of data to be established in this study. The established database for low energy building materials and equipment was classified into 5 levels for 165 codes as partly shown in table 1.

Table 1. Code system for building materials and equipment database.

| Major Class | Middle Class | Minor class | Sub-class | Sub-class | Code name |
|-------------|--------------|-------------|-----------|-----------|-----------|
|              | 30 Building materials |            | 03 Bid type insulation | 01 Bid type insulation | 301415 |
|              |              |            | 08 Fiber insulation | 01 Fiber insulation | 301415 |
|              |              |            | 14 Foam polystyrene insulation | 01 Foam polystyrene insulation | 301415 |
|              |              |            | 15 Extruded foam polystyrene insulation | 01 Extruded foam polystyrene insulation | 301415 |
| 40 Pipes and Fluid control systems | 10 Heating, cooling and ventilation system | 17 Cooling system | 01 Cooler | 01 Cooler | 401017 |
|              |              |            | 02 Evaporator | 01 Evaporator | 401017 |
|              |              |            | 03 Evaporative cooler | 01 Evaporative cooler | 401017 |
|              |              |            | 04 Condensing unit | 01 Condensing unit | 401017 |
|              |              |            | 08 FCU | 01 FCU | 401017 |
|              |              |            | 09 AHU | 01 AHU | 401017 |
|              |              |            | 10 Reciprocating chiller | 01 Reciprocating chiller | 401017 |
|              |              |            | 11 Turbo chiller | 01 Turbo chiller | 401017 |
|              |              |            | 12 Screw chiller | 01 Screw chiller | 401017 |
|              |              |            | 13 Absorption chiller | 01 Absorption chiller | 401017 |
2.2. Establishment of low energy building materials and equipment database

Since data modelling is necessary for database establishment, the list and specifications of entities are suggested and database is established according to the list and specification of entities. The list of entities provides the information from the source of data such as period of update and the number of materials and equipment for each data item to be gathered.

Attribute information of materials and equipment database can be classified into general information and detailed information for each item. The general information field provides basic which should be included such as product model name, image, company name, price and specifications. Detailed information field contains additional information or specified performance or services which the manufacturers want to inform to the consumers. Figure 1 shows the list and specification of entities in materials and equipment database. With the specification of entities, more than 45,000 data of building materials and equipment were gathered. About 34,000 data were gathered from Korea Price Information (KPI) system which is the largest building material and equipment database in Korea, however KPI focuses on the price, performance data for materials and equipment were not contained for some items. About 14,000 data were gathered from the certified material and equipment database of Korea Energy Agency (KEA), on the other hand, KEA focuses on the performance, they do not provides price data.

![Figure 1. List and specification of entities.](image-url)

3. Price prediction models

The users of the database usually focus on the performance and the price because they want maximize the performance of the materials or equipment within affordable budget range. Therefore the database needs to provide price prediction model by the performance for the materials or equipment. Data for chillers such as absorption chiller, screw chiller and so forth are accumulated with specification of entities for a chiller. Figure 1 shows the cost variation of chillers according to refrigerating capacity. As the R2 value of the prediction model is less than 0.7, chillers were separated and analysed by the types. Figure 2 and 3 show the variation for absorption chillers and screw chillers respectively. Absorption chillers could be predicted by the model, however, screw chiller model should be separated by detail properties as shown in figure 3. Table 2 shows the equation of prediction models.
Figure 2. Relationship between price and performance of chillers.

Figure 3. Relationship between price and performance of absorption chillers.

Figure 4. Relationship between price and performance of screw chillers.
Table 2. Prediction model for chillers.

| Item                        | Equation     | R2  |
|-----------------------------|--------------|-----|
| Chiller                     | Y=0.1075x +55.947 | 0.6972 |
| Absorption chiller          | Y=0.1001x+42.57 | 0.9373 |
| Small size screw chiller    | Y=0.1208x+7.2851 | 0.4830 |
| Normal screw chiller        | Y=0.1777x+50.023 | 0.3809 |
| Inverter screw chiller      | Y=0.1007x+318.93 | 0.9660 |
| Low velocity screw chiller  | Y=0.1740x+70.823 | 0.9929 |

4. Conclusions

The purpose of this study is to suggest the methodology for establishment of reliable low energy building materials and equipment and expansion of usability of the database by providing processed information from the gathered data.

The framework of the database was defined referred with Korea On-line E-procurement system for maintenance of the system and specification of entities was defined by the properties of the items. More than 45,000 data were gathered by the specification of entities and with the gathered data, price prediction models for chillers were suggested. To improve the usability of the prediction model, detailed properties should be analysed for each item.

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Acknowledgments

This research was supported by grant (17AUDP-B079104-04) from Architecture & Urban Development Research Program funded by Ministry of Land, Infrastructure and Transport of Korean government.