# Context Based Riskiness Assessment

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***Abstract*— In almost every interaction the trusting peer might fear about the likelihood of the loss in the resources involved during the transaction. This likelihood of the loss in the resources is termed as Risk in the transaction. Hence analyzing the Risk involved in a transaction is important to decide whether to proceed with the transaction or not. If a trusting peer is unfamiliar with a trusted peer and has not interacted with it before in a specific context, then it will ask for recommendations from other peer in order to determine the trusted peer's Riskiness value or reputation. In this paper we discuss the process of asking recommendations from other peers in a specific context and assimilating those recommendations according to its criteria of the interaction in order to determine the correct Riskiness value of the trusted peer.**

## I. INTRODUCTION

*Security* in the virtual world usually refers to the process of enabling sheltered communication between two communicating entities [1]-[3]. *Risk* is defined as the likelihood that transaction might not proceed as expected in a given context and at a particular time once it begins [4]. The study of Risk can not be compared to the study of Security because securing a transaction does not mean that there will be no Risks in personal damages and financial losses. Risk can be seen as a combination of a) The uncertainty of the outcome and b) The cost of the outcomes when it occurs; usually the loss incurred which is related to Risk.

Peer-to-Peer type of communication is being described as the way e-commerce transactions are going to be carried out on the Internet in the near future [5]. Architectures have been proposed by researchers for integrating web services with Peer-to-Peer communicating agents like Gnutella [6]-[9]. However based on out literature survey [4] we conclude that Peer-to-Peer communications suffer from some disadvantages and Risk associated in the transaction is one of them. Hence we need to develop a mechanism by which we can over come this disadvantage so that they can be used effectively with what ever service they is being integrated with. So in order to achieve this we proposed the term *Riskiness* [10]. Riskiness is defined as the numerical value that is assigned by the trusting peer [11] to the trusted peer [11] after an interaction, which shows the level of Risk present in an interaction against the Riskiness scale which is shown in figure 1. It quantifies the level of Risk that the trusted peer is worthy of on the Riskiness scale, hence giving an indication to other peers about the nature of the peer with whom they are dealing with or going to deal with and up to what level of Risk might be present in dealing with that peer. Riskiness value is assigned to the trusted peer by using the metrics defined in Hussain et al [10]. These metrics assess the actual behavior of the trusted peer in the interaction and compare it with the expected behavior determining the un-committed behavior in the interaction, which also signifies the Risk in the interaction. The larger the difference between these two behaviors the higher the level of Risk present in the interaction. A trusting peer assigns a Riskiness value to the trusted peer in the particular context of the interaction by assessing its behavior according to its criteria. Even in the same context each trusting peer might have their own criteria in their interaction and the Riskiness value they assign to the trusted peer is on this criteria. But this Riskiness value is assigned to the trusted peer after an interaction [10]. Before a trusting peer starts an interaction with a trusted peer in a particular context, it might want to analyze the level of Risk present in the transaction in dealing with the trusted peer. By analyzing the Risk in the transaction it might get an indication of how safe its resources involved in the transaction are, as it is mentioned in the literature that the decision to buy or proceed with a transaction is based on the risk-adjusted cost-benefit analysis [12]. If the trusting peer hasn't ever interacted with the trusted peer before or is not familiar about the Riskiness value of the trusted peer in the specific context of its interaction, then it will ask for recommendations from other peers who had previously dealt with the trusted peer over the same context. In reply the trusting peer might receive recommendations from a number of peers. Each peer giving recommendations, recommended a Riskiness value for the trusted peer depending on its interaction with it, and which is assigned according to it's criteria in the interaction. But all these recommendations that the trusting peer receives might not be trustworthy. There might be some peers giving untrustworthy recommendations. In this paper we highlight this problem and propose a solution by which the trusting peer leaves out the un-trustworthy recommendations and takes only those recommendations from the trustworthy recommending peers which are of interest to it according to the criteria of its interaction.

## II. CRITERIA FOR RISK ASSESSMENT

The Riskiness value that the trusted peer gets from the trusting peer is dependent on a number of accessing criteria in their interaction. The accessing criteria are defined as the set of factors or bases against which the un-committed behavior

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of the trusted peer is going to be determined. The accessing criteria are derived from the expected behavior or the mutually agreed behavior. We call the accessing criteria as the criteria. The criteria for determining the Riskiness of the trusted peer are not same for all the interactions. They vary according to each trusting peer. Hence even in a same context the criteria of two trusting peers for assessing the behavior of a particular trusted peer might be different.

For example let us consider the interaction between Alice and Bob regarding the context of MP3 player. Alice wants to buy a MP3 player of a specific model and of a specific colour and queries all the other peers regarding the availability of the player. Bob replies back confirming the availability of that specific player and agree to sell it to Alice. After asking for recommendation from the other peers for Bob, Alice decides to proceed in the interaction. So the criteria on which Alice is going to determine the Riskiness of Bob in the context of 'buying an MP3 player' are:

- Whether Bob sells the MP3 player of the specific model which Alice wants.
- Whether the MP3 player is of the same colour that Alice wants.

Let us suppose that Mary too interacts with Bob over the context of 'buying an MP3 player'. But it is possible that the criteria of her interaction might be different from that of Alice even thought it is the same context and the Riskiness value she assigns to Bob is on those criterions in her interaction. In order to assign a Riskiness value to Bob, Alice will first asses the level of commitment in Bob's actual behavior according to these criterions and then compare it with the promised commitment or the expected behavior finding the un-committed behavior. She will then map the level of uncommitted behavior to the Riskiness scale, in order to get Bob's Riskiness value in the interaction. Further in this paper we will refer to the criterions in an interaction as C1, C2 …Cn where n represents the number of criterions.

## III. USING REPUTATION FOR DETERMINING RISKINESS

Reputation can be used as an alternative in making a decision when the Riskiness of a peer is not known [13]. The higher the reputation of a peer the lower the Risk can be considered in dealing with it and vice versa. Reputation comes in use when the trusting peer has not interacted with the trusted peer and hence doesn't know its Riskiness value. Reputation of a peer is obtained from other peers that have previously interacted with it by asking recommendations from them. The trusting peer issues a reputation query asking for recommendations for the trusted peer. As discussed in [14] any peer can give a recommendation. We term those peers as *Recommending Peers*. The recommending peers reply by giving recommendations along with a Riskiness value on the Riskiness scale that shows the level of Risk which they recommend for the trusted peer according to its behavior in their last interaction. The trusting peer then gathers all the reputation replies and combines them to make a decision. Two factors which relate to risk that need to be considered while assimilating the recommendations of the peers are:

- The reputation being considered should be of the same context and of the same criteria in which a decision is to be made
- The recommendations communicated by the recommending peers about the trusted peer correspond to the *time* at which the interaction between them took place. Subsequently these recommendations may not be necessarily valid at the time when the decision is to be made by the trusting peer.

But there is no guarantee that the recommendation given by a particular recommending peer is correct, genuine or in other terms trustworthy. Hence there is a Risk in considering the recommendation from the peers too. To overcome this we assign each recommending peer with a Riskiness value that shows the level of Risk present in taking its recommendation. That value is termed as the *Riskiness of the Recommending peer (RRP)* and is explained further in section IV. The recommendations that the trusting peer gets from the recommending peers can be classified into 3 different categories namely (i) Trustworthy Recommendation (ii) Un-Trustworthy Recommendation and (iii) Un-Known Recommendation.

While considering the recommendations from the recommending peers, we propose that the trusting peer will take only trustworthy and un-known recommendations and leaves out the un-trustworthy recommendations as the Risk in taking those recommendations is high. The process of classifying the recommendations as trustworthy, unknown and untrustworthy is discussed in the next section. After the trusting peer has taken the recommendations and complete the interaction, it should modify the Riskiness value of the recommending peers with whom it has taken the recommendations from, in accordance to the recommendation given by them. This may help the other trusting peers while taking recommendation from these peers at a later stage to determine whether it is a trustworthy or an un-trustworthy recommender.

To explain with an example let us suppose that Mary wants to interact with George on a particular context. She hasn't interacted with him before and asks for recommendations from other peers. She gets recommendations from peer C, D, E and F. Out of these peers, C and D are trustworthy recommending peers, E is an unknown recommending peer and F is an un-trustworthy recommending peer. Hence Mary will take the recommendations from peers C, D and E only. But after the transaction Mary found that the recommendation given by peer C did not match with its final observance in the outcome of the interaction. Hence after the interaction Mary should modify the Riskiness value of the Recommending Peer C accordingly in order to assign it with its correct Riskiness value while giving recommendations.

In order for the trusting peer to assimilate the recommendations that it gets from other peers properly we have defined a standard format known as the Risk set for giving recommendations in Hussain et al [15]. The recommending peers reply back with the Risk Set as their recommendation. The Risk set contains the recommended Riskiness value for the trusted peer along with the assessment criteria depending on their last interaction. As explained in Hussain et al [15] the Risk set is an ordered way of giving

recommendations so that the trusting peer asking for recommendations can know the meaning of each element in the recommendation and take only those recommendations whose assessment criteria are of interest to it. This is further explained in section V. The format of the Risk set is:

{TP1, TP2, Context, CR, R', (Assessment Criteria, Commitment level), R, Cost, Start time, End time, RRP}

Where TP1 is the Trusting peer in the interaction,

TP2 is the Trusted peer in the interaction,

Context represents the context of the interaction,

CR represents the Current Riskiness value of the trusted peer before the transaction, which is achieved either by the last interaction of the trusting peer with the trusted peer or by asking recommendations from other peers,

R' shows the predicted Riskiness value of the trusted peer depending on its past values,

(Assessment Criteria, Commitment level) shows the factors or bases which the recommending peer used in its interaction with the trusted peer to assign it a Riskiness value. Commitment level specifies whether the particular criterion was fulfilled by the trusted peer or not according to the expected behavior,

R is the Riskiness value assigned by the recommending peer to the trusted peer after the interaction, which is also the recommended Riskiness value,

Cost represents the cost of the interaction,

Start Time is the time at which the interaction started,

End time is the time at which the interaction ended,

RRP is the Riskiness value of the recommending peer while giving recommendations. This determines whether the peer is trustworthy or not while giving recommendations. Further explanation of finding whether the peer is giving trustworthy recommendation or not is giving in the next section.

## IV. DETERMINING TRUSTWORTHY AND UN-TRUSTWORTHY RECOMMENDATIONS

As mentioned in the previous section, the recommending peer gives its recommendations in the form of Risk set, which along with other attributes also contains the recommended Riskiness value for the trusted peer by the recommending peer. This Riskiness value is assigned by the recommending peer to the trusted peer on the Riskiness scale after assessing the level of un-commitment in the trusted peer's actual behavior as compared to the expected behavior according to the criteria of the interaction. The Riskiness scale has 7 levels and ranges from (-1, 5) with level 0 depicting the highest level of Risk and level 5 depicting the lowest level of Risk as shown in figure 1. Level -1 shows that the level of Risk is unknown. A Riskiness value of -1 implies that the Riskiness of the trusted peer is unknown.

But as stated earlier there is a Risk in considering the recommendation from any peer as it might be possible that they are not giving the trustworthy recommendations. Hence to overcome that each recommending peer is assigned with a Riskiness value while giving recommendations and as explained earlier this value is called as the *Riskiness of the Recommending peer (RRP).*

This Riskiness value of the recommending peer is determined by the difference between:

Figure 1 showing the Riskiness Scale

| Riskiness Levels | Magnitude of Risk | Riskiness Value | Star Rating |
|---|---|---|---|
| Unknown | . | - 1 | Not Displayed |
| Totally Risky | 90 - 100 % of Risk | 0 | Not Displayed |
| Extremely Risky | 71 – 90 % of Risk | 1 | From to |
| Largely Risky | 51 – 70 % of Risk | 2 | From to |
| Risky | 26 – 50 % of Risk | 3 | From to |
| Largely UnRisky | 11 – 25 % of Risk | 4 | From to |
| UnRisky | 0 – 10 % of Risk | 5 | From to |

- The Riskiness value of the trusted peer that the trusting peer found after the interaction with it.
- The Riskiness value that the recommending peer suggested for the trusted peer.

When the trusting peer broadcasts a query asking for recommendations about a trusted peer, it will consider replies from those peers who have interacted with that particular trusted peer before. Hence what ever Riskiness value they recommend to the trusting peer will be greater than -1, as -1 represents the Riskiness value as unknown which cannot be assigned to any peer after an interaction. After an interaction a value only with in the range of (0, 5) can be assigned. Hence the maximum range for the Riskiness value of the recommending peer (RRP) can be between (-5,5) since this is the maximum possible range of difference between the Riskiness value of the trusted peer found out by the trusting peer after the transaction and the Riskiness value recommended by the recommending peer for the trusted peer.

But we think that in order to reduce the Risk in considering the recommendations, the trusting peer should only consider recommendations from peers who give trustworthy recommendations or who are unknown in giving recommendations and leave the recommendation from peers who are untrustworthy in giving them. We propose that a recommending peer is said to be giving trustworthy recommendations if its Riskiness value while giving recommendations (RRP) is in the range of (-1, 1). A value with in this range will state that there is a difference of one level between what the trusting peer found out after the interaction and what the recommending peer suggested. If the Riskiness value of the recommending peer is beyond those levels then it hints that it is giving recommendations which the trusting peer finds to vary a lot after the interaction, and there is at least a difference of two levels on the Riskiness scale between what the trusting peer found and what the recommending peer suggested. The peer whose Riskiness value while giving recommendation (RRP) is beyond this level of (-1,1) is said to be an un-trustworthy recommending peer. Hence the recommendation from peers with Riskiness value beyond these levels will not be considered.

If the recommending peer gives more than one recommendation in an interaction, then its Riskiness value while giving recommendation can be found by taking the average of the difference of each recommendation.

Hence Riskiness of the recommending peer (RRP) =

$$\frac{1}{N}\sum_{i=1}^{N} (\mathrm{Ti} - \mathrm{Ri})$$

Where Ti is the Riskiness value found out by the trusting peer after the interaction,

Ri is the Riskiness value recommended by the recommending peer for the trusted peer, and

N is the number of recommendations a particular peer gave

## V. ASSIMILATING RECOMMENDATIONS ACCORDING TO THE CRITERIA OF THE INTERACTION

When the trusting peer asks for recommendations, it should only consider the recommendation replies from the trustworthy and unknown recommending peers in the same context of its interaction. But as discussed in section II, even in a same context there might be different criteria for each trusting peer to assign a Riskiness value to the trusted peer. Hence the recommendation that the recommending peers give to the trusting peer is according to the criteria of their interaction. If those criterions of the recommending peer giving recommendations do not match with the criterions of the trusting peer asking for recommendations then it is baseless for the trusting peer to consider the recommendations from the recommending peers in those criterions. Hence apart from considering a set of only trustworthy and unknown recommendations, the trusting peer in that set of recommendations should further consider only those recommendations whose criterions are same as it's in the interaction.

In section III we defined a standard format for giving recommendations called as the Risk set. When a peer gives its recommendation in the form of a Risk set along with the recommended Riskiness value it also specifies the criteria in the attribute 'Assessment Criteria'. This is the criteria in which the recommending peer assessed the Riskiness value of the trusted peer in its interaction in a particular context. It is highly possible that the Riskiness value recommended by the recommending peer might be of no use to the trusting peer even though it is in the same context and a trustworthy recommendation, because the criteria that it used to assign a Riskiness value might be different from what the trusting peer wants. Hence when a trusting peer is considering the recommendations from the recommending peers it should consider the recommendations in only those criterions which are of interest to it in its interaction and map those recommendations to the Riskiness scale. The attribute 'commitment level' beside each 'assessment criteria' is used to specify whether the particular criterion was fulfilled by the trusted peer or not in the interaction. This is represented by a value of either 0 or 1 which shows the level of commitment as shown in table 1. A value of 0 indicates that the trusted peer did not commit to the criterion in its actual behavior according to the expected behavior where as a value of 1 indicates that the trusted peer committed in the criterion according to the expected behavior.

To explain with an example let us consider that a trusting peer 'A' wants to interact with a trusted peer 'B' over a context C. The trusting peer's criteria in the interaction are C1 and C2. It has not interacted with the trusted peer 'B' before in the context C and hence before proceeding in the interaction asks for recommendations from other peers who had dealt with the trusted peer 'B' before in the context C. Let us suppose that it gets recommendations from peers W, X, Y and Z in the form of a Risk set as defined in section III.

TABLE I. TABLE SHOWING THE COMMITMENT LEVEL OF THE CRITERION

| Commitment level | Semantics of the Value |
|---|---|
| 0 | The trusted peer did not fulfill the criterion as it was expected from him according to the expected behavior |
| 1 | The criterion was fulfilled exactly according to the expected behavior. |

Let is consider this is the recommendation from recommending peer 'W':

{Peer 'W', Peer 'B', Context 'C', 4, 4, ((C1, 1) (C3, 0)), 3, UNKNWON, 12/08/2005, 13/08/2005, -1}

Recommendation from recommending peer 'X'

{Peer 'X', Peer 'B', Context 'C', 3, 4, ((C5, 1) (C6, 0)), 4, 200, 1/08/2005, 1/08/2005, 1}

Recommendation from recommending peer 'Y'

{Peer 'Y', Peer 'B', Context 'C', 3, 3, ((C4, 1) (C2, 0)), 4, UNKNWON, 2/08/2005, 3/08/2005, UNKNWON}

Recommendation from recommending peer 'Z'

{Peer 'Z', Peer 'B', Context 'C', 2, 3, ((C2, 1) (C6, 0)), 3, UNKNWON, 5/08/2005, 9/08/2005, -2}

As mentioned in section III, the trusting peer considers recommendations only from trustworthy and unknown recommending peers and leaves the recommendations from the un-trustworthy recommending peers. Hence by seeing the Riskiness value of the recommending peers (RRP) in the above recommendations we see that Peer 'W' and Peer 'X' are trustworthy recommending peers and Peer 'X' is an unknown recommending peer. Peer 'Y' RRP is not in the range of (-1, 1) and subsequently it is an un-trustworthy recommending peer and its recommendation is not considered.

We see that each of this peer have its own criteria in its interaction and the Riskiness value that they recommend for the trusted peer 'B' is based on their assessment of un-commitment by the trusted peer in these criteria.

Hence the trusting peer 'A' must consider only the criterion of its interest in its interaction from the recommendations and determine the Riskiness value of the trusted peer in each criterion according to those recommendations. It can then determine the final Riskiness value of the trusted peer according to its criteria by weighting the Riskiness value of each criterion according to the significance of the criterions.

The Riskiness value of the trusted peer in each criterion C (Rc) can be determined after assimilating the recommendations by using the following formulae:

Riskiness value of the trusted peer in Criterion C (Rc) =

$$\left| (\alpha * \frac{1}{N} (\sum_{i=1}^{N} (RRP_i) * (\text{Commitment Level}_c))) \right| + (\beta * \frac{1}{J} (\sum_{k=1}^{J} \text{Commitment Level}_c)) \quad \textbf{Equation-------1}$$

where $RRP_i$ is the Riskiness value of the trustworthy recommending peer i,

Commitment level $_c$ is the level of commitment by the trusted peer in the particular criterion 'c' as suggested by the recommending peer in its recommendations,

N and J are the number of trustworthy recommendations, and unknown recommendations,

α and β are the weights attached to the parts of the equation which will give more weight to the recommendation from the trustworthy peers, and α+β=1.

The first part of the above equation calculates the Riskiness value of the trusted peer in a criterion 'c' by taking the recommendations of the trustworthy recommending peers and the second part calculates the Riskiness value of the same trusted peer in the same criterion by taking the recommendations of the unknown recommending peers. The recommendations from the untrustworthy recommending peers are left out and not considered. In order to give more importance to the recommendations from the trustworthy recommending peers as compared to the recommendations from the unknown recommending peers weights are attached to the two parts of the equation. These weights are represented by α and β respectively. It depends upon the trusting peer on how much weight does it want to give to each recommendation. By multiplying the Riskiness value of the recommending peer (RRP) with the commitment level that it is suggesting for a criterion we are getting the accurate recommendation according to its Riskiness.

As mentioned earlier any recommending peer whose Riskiness value while giving recommendations is with in the range of (-1, 1) is said to be a trustworthy recommending peer. So it is possible that the Riskiness value for the trusted peer in a criterion 'c' from the trustworthy recommendations might come negative. We take the range of (-1, 1) to determine whether the recommendation is trustworthy or not and once it is determined it should have no effect in determining the final Riskiness value of the trusted peer in a criterion (Rc) by assimilating the recommendations. Hence we apply the *mod* operator in equation 1 to the first part of the equation which determines the Riskiness of the trusted peer in a criterion 'c' by taking the trustworthy recommendations.

Once the Riskiness value of the trusted peer in a criterion has been determined by using equation 1 to map it on the riskiness scale we have to multiply Rc by 5.Hence Riskiness value of the trusted peer in a criterion C, mapped to the Riskiness scale ($R_{RSC}$) is:

$$R_{RSC} = \text{ROUND}((Rc) * 5) \qquad \textbf{Equation--------2}$$

When the Riskiness values for each criterion on the Riskiness scale has been determined by taking the recommendations, the final Riskiness value can be found out by weighing the individual Riskiness value of each criterion according to its significance depending on the trusting peer. The levels of significance for each criterion (Sc) are shown in table II. All the criteria of an interaction will not be of equal importance or significance. Some criteria might play an important role in determining the Riskiness of the peer and some might not be as crucial as others. The significance of each criterion in an interaction might depend on the degree to which it influences the successful outcome of the interaction according to the trusting peer.

TABLE II. TABLE SHOWING THE SIGNIFICANCE LEVEL OF EACH CRITERION

| Significance of the criterion (Sc) | Semantics of the Value |
|---|---|
| 1 | The criterion of this value is important and will have some significance in determining the Riskiness of the trusted peer. But there are other criterions apart from this which will have a major effect in determining the Riskiness of the peer. |
| 2 | A criterion of this value has the highest level of significance in determining the Riskiness of the peer and will play an important effect in determining the Riskiness of the peer. |

Hence the final Riskiness value (CR) of the trusted peer 'B' as determined by the trusting peer 'A' according to its criteria and significance of each criterion in the interaction by asking recommendations from other peers can be calculated as:

$$CR = \text{ROUND}\left(\frac{1}{\sum_{c=1}^{n} Sc} \sum_{c=1}^{n} Sc * R_{RSC}\right) \qquad \textbf{Equation----3}$$

Where Sc represents the significance of the criterion C

$R_{RSC}$ represents the Riskiness value in criterion C

n is the number of criterions in the interaction.

It should be noted that the Riskiness value of the trusted peer (CR) determined by assimilating the recommendations should be set to 0 if it is less than 0 i.e. if R'<0.

The proposed concept will become clear when we explain by taking an example.

## VI. EXAMPLE OF DETERMINING CONTEXT BASED RISKINESS

In this section we will explain the process of finding the Riskiness value of the trusted peer according to the criteria of the trusting peer by assimilating the recommendations before starting an interaction by an example.

Let us consider the example mentioned in section V of the trusting peer 'A' asking for recommendations from other peers before starting a transaction with trusted peer 'B' over a context C. Let us suppose that the criteria of the trusting peer 'A' in the interaction are **C1, C2 and C9**.

It gets recommendations from peers W, X, Y and Z in the form of Risk set. They recommend a Riskiness value for the trusted peer in the form of Risk set according to the criteria of their interaction. Let us consider the recommendations are:

Recommendation from recommending peer 'W'

{Peer 'W', Peer 'B', Context 'C', 4, 4, ((C1, 1) (C3, 0)), 3, UNKNWON, 12/08/2005, 13/08/2005, 0.7}

Recommendation from recommending peer 'X'

{Peer 'X', Peer 'B', Context 'C', 3, 4, ((C5, 1) (C2, 1)), 4, 200, 1/08/2005, 1/08/2005, 0.5}

Recommendation from recommending peer 'Y'

{Peer 'Y', Peer 'B', Context 'C', 3, 3, ((C6, 1) (C2, 0)), 4, UNKNWON, 2/08/2005, 3/08/2005, UNKNWON}

Recommendation from recommending peer 'Z'

{Peer 'Z', Peer 'B', Context 'C', 2, 3, ((C2, 1) (C9, 0)), 3, UNKNWON, 5/08/2005, 9/08/2005, -2}

Classifying the recommendations as trustworthy, untrustworthy and unknown according to the Riskiness value of the recommending peer (RRP) and representing it according to their criteria as shown in table III we get:

TABLE III. TABLE SHOWING THE RECOMMENDATIONS ACCORDING TO CRITERIA

| Trustworthy Recommendations | Unknown Recommendations | Untrustworthy Recommendations |
|---|---|---|
| **Peer 'W'** C1 (1), C3 (0) **Peer 'X'** C5 (1), C2 (1) | **Peer 'Y'** C6 (1), C2 (0) | **Peer 'Z'** C2 (1), C9 (0) |

The trusting peer will take only trustworthy and unknown recommendations and leave the un-trustworthy recommendations. Hence it will take recommendations only from peer 'W', 'X' and 'Y' and assimilate those recommendations so that it can find the Riskiness value of the trusted peer according to its criteria i.e. C1, C2 and C9. According to the Risk set the Riskiness value of recommending peers (RRV) of peer 'W' and 'X' are -1 and 0.5 respectively and the trusting peer gives a weight of 0.9 to trustworthy recommendations and 0.1 to un-known recommendations (α and β respectively).

Hence taking the trustworthy and unknown recommendations and determining the Riskiness value of the trusted peer in each of the criterion according to equation 1:

**Riskiness value of the trusted peer in criterion C1:**

As there is only one recommendation for criterion C1 from trustworthy recommending peer 'W':

$R_{C1} = | (0.9 *(-1*(1))) | + (0.1 * 0) = 0.9$

Representing it on the Riskiness scale by using equation 2

$\mathbf{R_{RSC1}}$ = ROUND (0.9*5)

$\mathbf{R_{RSC1} = 5}$

**Riskiness value of the trusted peer in criterion C2:**

For criterion C2 there is one recommendation each from a trustworthy recommending peer 'X' and an unknown recommending peer 'Y':

$R_{C2} = | (0.9* (0.5* (1)))| + (0.1 * 0) = 0.45$

Representing it on the Riskiness scale by using equation 2

$\mathbf{R_{RSC2}}$ = ROUND (0.45*5)

$\mathbf{R_{RSC2} = 2}$

There is no recommendation about the trusted peer to the trusting peer in the recommendations for criterion C9. Hence according to the Riskiness scale it will take a Riskiness value of -1 to that particular criterion as -1 denotes that the Riskiness is unknown.

**Riskiness value of the trusted peer in criterion C9:**

$\mathbf{R_{RSC9} = -1}$

Let us assume that the significance of the criterions C1, C2 and C9 according to the trusting peer is 2, 2 and 1 respectively. Now using equation 3 to determine the Riskiness value (CR) of the trusted peer in the criterions of its interest in the interaction:

$$CR = \text{ROUND}\left(\frac{1}{5}\ ((2*5) + (2*2) + (1*-1))\right)$$

CR= ROUND (2.6)

**CR = 3**

Hence the Riskiness value (CR) of the trusted peer 'B' as found by the trusted peer 'A' by asking recommendations from other peers before starting an interaction and according to its criterions in the interaction i.e. C1, C2 and C9, is 3 on the Riskiness scale.

## VII. CONCLUSION

In this paper we proposed a solution to the problem of the trusting peer determining the Riskiness value of the trusted peer according to the criteria of its interaction leaving out those recommendations which are of no interest to it. We also defined how to classify the recommendations as trustworthy and untrustworthy and defined a standard format for giving recommendations so that the trusting peer can assimilate those recommendations easily. We then explained the process of determining the Riskiness of the trusted peer according a specific set of criteria in the interaction by using an example.

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