



# A Proposed Model for Buyers Agent e-commerce Systems Based on The Quality of Information

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**Abstract:** The comparing and evaluation of e-commerce websites is becoming an important issue for customers, due to the immense increase in the number of web site, in order to decide which website is better to deal with. In this paper a buyer agent e-commerce model that is based on four Information Quality (IQ) dimension (Relevancy, Reputation, Timeline, and Amount of Data) is proposed, tested and evaluated against a priced based model. An Evaluation of the four dimensions is carried out in order to determine the most effective dimension. Evaluations are done through simulation process. The model also evaluated by a group of 10 people, the result of their evaluation agreed with the result of the simulated evaluation. Realizing the issues existing in current agent-based systems, this research, from the goods information point of view, ranks goods items based on the Information Quality dimensions.

**Keywords:** Commerce, Buying Agents, Relevancy, Reputation, Timeline, and Amount of Data.

## 1. INTRODUCTION

There are many e-commerce systems in practice, such as eBay and Amazon, these e-commerce systems employ software agents which play a great role in automating numerous tasks such as information retrieval and filtering, providing personal assistance, playing the role of domain expert, and supporting people in decision making. One of the emergent part of e-commerce systems, which has been recently researched and gained a great deal of importance is buying agents, which intend to efficiently retrieve and filter goods that are economically suitable for buyers. Badiçà, et al[3].

The most prevailing solutions currently implemented for buying agents are ranking algorithms which use one or multiple simple features of goods items to calculate and rank a list of these good items and their sellers such as the reputation of the seller and goods price. However these approaches help people to locate the goods they are interested in; their results may not be satisfactory because of some drawbacks of these algorithms, such as unsuitability of some situations and the low efficiency in locating the desired information.

The most critical component of an e-commerce transaction is information; upon its availability buyers base

their decisions, poor decisions made by people are due to lack of information. Quality of information in terms of relevancy, reputation, timeliness, and completeness plays a crucial role in supporting buyers' decision making process. Buyer will not pick up a good when its information seems to be irrelevant, incorrect or delivered at the wrong time.

A description of e-commerce intelligent agent with Web-based applications that includes e-commerce in form of business-to-business (B2B), business-to-customer (B2C), and customer-to-customer (C2C) has been given by T.Hassanian and I. Albidewi [8].

Hasan Al-sakran applied an intelligent agent to negotiate between buyer and seller in (B2C) e-commerce using big data analytic Al-Sakran [2].

In this paper, we took Information Quality into consideration and applied IQ-based ranking in the buying agent for (B2C/C2C) e-commerce system,

The purpose of this paper is to develop, implement, and evaluate a model for buyers agent e-commerce systems based on the quality of information related to the e-commerce's website.

The rest of this paper is organized as follows; Section (2) deals with the information quality (IQ) definition,



concepts and dimensions.

Section (3) discusses how to assess the different (IQs).

Section (4) deals with buying agents and its applications in e-commerce.

Section (5) discusses the proposed IQ dimensions to be used in the proposed model.

Section (6) explains the proposed model.

Section (7) contains an illustration of how the proposed model performs the ranking process.

Section (8) discusses how the proposed system has been evaluated.

Section (9) is the conclusion section.

## 2. INFORMATION QUALITY (IQ) DEFINITION, CONCEPTS AND DIMENSIONS

Information Quality as a recognized discipline was widely investigated in the literature. IQ research was conducted in different application areas, such as information and database systems Majki [12], websites Katerattanakul, & Siau [10], and e-businesses Kim et al. [11]. Among these researches, Martinez and Hammer [13], for instance, had provided an approach to count the quality of information in a database system. Katerattanakul, & Siau [10], had provided an approach to measure the Information Quality of a website. Cappiello et al. [4], had conducted the data quality assessment from a user's perspective. Majki et al [12], had presented a general framework for query answering in Data Quality-based Information Systems. Kim et al. [11], had analyzed the characteristics of e-businesses and developed an E-Quality framework. In the research of Zhu & Gauch [19], IQ was used to retrieve documents in centralized and distributed Internet search environments.

According to Al-Hakim. [1], customers view quality in different ways based on their individual roles in the production-marketing chain. Thus, it is important to understand the various perspectives from which Information Quality (IQ) is viewed. Wang [18], found an analogy between the quality issues in product manufacturing and those in information, and further asserted that information manufacturing can be viewed as processing system acting on raw data to produce information products.

Al-Hakim [1], had also emphasized that quality could be a confusing concept. He provided two main reasons for this assertion: (1) people view quality using different perspectives and dimensions based on their individual roles, and (2) the meaning of quality continues to evolve as the quality profession grows and matures. Similar to product quality, IQ has no universal definition, to define IQ, it is important to comprehend both the

perspective from which IQ is viewed and its dimensions.

Strong, et al. [16], provided the most comprehensive list of 15 IQ dimensions, these dimensions in turn are grouped into four categories as shown in Table (1).

## 3. IQ ASSESSMENT

IQ assessment is defined as the process of assigning numerical or categorical values (quality scores) to the quality criteria in a given data setting Gertz et al [6].

**Table (1): Information quality categories and dimensions**

IQ Categories	IQ Dimensions
Intrinsic IQ	Accuracy, Objectivity, Believability, Reputation
Accessibility IQ	Access, Security
Contextual IQ	Relevancy, Value-Added, Timeliness, Completeness, Amount of Data
Representational IQ	Interpretability, Ease of understanding, Concise representation, Consistent representation

In Pipino, [14], the authors have studied the various types of metrics and how to combine the values of the quality indicators. Objective data quality metrics were developed by using the following three functional forms.

- *Simple Ratio*: Which is defined in Pipino et al. [14], as the simple ratio is measuring the ratio of desired outcomes to total outcomes.
- *Min or Max operation*: This function form is usually applied to handle dimensions that require the aggregation of multiple data quality indicators (variables). It consists of two measurements one computes the minimum (or maximum) value and the other one measures the Maximum (or minimum) from the normalized values of the individual data quality indicators.
- *Weighted Average*: For the multivariate case, an alternative to the min operator is a weighted average of variables. If a company has a good understanding of the importance of each variable to the overall evaluation of a dimension, for example, then a weighted average of the variables is appropriate.

### A. IQ assessment Models:

In an agent-based e-commerce system, when a buyer is in need of some goods, he/ she will send a request to the system, which then triggers a buying agent to search

suitable goods items within the system for the buyer. The IQ-based approach acts as a "shadow" operator and compute the quality of goods items based on the quality values of the input data and available IQ metadata Gertz, et al [6]. An important question arises: how buying agents provide buyers with quality information in addition to the query results? There are two suggested models to answer this question: the data-driven model and the quality-driven model.

In a data-driven model, a user can query the source as usual, while additional information about the quality of the query results is provided. That is, operators of the data quality algorithm can compute the quality of each item in results while the query is processed. When this model is applied to a buying agent system, the structure would be as shown in Figure (.1).

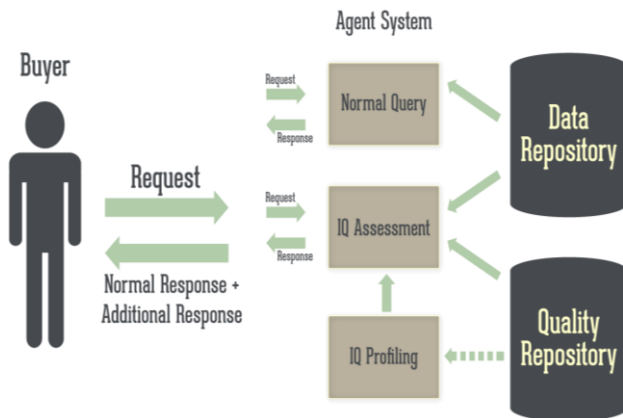


Figure (1): the data driven model

In this structure, after receiving a request from a buyer, a buying agent will go to search the Data repository for the suitable goods items that meet the buyer's requirement "Normal Query"; at the same time, it make use of the data quality algorithm to calculate the IQ of each goods items within the search result "IQ Assessment". Finally, the agent can send both the search results and the IQ resultst to the buyer.

In a quality-driven model, the user can specify the IQ requirements. During the query processing and in order to meet the specified requirements, the system can decide what sources and IQ metadata to use, calculates the IQ, and then sends the results of the IQ to the user. Figure (2), illustrates an agent system that can apply this model. In this model, a buyer agent will calculate IQ for each item, and then send to the buyers the items that meet their IQ requirement that were specified by them. This approach is more like a query optimization problem that treats quality values as criteria.

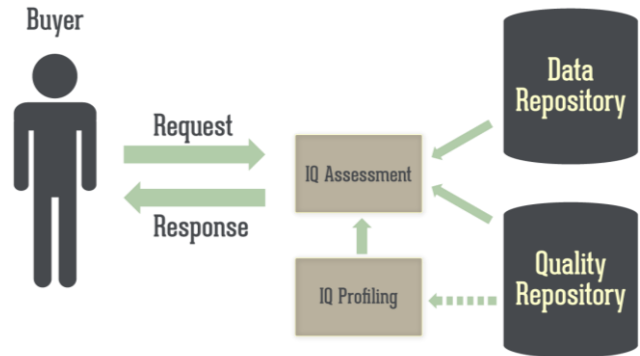


Figure (2): the quality driven model

#### 4. BUYING AGENT:

Danial et al [5] define E-commerce as ‘the buying and selling of information, products and services via computer networks.’With the development of e-commerce, intelligent software agents (or "agents" for short) are widely researched. A multi-agent system (MAS) can be defined as a network of multiple agents that interact with one another. Within this system, an autonomous and intelligent agent is well suited for many areas; for example, managing the information overload, retrieving and filtering information, acting as a personal assistant, servicing as a domain expert, and helping people make decisions. In the research of multi-agent systems for ecommerce, the technology applied in buying-agents, which aims to search and find suitable goods efficiently and economically for buyers, is a crucial part.

As the tasks of agents that are involved in e-commerce, the authors of the paper "Agents in e-Commerce", He and Leung, said: "We employ the Consumer Buying Behavior (CBB) model ((Guttman et al. 1998), page 2) to capture consumer behaviour in order to analyze the tasks of agents involved in e-commerce. There are six stages in the CBB model: (1) need identification, (2) product brokering, (3) merchant brokering, (4) negotiation, (5) purchase and delivery, and (6) product service and evaluation". This research is based on the premise that the users know exactly what they want and then the agent help them to find the appropriate goods. Consequently, this research will focus on the merchant brokering stage.

In the merchant brokering stage, the technique widely used in buying agents is price comparison. Price comparison is used to compare the prices of a product from different merchants, and select the cheapest one. However, price is not always everything. Considering price only causes other value-added services from merchants to be ignored, and thus it fails to offer enough chances for merchants to differentiate themselves in competitive markets. Moreover, a customer cannot have



an option to choose between the price of a product and its other features (e.g. its delivery time and extended warranty). Thus, multi-attribute comparison is needed in shopping agents. With this kind of shopping agent, it is easier for customers to perform cross-merchant product comparisons. Actually more and more studies have focused on this research. Jango which is an e-commerce site selling music present the opportunity to balance the model and make of a product. Tete-a-Tete (T@T) allows buyers to have more control over the attributes of the product required. In fact, buyers can specify the importance of each attribute. The returned rating list will then show how well a product fits the buyer's requirements.

More recently, attention was focused on the attribute of seller's reputation. According to Sabater and Sierra, (2001), [15] Reputation is "the opinion or view of one about something". In electronic marketplaces, the reputation that a user has is the result of aggregating all the impressions of the other users that interacted with him/her in the past. Amazon Auctions and eBay, for instance, are online auction houses where users buy and sell goods. Each time a new transaction is finished, the buyer rates the seller.

Buying-agent systems can be classified into two broad categories based on their architectures: 1) centralized; and 2) distributed. Centralized agent systems typically require that all the goods information reside locally at a single site and all queries are also handled by that site. Ebay.com and Amazon.com are typically belong to this type. All the transaction will also happen in the local system.

In contrast, distributed agent systems allow agents to simultaneously access goods information distributed across multiple remote sites, such as Google.Shopping and fetchbook.info. In the local site, there are only some basic information about the goods, such as seller/other store's name, price, and the link to the original site that the goods information is persisted. Users also have to go to other sites to get their transactions completed.

## 5. THE PROPOSED IQ DIMENSIONS

As we noticed in section 4, relying on a single attribute to evaluate any e-commerce site is not enough. So in this section, we will discuss the IQ dimension which we chose to be used in our model. Four dimension out of the 15 dimensions shown in Table 1 have been used in our model. These are: Relevancy, Reputation, Timeliness, and Amount of Data. The reason for choosing these dimensions is that these four dimensions are among the most widely researched dimensions in the field AL-Hakim [1], Cappiello, et al. [4], Katerattanakul, and Siau, [10]; they are also the most fully-fledged dimensions AL-Hakim, [1] Cappiello, et al. [4], Pipino, et al. [14].

### A. Relevancy (Qrk)

In Strong et al. [16], Relevancy has been defined as the extent to which the data is applicable and helpful for the task at hand. In the context of e-commerce systems, Relevancy is the extent to which the goods items, retrieved by buying agents and sent to buyers, are pertinent to the buyers' needs and interests.

$$Qrk = \frac{\text{Number of query keywords in the description field}}{\text{Total number of words in the goods item}}. \quad (1)$$

According to this definition, the value of Qrk is between 0 and 1.

### B. Reputation (Qpk)

Reputation, as described in Sabater and Sierra [15] is the "opinion or view of one about something", this opinion is formed and updated through direct interactions with an entity (e.g., a seller) or through the information provided by other members of the society about the experience they have had with that entity in the past.

In Amazon and eBay, Reputation is measured by making use of the percentage of the positive feedback and the total number of feedbacks of the users. Then equation (2) below is used to measure reputation:

$$Qpk = a/b / \max(a,b) \quad (2)$$

Where:

a = the seller's percentage of positive feedback.

b = the total number of feedbacks.

Note that the value of the Reputation dimension will also be in the range [0, 1].

### C. Timeliness (Qtk)

Timeliness has been defined in terms of "whether the data is out of date and the availability of output on time" Pipino et al. [14]; a closely related concept is currency, which is interpreted as the time a data item was stored Veronika & Mokrane [17], Timeliness is measured using equation 3 below:

$$Qtk = \max \left[ 0; \left( 1 - \frac{\text{Currency}}{\text{volatility}} \right) \right]^s \quad (3)$$

Where s is the sensitivity factor, Currency is defined as the age plus the delivery time minus the input time; Volatility refers to the length of time the data remains valid. The Timeliness value obtained with this equation is in the range [0, 1]. The higher the Timeliness value is the better, it reflects fresh information.

D. Amount of Data (Qak)

It is indicating the extent to which the volume of the data is appropriate for the task at hand Gertz et al. [6]

$$Qak = (\text{the number of words in goods information} / \text{Max} (\text{number of words in good Information})) \quad (4)$$

6. THE PROPOSED MODEL

The proposed model for IQ assessment in a generic agent system is depicted in Figure (3).

This model is a data driven which consists of the following parts:

- 1.) Three repositories for the Data, repository is the place where all information of goods items are persisted, Quality repository which stores Information Quality related metadata, and Unqualified Product Repository stores information for poor quality goods
- 2.) Five Modules, these are:
  - a) The Normal Query module which analyzes buyers' requests and queries the data repository. At the end of the execution of this module, the query result is sent to the quality assessment module. The query result will be a list of goods items which satisfied the query criteria.
  - b) The Information Quality Measurement Module; which is responsible for the retrieval of the requested data and the necessary metadata, and then performs the evaluation process based on these data. Within the module, the following steps are conducted in order:

- The module retrieves the quality metadata from the Quality Repository for the queried goods.
  - The module measures four data quality dimensions one by one, namely Relevancy, Reputation, Timeliness, and Amount of Data.
  - At the end of the execution of the measurement procedure, the module sends the requested data, along with the results of the quality evaluation, which is a set of values for the Information Quality dimensions, to the filtering module.
- c) *Profiling Module*; This module uses the specification of buyers' Subjective Quality Level they choose for each data quality dimension, namely Relevancy, Reputation, Timeliness, and Amount of Data, denoted by Sr, Sp, St, and Sa, respectively. These values are obtained based on the understanding and requirements of buyers for the IQ dimensions.
  - d) *Filtering Module*; the objective of this module is to limit the size of the result set. There are three steps involved in the process of filtering:
    - The module retrieves the Subjective Quality Level values of the buyer from the profiling module.
    - The module filters the product items according to their IQ values and the buyer's Subjective Quality Level values.
    - The module sends the filtered results to two different places: the selected qualified product information is sent to the IQ Interpretation module.
  - e) *IQ Interpretation Module*; in this module, the "index of data quality" is calculated to deal with the information of qualified goods items then presents it to the buyer. Index of data quality is a single aggregate measure of Information Quality, calculated using the average function of dimension values by equation (5).

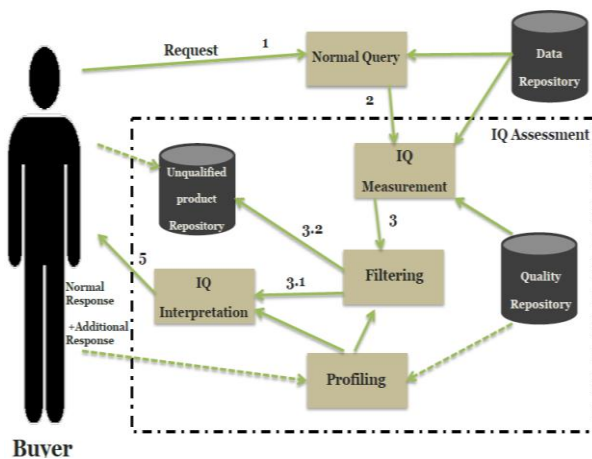


Figure (3) Proposed architecture for IQ assessment in a generic agent system.

$$IQ_{mik} = (Q_{rk} * W_{mir} + Q_{pk} * W_{mip} + Q_{tk} * W_{mit} + Q_{ak} * W_{mia}) / (W_{mir} + W_{mip} + W_{mit} + W_{mia}) \quad (5)$$

Where:

$IQ_{mik}$  be the quality index of the goods item  $G_k$ , (of product  $P_i$ ) when considering buyer  $B_m$  requirements.

$Q_{rk}$ ,  $Q_{pk}$ ,  $Q_{tk}$ , and  $Q_{ak}$ , are the Information Quality values for the Relevancy, Reputation, Timeliness, and Amount of Data dimensions of the goods item  $G_k$ ;



The values of  $Q_{rk}$ ,  $Q_{pk}$ ,  $Q_{tk}$ , and  $Q_{ak} \in [0, 1]$ .

And  $W_{mir}$ ,  $W_{mip}$ ,  $W_{mit}$ ,  $W_{mia} \in [0, 1]$  are the weights for each IQ dimension.

## 7. ILLUSTRATIVE CASE

To illustrate how the proposed model performs the ranking, let us consider a typical scenario taken from daily life, where a buyer, named Frank, tries to buy a Konica camera. Then the following actions are taken by the proposed model:

- 1) *The Normal Query Module uses "Konica camera" as search keywords; this module will query the database and retrieve all the goods items which match this criteria. Suppose the system shows that there is 264 items found for "Konica camera". All these items as well as their detail information are put into the result set and then sent to the next module (The Quality Measurement Module).*
- 2) *The Quality Measurement Module measures every dimension of each product items in the result set (i.e., Relevancy, Reputation, Timeliness, and Amount of Data). The result set will be sent to the next module (the Filtering Module) for further processing.*
- 3) *Before sending the request for the camera, Frank is prompted to specify his Subjective Quality Level for IQ. Suppose he specify {0.6, 0.5, 0.4, 0.5} as his personal requirements on limits of acceptability for each quality dimension. That is, his requirements are (60%) Relevancy, (50%) for seller's Reputation is 0.5, f (40%) or information Timeliness, and (50%) for Amount of Data. These values will be used by the last two modules.*
- 4) *The filtering Module filters each item in the result set depending on the values specified in step 3 above. Thus, those items, whose information Relevancy is greater than or equal to 0.6, whose seller's Reputation is greater than or equal to 0.5, whose information Timeliness is greater than or equal to 0.4, and whose Amount of Data is greater than or equal to 0.5, will be treated as qualified items and sent to the IQ Interpretation module. The other items, which do not meet the buyer's requirements, will be stored in the Unqualified Product Repository. So, after this step, the size of the result set could be, reduced.*
- 5) *The filtering module uses equations (1) to (5) above to calculate the quality index for each item. For example, if an item has Relevancy dimension value of 0.8, Reputation value of 0.95, Timeliness value of 0.86, and Amount of Data value of 0.7, then the index of data quality for this item is*

*0.8325, assuming all the weights in equation (5) are set to be equal 1. This quality index as well as the item's product information will be sent and presented to user Frank.*

## 8. THE MODEL EVALUATION AND RESULTS

The data used for evaluating the proposed system composed of 2,000 goods items imported from eBay.com, each item containing over 80k characters of goods information. These items were all imported and persisted in the "Goods item" table.

In addition, a new field – "is User Satisfied (Figure (4)) is also added into the table "Goods Item" for the purpose of our evaluation, for which we will discuss the reason in.

ID	character varying [15] [PK]
Title	character varying [100]
Category	character varying [600]
Ship Cost	character varying [100]
Post Code	character varying [50]
Seller ID	character varying [30]
Feedback No	big int
Feedback Perc	double precision
Price	double precision
Shipping Des	character varying [100]
Payment Method	character varying [5]
Description	character varying [5000]
Location	character varying [100]
isUserSatisfied	boolean

Figure (4) Goods Item and their attributes

### A. The Proposed System Evaluation

In this section we evaluate our proposed Model by comparing its performance against the priced based model. We carried an experiments, where we simulated two types of agents, group (B1) of 60 agents who only use the price-based ranking approach, and group (B2) of 60 agents who only use the IQ-based ranking approach. We also classified the goods items into two groups: one that does not satisfy the users, and one that does satisfy the users. For every sub-experiment, the system chose 25 goods items from each group and combin them into a new goods list. Two types of agents then ran their ranking program on the goods list, and the result lists will be recorded by the system, the precision of the ranking of



the approaches (priced and IQ) is measured by counting the number of good items obtained in each approach and compare with the top 10, 20, and 30 good items satisfied by the user. This process is repeated 60 times, the results are shown in Table 5 below. The experimental goods used in our evaluation are “Apple Phone” with good ID G1 and “Cisco 3620 router” with good ID G2, as they are common goods.

In table (2), the values under column B1 indicate the number of satisfactory goods items in the result lists handled by agents in group B1, while the values under column B2 indicates the number of satisfactory goods items in the result lists handled by agents in group B2. Each "First n Results" row shows the number of satisfactory goods in the top n results. Rows G1 and G2 indicate that the results were received from the experiments conducted on product Gland G2, respectively. The data in column "Improvement" show the difference between the data in column B1 and the data in column B2' calculated from the same row. When the difference is a positive number, it demonstrates that group of agents under column B2 obtains better results than the group under column B1. This further suggests that the approach used by agents in group B2 is more effective than that used by agents in group B1.

**Table (2): Experimental Results from IQ-Based Approach and Price-Based Approach**

In order to present the used	Goods Id	B1	B2	Improvement
First 10 Results	G1	117	134	17
	G2	98	313	215
First 20 Results	G1	219	356	137
	G2	218	475	257
First 30 Results	G1	234	398	164
	G2	356	579	225

It can be observed that each value in "Improvement" column is a positive number. These numbers suggest two things: first, the IQ model we propose can improve the effectiveness of agent in retrieving goods item; second, the proposed Information Quality model is applicability in the context of agent systems.

The results in Table (2) also reveal that the improvement is increasing as the size of the result set increases. This increasing is significant between the first 10 and first 20 results, while not so dramatic between the first 20 and 30 results from the quality-based approach, while the blue line connected all the data received from the price-based approach. We can see that the purple line is always above the blue line.

*B. Individual Information Quality Dimensions Evaluation*

In this section, we are interested in examining the relative importance of the four recognized individual Information Quality dimensions. We therefore intend to experimentally compare the ranking results that uses only one quality dimension each time. Consequently, four set of experiments need be conducted separately, and each time only one quality dimension incorporated. This is easily done by setting the weight value for the assessed dimension to (1) and rest of the dimension weights to (0). The result for this experiment is shown in Table (3).

**Table (3): Experimental Results from Individual Information Quality Dimensions**

x	GoodsId	Relevancy	Timeliness	Reputation	Amount of Data
First 10 Results	G1	117	103	98	84
	G2	209	186	193	105
First 20 Results	G1	128	122	96	109
	G2	473	395	308	438

The data in each column is the sum of the satisfactory goods items after 60 runs in the corresponding dimension. The results are observed in top 10 and top 20 results. So this table suggests that the number of satisfactory goods items obtained by using Relevancy dimension is a slightly higher than those that are obtained by using the other three dimensions. Furthermore, the other three dimensions have almost equal effect on the ranking result. Which means that the relevancy dimension has more impact on evaluation and can be considered more important than other dimensions.

*C. Users Evaluation for the Proposed Model*

In this section, as we did in section (A) above, we evaluate our proposed model by comparing its performance against the priced based model but the evaluation will be carries by people other than by simulation process. 10 people were chosen who have knowledge of e-commerce systems and experience with online shopping. The goods used in this experiment and there ID are shown in Table (4) below.

**Table (4): The goods used in the user Evaluation model.**

Goods Id	G1	G2	G3
Goods Name	Apple iPhone	Cisco2610 Router	Cisco3620 Router



It can be observed, that each value in "Improvement" column (Table (5)) is greater than zero, which suggests that the proposed IQ model can improve the effectiveness of buying agents in retrieving goods items. This also implies the applicability of the proposed Information Quality model in e-commerce agent systems. The results in the table also reveal that the improvement is increasing as the result set increases. This increasing is large between the first 10 and 20 results, while not so dramatic between first 20 and 30 results. These results are quite consistent with those found from the simulation evaluation (A).

From Table (5), we also notice that although G2 and G3 belong to same product category, the Information Quality model has different effect on their ranking results. It seems that the goods categories do not affect the result of the Information Quality ranking approach.

The result of this experiment is shown in Table (5) below.

#### D. Users Evaluation for Quality dimensions

As we did in Section B, the effectiveness of Quality dimension is assessed but by users rather than by simulation. The same group of people and good used in section (C) are used for the experimentation of this section. The result of the experiment is shown in Table (6).

## 9. CONCLUSIONS

The model proposed in this paper provides a feasible and effective way in sorting goods items of e-commerce systems. This was successfully demonstrated through the implementation of a prototype system and the evaluation of the proposed approach.

This proposed model presents a new solution to deal with goods items and fits well with the decision making behaviour of buyers, since buyers usually make decision based on the whole information that they have and not on the price or reputation alone.

**Table (6): Experimental Results for user's evaluation of Individual Information Quality Dimensions**

Result Set Used	Goods ID	Relevancy	Timeliness	Reputation	Amount of Data
First 10 Results	G1	2.3	2.1	2	1.8
	G2	10.1	2.9	6.8	5.9
	G3	5.4	5.3	5.4	3.2
First 20 Results	G1	3.3	3.7	2	3.2
	G2	17.2	10.2	13.4	11.7
	G3	9.4	8.9	7.3	9.6

Result Set Used	Goods ID	Price Based Ranking	Quality Based Ranking	Improvement
First 10 results	G1	2	2.1	0.1
	G2	6.8	7.1	1
	G3	1	7.2	6.2
	Avg	3.3	5.7	2.4
First 20 results	G1	6.9	8.1	1.2
	G2	14.3	15.6	1.3
	G3	3.7	11.1	7.4
	Avg	8.3	11.6	3.3
First 30 Results	G1	6.7	8.4	1.7
	G2	22.3	23.6	1.3
	G3	14.7	14.7	7.4
	Avg	15.57	15.57	3.47

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