*J. Basic. Appl. Sci. Res.*, 3(2)386-393, 2013
© 2013, TextRoad Publication

ISSN 2090-4304
**Journal of Basic and Applied Scientific Research**
*www.textroad.com*

# AHP Algorithm for Validating Electronic Resources on Semantic Web

**Zahra Jahan Bin**

Master's student of Information Technology Engineering, University of Guilan, Iran

**ABSTRACT**

With growth of web, management and application of management policy on web content have been necessary over time on which basis resources and servers of web are included in a controlled and popular structure. Due to dynamicity of web, this is not possible comprehensively. On the other hand, the higher the volume of web resources, the more difficult the selection of a suitable resource in a search and distinction between accurate and correct information and incorrect information will be. For this reason, there is need for a mechanism on which basis one can evaluate resources obtained from a search to select a resource with a suitable coefficient. Main goal of this research is to present a model and algorithm for validation of electronic resources on web on which basis validity of different resources is evaluated and suitable resource is specified for the desired purpose.
**KEY WORDS:** validity of resources, semantic web agent, AHP algorithm.

## 1- INTRODUCTION

One of the main goals of web is to share resources and this idea is regarded as the strongest agent of its growth and development. Considering the available technology, the present web structure is mentioned using syntactic tags and a compiler produces a representation of web page using these tags. Different organizations and people use web as a tool for presentation using resources. These entities use different products based on their activities and provide them to be used by others. Now, these questions are raised: how can we make good choice among these resources and select suitable resource for the intended purpose? How can we trust in the choice? What infrastructures and webs are necessary for a good choice? Answers of such questions are effective on evaluation of resource. In order to evaluate resources, there are different mechanisms which are suitable for applications and operational environment. When technology is progressed and new tools and equipment are created for defining structure of web (web resources), another approach has been created for defining its structures. In this method, XML language has been used instead of Html grammatical tags in order to define web [10]. XML is used for injecting meaning in tags. Semantic tags [2,3,6]are used for definitions of resources. This method relies on creation of meaning for defining parts of resources. As a result, one can use the available meaning in components of resources and evaluate authenticity of the resource on its basis.

## 2- Trust

Trust is regarded as one of the main bases of interactions, transactions and communication of the routine life. This problem becomes more important in web which provides indirect and unknown communication. Trust is a conceptual subject [5,9]. For this reason, it is complex and difficult to discuss it in computer world. On this basis, each one of the specialists tries to study this subject locally or consider limited domain to study this subject. In Cambridge[15] international Dictionary, trust means to have belief or confidence in the honesty, skill or safety of an entity. Trust means definite belief based on competency of an entity on which basis a special activity can be done safely and confidently[16]. In [17] Trust means a belief in an entity which is obtained from results of observations of the previous activity of this entity and this belief doesn't guarantee the best result under sensitive condition. In this definition, it is noted that trust doesn't guarantee the best result but it guarantees the best decision based on the available conditions. Diversity of the above definitions depends on environmental conditions of performing operation and type of operation and entities which participate in activity and trust. But all follow one common concept which is answer of these questions: how is the dimensional behavior of entity to interaction? How can one select the most suitable resource among the available resources?

### 2-1- trust and validity

Basis of trust issue is a set of the interacting entities [17]. Trust is a triplet relation between three entities and this relation is established due to a special activity. Considering figure 1, relation of trust inroads the following components:
Trust context: activity which two entities want to perform.
Trustee: the entity which performs an activity.
Thruster: the entity which requests a resource.
Recommender: the entity which has information or experience about provider of resources.

***Corresponding Author:** Zahra Jahan Bin, Master's student of Information Technology Engineering, University of Guilan, Iran.

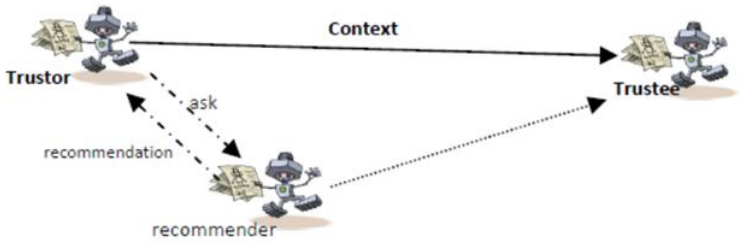



Figure 1- trust relation between three entities of the network

Two concepts of trust and validity can be defined as personal confidence of entity which requests resource about the provider entity [1] and validity means honesty and ability of the providing entity to provide service. Based on this definition, trust and validity have direct relationship with each other and sometimes may be assumed equal. But trust is obtained based on validity or trust is function of validity. [8,13]Two other terms which are discussed for resources validation are confidence and reputation. Confidence can be regarded the same as trust and these two words are synonymous and are defined by determining validity of resources. Reputation is regarded as a trait for each resource and is measurable considering performance of an entity. Reputation is a resource as one of the effective factors in evaluation of a resource.

**2-3- trust and web**

Among the computer wide-area networks which are applied for provision of resources, web is one of the widest computer networks. At present, there are two structures for web: traditional web and semantic web. In traditional web structure, resources and services are mentioned using Html standard and all have a flat structure. In semantic web structure, resources are motioned using XML standard and based on their components [7,9,13]. This structure is developing and creating necessary infrastructures for implementation. Main difference of these two structures is manner of expression or provision of resources.

In traditional web, because resources are provided as the text files which cannot be inferred due to non-semantic Html structure, issue of trust is regarded as a separate process. In this web structure, evaluation process is applied after retrieving resource or service. In this structure, generality of a resource such as people or the organizations which provide these resources is emphasized. In semantic web, components can be inferred with machine due to injection of meaning in definition of resources components. In structure of semantic web, trust has been introduced as an applied layer for web and emphasizes on content of resources and its constituent details.

**3- Providing Resources Validation Model**

The models which have been provided for evaluating validity of resources rely on creation of an entity and don't have opinion about its constituent components (its content). For example, a site may be provided by a reliable reference but its constituent components may be created by different people. It means that a set of traits and attributes is determined to create each resource and then these traits are initialized in order to provide this resource. At the end, semantic web agent uses analytic hierarchy process (AHP) for selecting suitable resource.

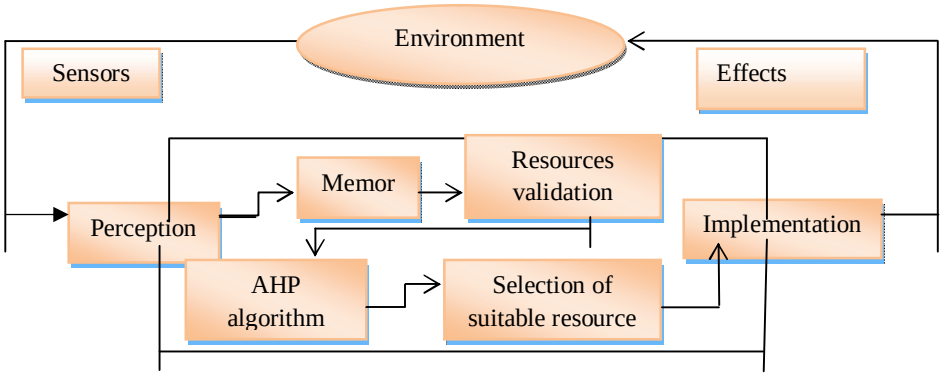



Figure 2- architecture of the proposed model agent

For this model, we considered an operational environment containing agents. In this operational environment, there are some purchasing agents and some selling agents. The resources which selling agent of $S_j$ gives to the applicants has been expressed as semantic web using attributes of {A1,….An}. Agent $B_i$ requests $S_j$ agents for a resource and agents$S_j$ provide their proposed resource (attribute of that resource)to agent $B_i$ and agent $B_i$ evaluates the obtained resources based on AHP algorithm and selects an agent $S_j$for interaction based on evaluation results.

## 4- Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is one of the most comprehensive systems designed for decision making with multiple criteria because this technique formulates the problem hierarchically and can consider different quantitative and qualitative criteria in the problem [4]. This process involves different options in decision making and can analyze sensitivity criteria and sub criteria. In addition, it has been based on pairedcomparisonwhich facilitates judgment and calculation. It also shows compatibility and incompatibility of decision which is one of the top advantages of this technique in multi attribute decision making. InAnalytic Hierarchy Process, elements of each level are compared with the related element in higher level as paired comparison and their weight is calculated which we call local priority (relative weight). Then, final priority (ultimate weight) of each option is specified which is called overall priority (absolute weight). All paired comparisons are made in hierarchical analysis.

### 4-1- Implementation of AHP Algorithm for Validating Resources onSemantic Web

1- Hierarchical making:

The first step in Analytic Hierarchy Process is creation of a graphic representation of the problem in which goal, attributes and entities providing resources are shown. Level 1 shows the target in hierarchy which is selection of the best resource and level 2 shows attributes of resurce which are A1…..An and the last level shows the entities which provide resource as E1…..Em.

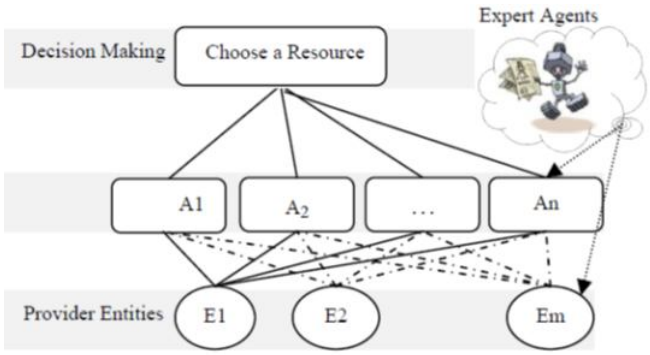



Figure 3: structure of AHP Algorithm in evaluation of web resources

2- Formation of paired comparison matrix of resources providers :

In Analytic Hierarchy Process, elements of each level are compared with element of its related element in higher level and their priorities are calculated. It should be noted that preference of each element over itself is equal to 1 in paired comparison. Therefore, elements on diameter in paired comparison matrix are equal to 1. It is also worth noting that if A has preference of 2 on B, preference of B on A will be 1.2.

Table 1: resources providers paired comparison matrix

| $A_{k(1..n)}$ | $E_1$ | $E_2$ | … | $E_m$ |
|---|---|---|---|---|
| $E_1$ | 1 | $a_{12}$ | | |
| $E_2$ | $1/a_{12}$ | 1 | | |
| . | | | 1 | |
| $E_m$ | | | | **1** |

3- Calculating local Priority :

When paired comparison matrix was formed, we can calculate priority of each option. In order to calculate priority of each option of paired comparison matrix (local priority), we mention approximate methods (Arithmetic Mean). This method has three steps:

Step 1: we Sum of values of columns.

Table 2- local priority calculation matrix

| $A_{k(1..n)}$ | $E_1$ | $E_2$ | … | $E_m$ |
|---|---|---|---|---|
| $E_1$ | 1 | $a_{12}$ | | |
| $E_2$ | $1/a_{12}$ | 1 | | |
| . | | | 1 | |
| $E_m$ | | | | **1** |
| Totals | $S_1$ | $S_2$ | … | $S_m$ |

Step 2: we divide each element of paired comparison matrix by its column to normalize paired comparison matrix. Sum of values of columns in a normalized matrix is one.

Table 3: local priority calculation matrix

| $A_{k(1..n)}$ | $E_1$ | $E_2$ | … | $E_m$ |
|---|---|---|---|---|
| $E_1$ | 1 | $a_{12}$ | | |
| $E_2$ | $1/a_{12}$ | 1 | | |
| . | | | 1 | |
| $E_m$ | | | | 1 |
| Totals | 1 | 1 | … | 1 |

Step 3: we calculate mean value of elements in each row of normalized matrix. These mean values are estimate of the desired weights.

Table 4- formation of resources attributes paired comparison matrix

| $A_{k(1..n)}$ | $E_1$ | $E_2$ | … | $E_m$ | W |
|---|---|---|---|---|---|
| $E_1$ | 1 | $a_{12}$ | | | $W_1$ |
| $E_2$ | $1/a_{12}$ | 1 | | | $W_2$ |
| . | | | 1 | | . |
| $E_m$ | | | | 1 | $w_m$ |
| Totals | 1 | 1 | … | 1 | 1 |

4- Formation of resources attributes paired comparison matrix

After calculating weight of the resources relative to all attributes, we should specify weight of the attributes. In other words, role of each attribute in determination of the best resources should be specified.

Table 5: resources attributes paired comparison matrix

| | $A_1$ | $A_2$ | … | $A_n$ | W |
|---|---|---|---|---|---|
| $A_1$ | 1 | $b_{12}$ | | | $W_1$ |
| $A_2$ | $1/b_{12}$ | 1 | | | $W_2$ |
| . | | | 1 | | . |
| $A_n$ | | | | 1 | $W_n$ |
| Totals | 1 | 1 | … | 1 | 1 |

5- Formation of attributes –based resources providers weight matrix

Table 6- attributes –based resources providers weight matrix

| | $A_1$ | $A_2$ | … | $A_n$ |
|---|---|---|---|---|
| $E_1$ | $W_{11}$ | $W_{12}$ | | $W_{1n}$ |
| $E_2$ | $W_{21}$ | $W_{22}$ | | $W_{2n}$ |
| . | . | . | | . |
| $E_m$ | $W_{m1}$ | $W_{n2}$ | | $w_{mn}$ |

6- Calculating ultimate weight of resources

Weight of attributes relative to target and weight of the resources providers relative to attributes were calculated. Now, combination of these weights is expressed for calculating ultimate weight of resources.

Since weight of attributes reflects their importance in determination of goal and weight of each resource relative to attributes is role of that resource in the related attribute. It can be said that ultimate weight of each resource is obtained by multiplying weight of each attribute by weight of the related resource.

$$W_{E1} = W_{A1} * W_{11} + W_{A2} * W_{12} + \ldots + W_{An} * W_{1n}$$

## 5- Evaluating Model and proposed Algorithm

In order to evaluate the proposed model using AHP algorithm, a questionnaire was prepared and given to the expert team. In this questionnaire, attributes of the desired resources have been compared through paired comparison and ranked. After distributing the questionnaire, the expert team was asked to mark importance of each attribute in the related table and this duty in web is assumed by expert agents. In order to implement the

proposed model, user requests the semantic web agent to search for a book (resources) with special title and shows similar resources to him. After the agent finds similar cases, user needs to make decision and select suitable resource for the desired purpose, therefore, he asks the agent to propose the more suitable resource to him among the available resources. The agent extracts attributes of the desired resource with help of semantic search engine and then communicates with the expert agents and asks them to allocate weights to attributes of the resource (book). Then, the semantic web agent obtains the ultimate weight of the resources considering paired comparison matrices and Analytic Hierarchy algorithm and proposes the resource which has the highest weight as the most suitable resource to the user.

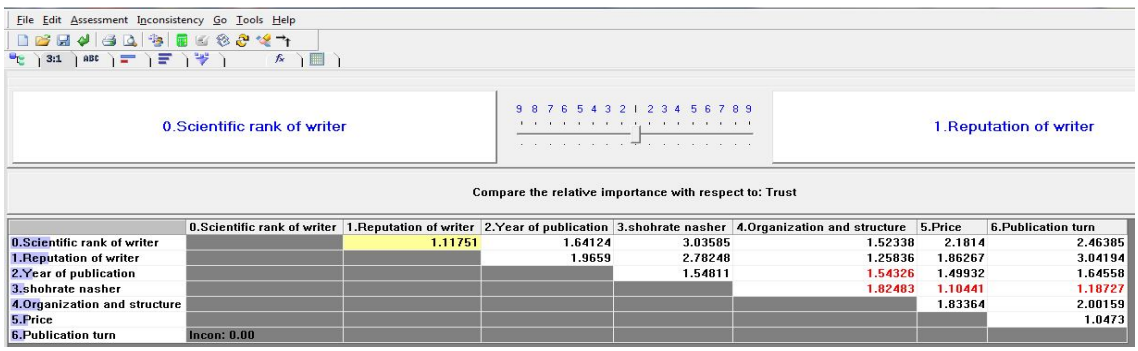
All paired comparisons are made in Analytic Hierarchy algorithm. In these comparisons, experts will use oral judgments such that if element i is compared with element j, the decider will say that i on j is one of the following cases. These judgments have been converted to quantitative values between 1 and 9:

- Extremely Preferred
- Very strongly Preferred
- Strongly Preferred
- Moderately Preferred
- Equally Preferred

The attributes were ranked using Expert Choice Software and results are extracted.

**5-1- formation of attributes paired comparison matrix**

Table 7 shows results of paired comparison obtained from views of 32 deciders whose paired comparisonhas permissible incompatibility rate of below 0.1. Views of these people were combined with help of geometrical mean and group AHP was used for obtaining ultimate ranking. Ultimate incompatibility rate for this matrix is 0.004 which is very low and fully reliable and mentions that the obtained rank has correct scientific basis and results are reliable and applicable.




| | 0.Scientific rank of writer | 1.Reputation of writer | 2.Year of publication | 3.shohrate nasher | 4.Organization and structure | 5.Price | 6.Publication turn |
|---|---|---|---|---|---|---|---|
| 0.Scientific rank of writer | | 1.11751 | 1.64124 | 3.03585 | 1.52338 | 2.1814 | 2.46385 |
| 1.Reputation of writer | | | 1.9659 | 2.78248 | 1.25836 | 1.86267 | 3.04194 |
| 2.Year of publication | | | | 1.54811 | 1.54326 | 1.49932 | 1.64558 |
| 3.shohrate nasher | | | | | 1.82483 | 1.10441 | 1.18727 |
| 4.Organization and structure | | | | | | 1.83364 | 2.00159 |
| 5.Price | | | | | | | 1.0473 |
| 6.Publication turn | Incon: 0.00 | | | | | | |

Figure 4- output of paired comparison matrix

Table 7: paired comparison matrix

| | Scientific rank of writer | Reputation of writer | Year of publication | Reputation of publisher | Organization and structure of resources | Price | Publication turn |
|---|---|---|---|---|---|---|---|
| Scientific rank of writer | | 1.1175 | 1.6412 | 3.035 | 1.52338 | 2.1814 | 2.4638 |
| Reputation of writer | | | 1.9659 | 2.7824 | 1.2583 | 1.8626 | 3.04194 |
| Year of publication | | | | 1.54811 | 1.54326 | 1.4993 | 1.6455 |
| Reputation of publisher | | | | | 1.8248 | 1.1044 | 1.1872 |
| Organization and structure | | | | | | 1.8336 | 2.0015 |
| Price | | | | | | | 1.0473 |
| Publication turn | | | | | | | |

In the cells of the table which paired comparison has been written in black, rows are preferred over columns based on the written number. If color of the number is red, columns will be preferred over the rows based on the written number. For example, in comparison between scientific rank of the writer and reputation of the writer, number 1.175 shows that scientific rank of the writer is effective 1.175 times as much as reputation of writer on evaluation of the resource (book) and in comparison between reputation of publisher and price , price is effective 1.824 times as much as reputation of publisher .

### 5-3- Results of AHP Questionnaire

If we want to show comparison between both attributes as questionnaire and round numbers based on views of 32 deciders whose questionnaire data were analyzed, one can use table 8 which is output of software. In fact, this table indicates importance and preference of each one of the attributes over other attributes.

Table 8- results of AHP questionnaire

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scientific rank of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Reputation of writer |
| Scientific rank of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Year of publication |
| Scientific rank of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Reputation of publisher |
| Scientific rank of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Organization and structure |
| Scientific rank of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Price |
| Scientific rank of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Publication turn |
| Reputation of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Year of publication |
| Reputation of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Reputation of publisher |
| Reputation of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Organization and structure |
| Reputation of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Price |
| Reputation of writer | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Publication turn |
| Year of publication | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Reputation of publisher |
| Year of publication | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Organization and structure |
| Year of publication | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Price |
| Year of publication | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Publication turn |
| Reputation of publisher | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Organization and structure |
| Reputation of publisher | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Price |
| Reputation of publisher | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Publication turn |
| Organization and structure | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Price |
| Organization and structure | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Publication turn |
| Price | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Publication turn |

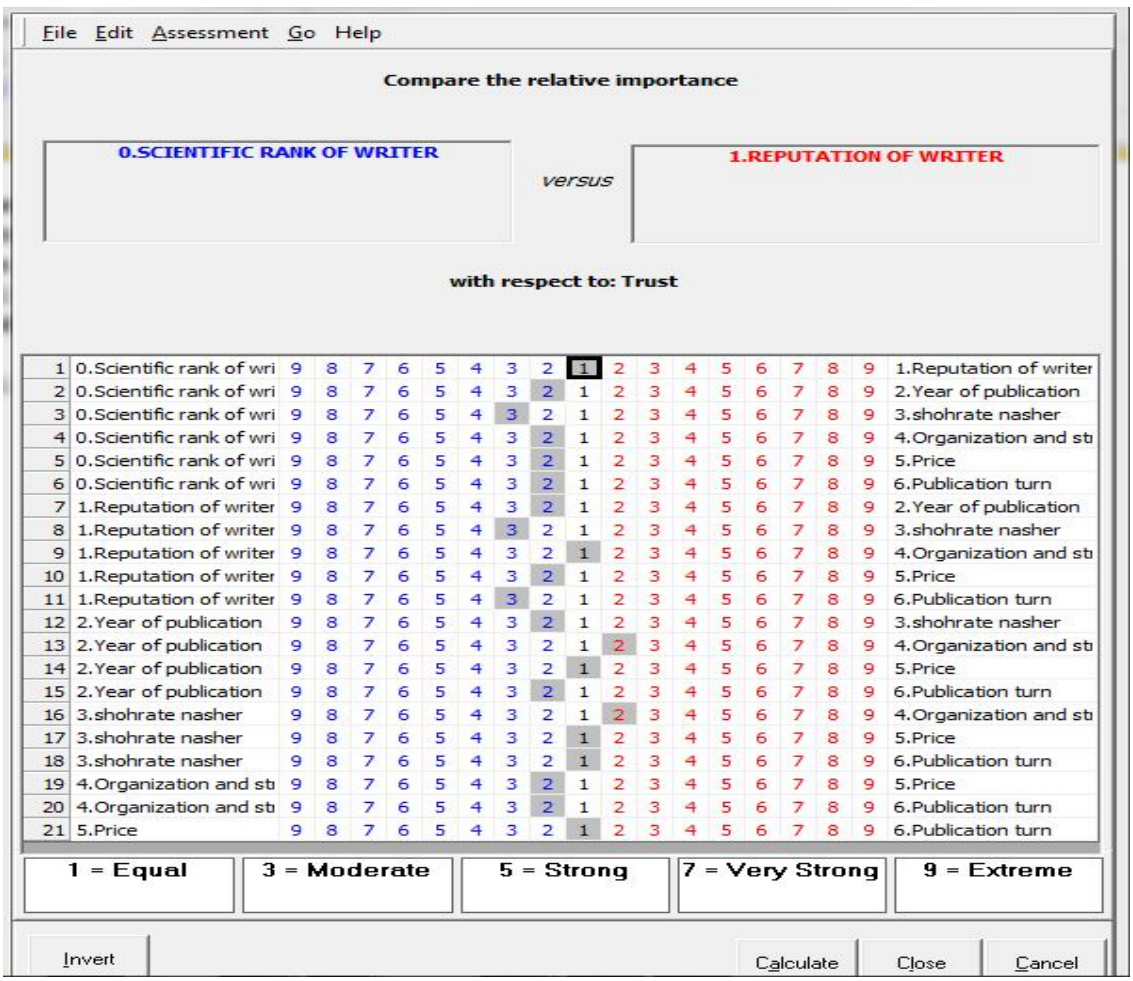



Figure 5- output of AHP questionnaire results

### 5-4- final ranking of attributes

After paired comparison of the resource attributes, ultimate weight of the attributes is specified in this stage and the attribute which has the highest weight is in the first rank and resource is validated based on that attribute and finally suitable resource is specified.

Table 9: final rank of attributes

| Rank | Attribute | Weight |
|---|---|---|
| 1 | Scientific rank of writer | 0.227 |
| 2 | Reputation of writer | 0.219 |
| 3 | Organization and structure of resources | 0.167 |
| 4 | Year of publication | 0.127 |
| 5 | Price | 0.095 |
| 6 | Publication turn | 0.085 |
| 7 | Reputation of publisher | 0.080 |

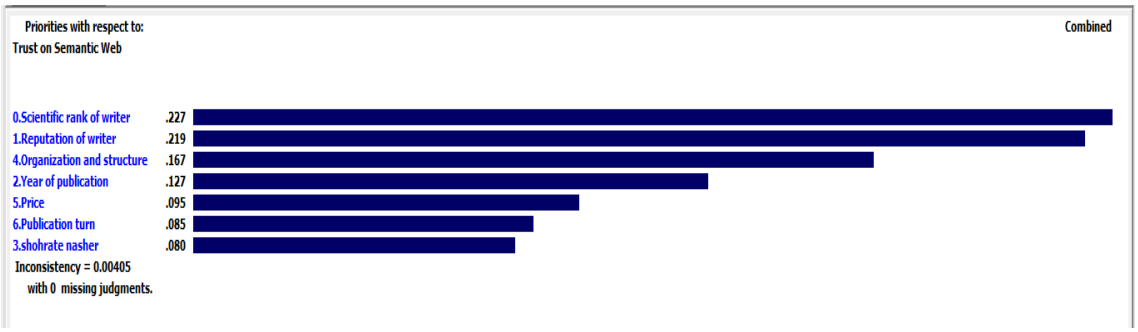



Figure 6- final ranking of resources attributes

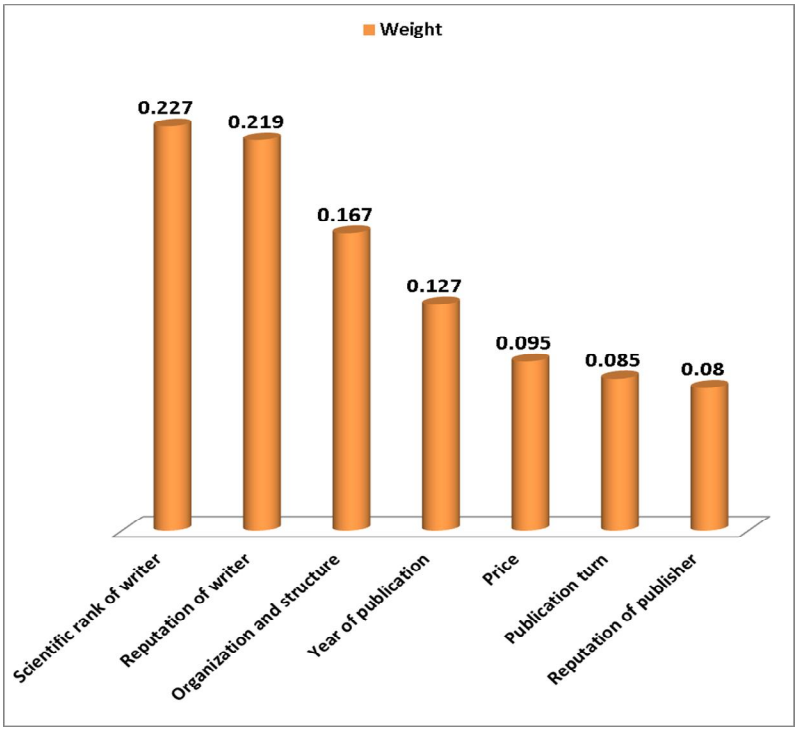



Figure 7: ultimate weight of the resources attributes

Considering figure 7, scientific rank of the writer had the highest rank and reputation of publisher had the lowest weight among attributes extracted from the desired resource (book). Therefore, considering output of AHP algorithm, the book which has the highest weight in terms of scientific rank of writer is the most suitable book for the user. Therefore, the semantic web agent suggests the user to buy a book which has the highest rank in terms of scientific rank of writer.

## 6- Conclusion

In this research, first, concepts of resources validation were introduced and then a model was presented for validating the resources. The proposes model is evaluation of the resources validity using AHP algorithm which is one of the most comprehensive designed systems for multi attribute decision making because this technique formulates the problem hierarchically and can consider different quantitative and qualitative criteria in the problem. This process involves different options in decision making and can analyze sensitivity criteria and sub criteria.In addition, it has been based on pairedcomparisonwhich facilitates judgment and calculation. It also shows compatibility and incompatibility of decision which is one of the top advantages of this technique in multi attribute decision making. Using AHP technique, validity of the resources is obtained and the suitable resource can be selected for the desired purpose.

## REFERENCES

[1]SanttuToivinen, Gabriele Lenzini, and IlkkaUusitalo. “Context-aware Trust Evaluation Functions for Dynamic Reconfihurable Systems”. WWW2006,May 22-26,2006,UK.

[2] D. Artz, and Y. Gil,”A survey of trust in computer science and the Semantic Web”, Web Semantics: Science, ervices and Agents on the World Wide Web, Vol. 5, No. 2, pp. 58- 71, June 2007.

[3] Y.Gil,and D. Artz,”Towards content trust of web resources”, Web Semantics: Science, Services and Agents on the World Wide Web 5, pp. 58-71, June 2007.

[4] T.L. Saaty, “The Analytical Hierarchy Process, Planning, Priority, Resource Allocation”. RWS Publications, USA,1980.

[5] J.Patel, W.T.L.Teacy, N.R.Jennings, and Michael Luck. ”A Probabilistic Trust Model for Handling Inaccurate Reputation Resources”. In Proceedings of Third International Conference on Trust Management,2005.

[6] V.D. Almendra and D.Schwabe ,“Trust Policies for Semantic Web Repositories”, The Semantic Web ISWC 2006. 5th International Semantic Web Conference , Volume 1, Issue: 1, Pages: 5- 9,2006.

[7] M. Doroodchi, A.Iranmehr, "Trust Modeling for secure web application development" European and Mediterranean Conference on Information Systems (ISPA), Sydney, Australia, 2008.

[8] Z. Malik, and A. Bouguettaya, “Reputation Propagation in Composite Services,” Nepal, 2009.

[9] N. Dragoni, “Toward trustworthy web services - approaches, weaknesses and trust-by-contract framework,” IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology, vol. 3, pp. 599–606, Miami, 2009.

[10] G.Antoniou and F.V.Harmelen.”A Semantic Web Primer. ISBN 0-262-01210-3,2004.

[11] Cai- Nicolas Ziegler and Georg Lausen. “Propagation models for Trust and Distrustin Social Network”. Springer, 2005.

[12] W. Huang, et al, “Categorizing Web Features and Functions to Evaluate Commercial Web sites”, Industrial Management & Data Systems, Vol. 106, PP. 523-539, 2006.

[13] S.Batra and R. R.Bishu, “Web Usability and Evaluation: Issues and Concerns”, presented at The Hcii, 2007.

[14] S. Paradesi, P. Doshi, and S. Swaika, “Integrating behavioral trust in web service compositions,” USA, 2009.

[15] Denise Umuhoza.” Metric of Trust for Mobile Ad hoc Networks Using Source Routing Algorithms”.

University of the Western Cape.May 2006.

[16] Indrajit Ray and SudipChakraborty. “A Vector Model of Trust for Developing Trustworthy ystems”, Proceedings of the 9th European Symposium on Research in Computer Security, pp 260-275, France, 2004.

[17] Jianqiang Shi, Gregorv.Bochmann , and Carlisle Adams. “A Trust Model with Statistical Foundation”. Systems Science, School of Information Technology and Engineering(SITE),University of Ottawa, 2005.