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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
CO DE	ID	CO DE	ID	CO DE	ID	CO DE	ID	CO DE	ID	CODE
30	Building materials	14	Insulation	15	Insulation	03	Bid type insulation	01	Bid type insulation	3014150301
						08	Fiber insulation	01	Fiber insulation	3014150801
						14	Foam polystyrene insulation	01	Foam polystyrene insulation	3014151401
						15	Extruded foam polystyrene insulation	01	Extruded foam polystyrene insulation	3014151501
40	Pipes and Fluid control systems	10	Heating, cooling and ventilation system	17	Cooling system	01	Cooler	01	Cooler	4010170101
						02	Evaporator	01	Evaporator	4010170201
						03	Evaporative cooler	01	Evaporative cooler	4010170301
						04	Condensing unit	01	Condensing unit	4010170401
						08	FCU	01	FCU	4010170801
						09	AHU	01	AHU	4010170901
						10	Reciprocating chiller	01	Reciprocating chiller	4010171001
						11	Turbo chiller	01	Turbo chiller	4010171101
						12	Screw chiller	01	Screw chiller	4010171201
						13	Absorption chiller	01	Absorption chiller	4010171301

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.

NO	subject area	Entity name	Description	Entity type	source of data	establishment method	change period	number of data	
1	Building materials	Physosol	Classification code for physosol	Common code	System of Public Procurement Service	Link	Occasional	100	10
2	Building materials	Particle board	Classification code for particle board	Common code	System of Public Procurement Service	Link	Occasional	100	10
3	Building materials	Polyethylene film	Classification code for polyethylene film	Common code	System of Public Procurement Service	Link	Occasional	100	10
13	Building materials	Glass block	Classification code for glass block	Common code	System of Public Procurement Service	Link	Occasional	100	10
14	Building materials	Concrete panel	Classification code for concrete panel	Common code	System of Public Procurement Service	Link	Occasional	100	10
15	Building materials	Brick	Classification code for brick	Common code	System of Public Procurement Service	Link	Occasional	100	10
16	Building materials	Tile & Rapture	Classification code for tile & Rapture	Common code	System of Public Procurement Service	Link	Occasional	100	10
17	Building materials	Insulation material	Classification code for insulation material	Common code	System of Public Procurement Service	Link	Occasional	100	10
18	Building materials	Air blower	Classification code for air blower	Common code	System of Public Procurement Service	Link	Occasional	100	10
19	Building materials	Air conditioning unit	Classification code for air conditioning unit	Common code	System of Public Procurement Service	Link	Occasional	100	10
20	Building materials	Refrigerator	Classification code for refrigerator	Common code	System of Public Procurement Service	Link	Occasional	100	10
21	Building materials	Heat exchanger	Classification code for heat exchanger	Common code	System of Public Procurement Service	Link	Occasional	100	10
22	Building materials	Heat pump	Classification code for heat pump	Common code	System of Public Procurement Service	Link	Occasional	100	10
23	Building materials	Solar heating system	Classification code for solar heating system	Common code	System of Public Procurement Service	Link	Occasional	100	10
24	Building materials	Boiler	Classification code for boiler	Common code	System of Public Procurement Service	Link	Occasional	100	10
25	Building materials	Duct	Classification code for duct	Common code	System of Public Procurement Service	Link	Occasional	100	10
26	Building materials	Pump	Classification code for pump	Common code	System of Public Procurement Service	Link	Occasional	100	10
27	Building materials	Blind	Classification code for blind	Common code	System of Public Procurement Service	Link	Occasional	100	10
28	Building materials	Excellent green building technology	Classification code for excellent green building technology	Common code	Pascho House DB, High	Link	Quarterly	8	8
29	Building materials	High-efficiency energy saving equipment (energy saving equipment)	Classification code for high-efficiency energy saving equipment	Common code	Korea Energy Agency	Link	Occasional	20000	2000
30	Building materials	High-efficiency energy saving equipment (energy saving equipment)	Classification code for high-efficiency energy saving equipment	Common code	Korea Energy Agency	Link	Occasional	13000	1300
31	Building materials	New & renewable energy facility certification	Classification code for new & renewable energy facility certification	Common code	Korea Energy Agency	Link	Occasional	2000	200

Specification of entities		prepared by	KICT	date of preparation	2015.11.20
Project name	Development of integrated building energy support system for distributing and spreading low-energy buildings				
system name	Building information DB system	Subject area	Building materials DB		
TABLE_ID	Naming scheduled on the design step	TABLE name	Information of insulation material		
Summary	Manage the specification, performance and price information based on cost information for each type of insulation material				
Storage method and period	Loading period Preservation period Number of initial establishment	Monthly Permanent (or 10 months) 10,000	Loading form Preservation form Number of MAX cases	Update/Append Table (or backup) 50,000	Characteristics of entity Collection Data change rate (%) 15%
Constraint condition	Primary Keys Referent table	Item name + heat conductivity + Price Building construction information, etc			

NO	Attribute name	PK	Description of attribute	DATA TYPE	sample data
1	Item name	Y	Sub sub-class name of product	text	Bubble insulation material
2	English name	N	English name of product	text	Adiabatic aluminum sheets
4	Item classification No.	N	Sub-class No. of product (Item classification No.)	number	30141503
5	Item identification No.	N	Unique product No. (Item identification No.)	number	20154397
6	Detailed item No.	N	Sub sub-class No. of product (Detailed item No.)	number	3014150301
8	Item registration date	N	Date of product registration on the list information system of Public Procurement Service	number	2000.09.07
9	Image	N	Product picture		
10	Model name	N	Product model name	text	HCC-030
11	Company name	N	Name of product manufacturer	text	Hyogwang
12	Durability	N	Product replacement period (year)	number	10
13	Unit	N	Unit	text	m2
14	Price	Y	Price(KRW/m2)	number	20,000
15	Purpose	N	Purpose	text	for housing
16	Shape	N	Shape	text	Spray coating type
17	Performance class (category)	N	Performance class (category)	text	category 2
18	Performance class (No)	N	Performance class (No)	text	No 2

Figure 1. List and specification of entities.

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.

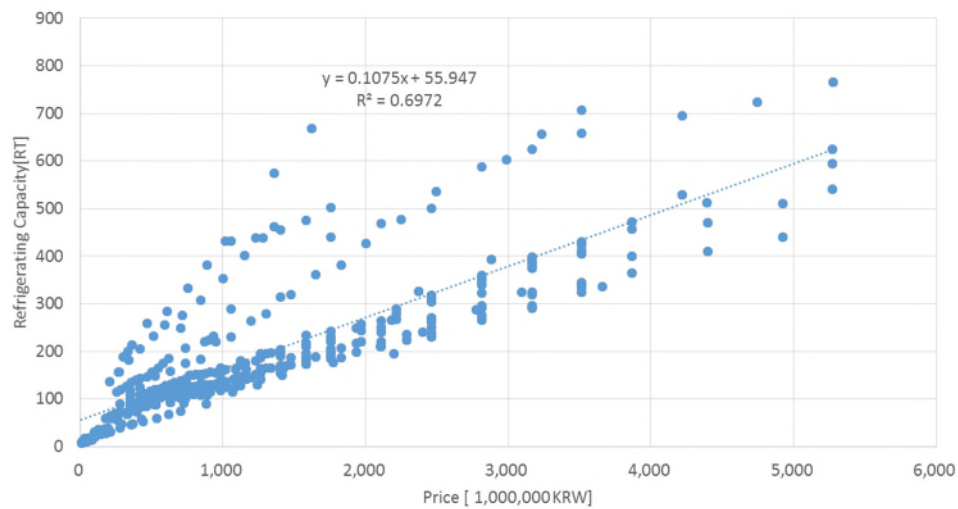


Figure 2. Relationship between price and performance of chillers.

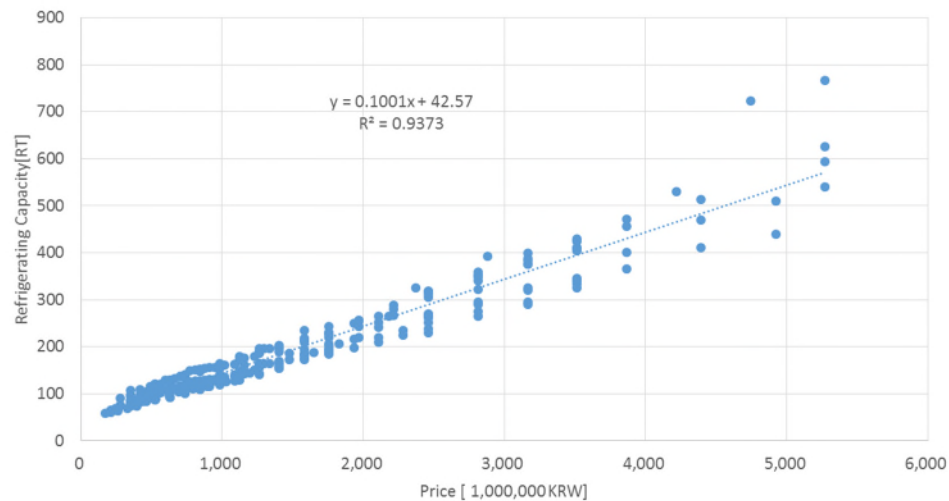


Figure 3. Relationship between price and performance of absorption chillers.

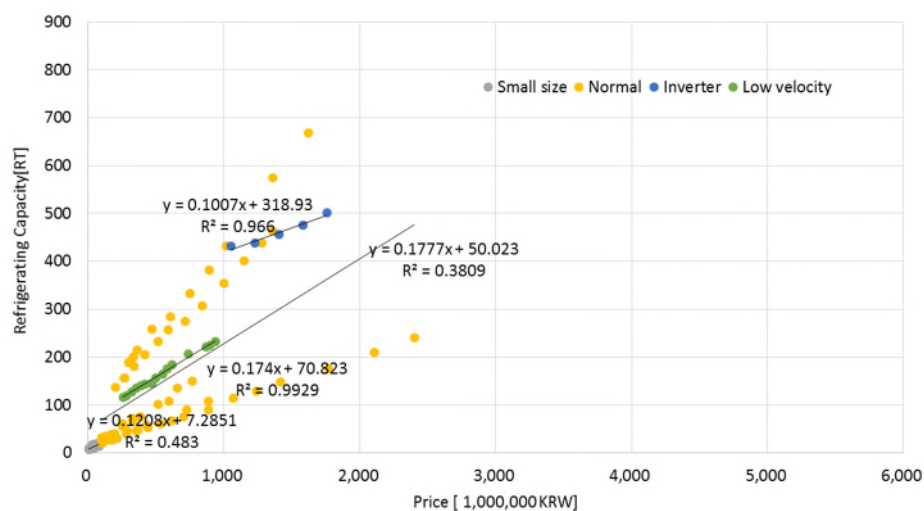


Figure 4. Relationship between price and performance of screw chillers.

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

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