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Application of Social Consensus Support System for IT Risk Measure "Social-MRC" to The Information Filtering Issue for Children

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Abstract. A countermeasure against an IT threat can easily become a threat in its own right; thus, it is necessary to create a system to build a social consensus on how best to combat threats that are emerging in our increasingly technology-centric society, such as how best to filter children's access to information or the introduction of surveillance cameras. To meet this demand, we are proposing a system to support the formation of social consensus in the creation and adoption of countermeasures to various IT problems. Our system, which we call "Social-MRC", consists of MRC-Studio to support consensus formation among opinion leaders, and MRC-Plaza to obtain the opinions of ordinary stakeholders. This paper describes the application of Social-MRC to the issue of filtering information for children.

Keywords: ITrisk, Risk Analysis, Risk Communication, Consensus Building, Information filtering

1. INTRODUCTION

With the spread and development of information technology, social risks are increasing and diversifying. For example, installing internet filtering software to prevent youths from browsing harmful content could potentially infringe on young people's right to access information. Therefore, it is necessary to consider multiple risks simultaneously when looking at mitigation strategies because measures to reduce one risk can often unintentionally create another risk. Specifically, it is necessary to develop systems that support the formation of social consensus on mitigation strategies for various IT risk issues, such as information filtering for children or the use of real-name Internet messaging boards.

Sasaki et al have developed the Multiple Risk Communicator (MRC) system for consensus building in organizations where the number of stakeholders is small [1]. However, MRC cannot be applied to problems where there are several thousand stakeholders, and so it was necessary to establish a new solution.

To meet the above requirements, Sasaki et al have incorporated the concept of "Social-MRC" to comprehensively support risk communication on two levels: communication among opinion leaders and communication with the participation of ordinary stakeholders. Social-MRC has a hierarchical structure and consists of MRC-Studio and MRC-Plaza. MRC-Studio supports consensus building among opinion leaders, and MRC-Plaza supports risk communication with participation from ordinary stakeholders. This paper describes the application of Social-MRC to the issue of information filtering for children.

We conducted risk analysis and consensus building experiments related to information filtering for children using a Social-MRC prototype.

2. MULTIPLE RISK COMMUNICATOR(MRC)

2.1. OVERVIEW OF MRC

The following is a summary of the MRC development requirements, as previously developed by the authors. (See the left side of Fig. 1.)

Requirement 1: Many risks (e.g., security risks and privacy risks) exist. Accordingly, a means of avoiding conflicts among risks is necessary.

Requirement 2: It is difficult to achieve objectives of system by applying only a single countermeasure. Accordingly, a system that seeks the optimal combination of countermeasures is necessary.

Requirement 3: Many stakeholders (e.g., managers, customers, and employees) exist. Accordingly, it is necessary to develop a risk communication strategy that can obtain consensus among many stakeholders.

To satisfy these requirements, MRC has several functions designed to find the optimal combination of the proposed measures using the evaluation index as described below to support consensus building among stakeholders.

- Objective function
  Used to seek the optimal combination of the proposed measures
- Constraints
  Criteria for choosing an acceptable combination of the proposed measures
- Proposed measures
  Possible countermeasures to help solve the problem

The right side of Fig. 1 shows the MRC elements: an input and output function, a computing function, a stakeholder support function, an overall control function, a database function, and a negotiation infrastructure. The users are specialists knowledgeable about MRC or the target subject matter, the decision-making participants, and a facilitator who mediates among these parties.

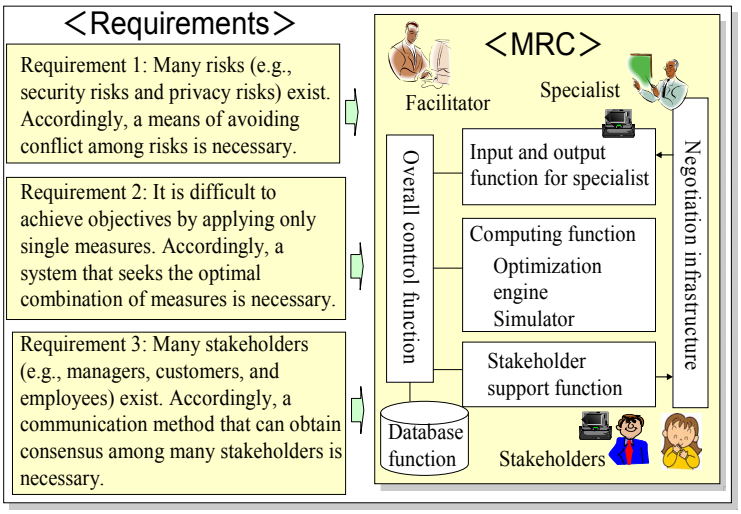

Fig. 1. MRC development requirements and background

2.2. EXSAMPLE OF AN MRC APPLICATION

Previously, MRC was applied to personal information leakage problems, internal control problems, and other matters [3]. MRC can effectively handle the following: (1) cases in which a few representative stakeholders gather to come to a consensus, or (2) cases where a consensus is formed through interactive role-playing in groups to simulate the stakeholders, such as companies or local government bodies. Thus as we can see, MRC is simply not scalable and thus cannot be applied to problems where several thousand or more stakeholders must come to a consensus, and so a more innovative solution to this problem is necessary.

3. SOCIAL-MRC

3.1. OVERVIEW OF SOCIAL-MRC

To meet the above requirements, Sasaki et al have adjusted the concept of Social-MRC to comprehensively support risk communication on two levels: communication among opinion leaders and communication incorporating the participation of ordinary stakeholders.

At the first level (communication among opinion leaders), necessary functions based on the functions previously developed for MRC were added and the new system was named MRC-Studio.

At the second level (participation in discussions by ordinary stakeholders), MRC-Plaza can be used to incorporate the opinions of ordinary stakeholders in the deliberations of opinion leaders and can be used to broadcast the discussions of opinion leaders to ordinary stakeholders (Fig. 2).

3.2. A PROTOTYPE OF SOCIAL-MRC

The prototype of Social-MRC is a combination of the MRC-Studio and MRC-Plaza prototypes. As the MRC-Studio prototype, the existing MRC itself was used, and MRC-Plaza was developed for the Social-MRC prototype[4].

MRC-Plaza was designed to incorporate the opinions of ordinary stakeholders in the deliberations of opinion leaders through the use of a micro-blog system, such as Twitter, and a video sharing service, such as Ustream, to provide live broadcasts of the opinion leaders' deliberations to ordinary stakeholders (Fig. 3).

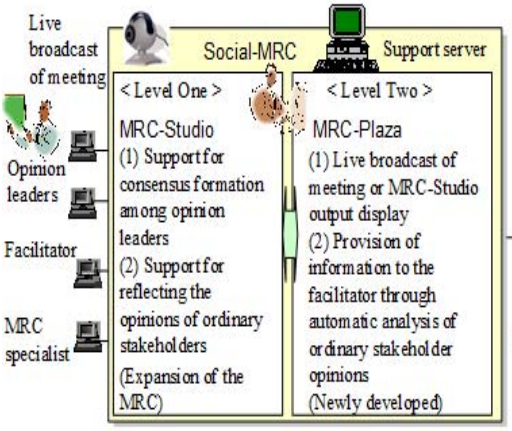

Fig.2 Overview of Social-MRC[2]

Fig.3 MRC-Plaza

4. THE INFORMATION FILTERING ISSUE FOR CHILDREN

4.1. OVERVIEW OF THE INFORMATION FILTERING ISSUE FOR CHILDREN

As the amount of information on the Internet explodes, the amount of information that may be harmful to children, such as the potential for children to become involved in crime or being adversely affected by viewing violent images. To prevent such problems, the Japanese government enacted a law to create a safe environment for children to use the Internet by promoting filtering. However, there are problems with the law, as described in Section 4.3. To help fix these problems, the law is due to be reviewed 2012[5].

4.2. OVERVIEW OF THE LAW TO CREATE AN ENVIRONMENT THAT CHILDREN CAN USE THE INTERNET SAFELY

This law came into effect on 1 April 2009. In the law, children are defined as persons "less than 18 years of age".

The purpose of this law is to achieve the following, with the view that there is a large amount of harmful information circulating on the Internet.

- Take necessary measures to properly study the ability to leverage the Internet for children
- Take measures to minimize the exposure of children to_harmful information through the widespread use of harmful-content filtering software to enhance the performance of children
- Enable children to use the Internet safely and securely; this law is intended to promote the advocacy of children

4.3. CONTENT OF THE LAW AND ISSUES

To achieve the objectives stated in Section 4.2, mobile phone operators, Internet service providers, PC makers, and web site administrators will have to implement various measures. This is a heavy burden for them. In addition, children may not be able to see some of the content they should be allowed to see, potentially infringing on a child's right to know.

5. RISK ANALYSIS OF THE INFORMATION FILTERING ISSUE FOR CHILDREN

5.1. STAKEHOLDERS AND CONSTRAINTS

Constraints for the various stakeholders are listed in Table 1.

Table 1.Stakeholders and Constraints

Stakeholders	Constraints
Children	The right to know
	Potential harm from viewing illicit content
Guardians	Convenience burden
	Risk to children
Web site administrators	Convenience burden
Internet service providers	Cost measures
Mobile phone operators	Cost measures
PC makers	Cost measures
Internet café operators	Cost measures
Content providers	Violation of freedom of expression
General participants	The right to know
Government	Cost measures

5.2. OBJECTIVE FUNCTION

The Objective function is used to seek the optimal combination of the proposed measures. The issue can be expressed as follows.

Min{risk to children + Measured Cost}(in yen)

- Risk to children is as follows:
  {the effect of fault tree(a) * the probability of fault tree(a) * the number of children in Japan} + {the effect of fault tree(b)* the probability of fault tree(b) * the number of children in Japan} + … +{the effect of fault tree(f)* the probability of fault tree(f) * the number of children in Japan
- Measured Cost refers to the total of cost to the government and companies involved

5.3. FAULT TREE ANALYSIS

To handle quantitative risks, a fault tree analysis was performed. An issue's fault tree is defined as the worst possible outcome that can occur as a result of children viewing harmful information on the Internet. Therefore, the authors determined the top event risks, considering the relatively large impact of the damage from these events.

The top event risks are as follows:

- Suicide induced by the site
- Death caused by being involved in a crime facilitated through the use of the Internet
- Murder by a child, due to the affect of a brutal site
- Involvement with crimes such as robbery or rape, which were arranged on the Internet
- Involvement in crimes such as extortion, assault, or criminal damage using the Internet
- Use of the Internet to solicit or offer prostitution

5.4. DETERMINATION OF VARIOUS PROPOSED MEASURES

The following proposed measures, including measures now being enforced by law, have been effective in mitigating their associated risks. We have highlighted 15 of these measures in Table 2.

Table 2: Proposed measures

No	Proposed Measures	Effect
1	Assign mobile phone filtering responsibilities to parents of children who use mobile phones (without punishment)	0.7
2	Allow parents to enforce filtering in mobile phones (with punishment)	0.99
3	Assign PC filtering responsibilities to the PC manufacturers (without punishment)	0.5
4	Make PC manufacturers filter PCs (with punishment)	0.9
5	Assign filtering responsibilities to managers of Internet cafes (without punishment)	0.5
6	Force managers of Internet cafes to filter content (with punishment)	0.9
7	Assign filtering responsibilities to ISP managers (without punishment)	0.4
8	Force ISP managers to filter content (with punishment)	0.8
9	Assign filtering responsibilities to web site managers (without punishment)	0.4
10	Force web site managers to filter content (with punishment)	0.8
11	Educate children in primary school and junior high school on how to use the Internet safely	0.3
12	Educate parents on the necessity of filtering	0.3
13	Assign ISP managers to explain how to recognize danger on the Internet to children who use their services, as well as how to avoid such dangers.	0.3
14	A third party identifies harmful content	0.1
15	The government identifies harmful content	0.3

5.5. DETERMINATION OF VARIOUS PROPOSED PARAMETERS

The measures effectiveness was measured and the results are shown in Table 2. The number given is a measure of how much the risk can be reduced by the countermeasure; for example, if a countermeasure has an effectiveness of 0.9, this means that by employing that countermeasure, the probability of the fault tree for that event is reduced by 90%. Cost measures and the degree of compromise/burden were determined using the reference values shown in Tables 3 and 4. The degree of burden and cost have three and five stages, respectively.

The end event probabilities for some of the fault trees we evaluated for this paper, for example, the fault tree for the issue of children having mobile phones, were determined using statistics compiled in previous reports. Other values were determined using a five-stage reference value chart, shown in Table 5.

Table 3.Measures cost

Level	Measures cost	Range(yen)
1	Small	0-10,000,000
2	Small to medium	10,000,001-100,000,000
3	Medium	100,000,001-1,000,000,000
4	Medium large	1,000,000,001-10,000,000,000
5	Large	10,000,000,001-100,000,000,000

Table 4.Degree of breach/burden

Degree breach/burden (0-10)	How participants feel
0-3	Do not feel there is a burden
4-6	Feel there is a burden rather
7-10	Feel there is a burden

Table 5.Probability of an event ends

Level	Probability	Value (frequency/year•people)
1	Low	0.0008
2	Medium low	0.004
3	Medium	0.02
4	Medium high	0.1
5	High	0.5

The magnitude of the effect was set according to the cost incurred when either of the two top event risks of the fault tree occurred, these being (a) suicide induced by the site and (b) death caused by being involved in a crime facilitated through the use of the Internet.

The cost for these types of events was determined to be 31,389,446 yen.

This value was calculated on the basis of the potential future income, minus living expenses, that the child would have earned in their lifetime had they survived.

The following data used to determine the monetary cost of the death of a child

- Calculate the monetary impact of the child's death using the Leibniz factor [6]
- Set Age. Here average value is used. (years 6 + years 17) ÷ 2 = 11.5
- The average wage in 2008: 48,826,000 [yen][7]
- Minus the cost of living expenses, an average of 50% of salary[8]

Murder by a child, due to the affect of a brutal site

The cost for this type of event was determined to be 39,337,446 yen. This value was calculated from the loss of potential future income using the above data. In addition, the following data was factored in to the overall financial costs of these acts.

- Set Age: 44 (The average age in Japan) [9]
- Living expenses deduction rate (average): 40% [8]

Involvement with crimes such as robbery or rape, which were arranged on the Internet

The cost of this type of event was determined to be 2,000,000 yen. This value was calculated based on the compensation paid to victims of rape [10].

Involvement in crimes such as extortion, assault, or criminal damage using the Internet

The cost of this type of event was determined to be 600,000 yen. This value was calculated from the compensation paid to injured parties [11].

Use of the Internet to solicit or offer prostitution

The cost of this type of event was determined to 1,000,000 yen. This value was calculated from fines for breaking the law [12].

The exact quantification of these will vary by individual. However, if these values are different in the process of consensus building in Social-MRC, an optimal combination can be calculated instead using values of participant.

6. CONSENSUS EXPERIMENT

6.1. EXPERIMENTAL OVERVIEW

We conducted consensus building experiments using a prototype of Social-MRC, employing role players to come to a consensus on what to do about filtering information for children.

Because it is difficult to argue with opinion leaders elected from each of the stakeholder groups listed in Table 1, the number of opinion leaders was reduced down to two people in this experiment, one person supporting regulation and the other opposing the regulation. Also, because the number of constraints listed in Table 1 turned out to be too high to allow for effective argument among the stakeholders, we decided to reduce the number of constraints. The chosen constraints (see Table 6) were debated by the opinion leaders in each group.

The costs of the infringement of the right to know and freedom of expression of content providers were calculated using the values for the parameters of the proposed measures. The value placed on harm to children was obtained by using a fault tree, representing the number of victims per year.

In addition, one presenter, one director, and one MRC expert helped in the experiment. In total, approximately 30 people participated in the experiment. The opinion leaders discussed the issue in the meeting room and the presenter helped keep the presentation running. The Director edited the server of MRC-Plaza for technical support, and the cameraman filmed the discussion. The MRC expert changed the value of each constraint and created the optimum combination of measures proposed by MRC-Studio. The participants accessed MRC-Plaza using notebook PCs, viewing discussion, writing comments, and participating in polls that were carried out to confirm that the solution chosen by MRC-Studio was in fact optimal. The role of the players is as follows.

Role Players

- One opinion leaders for the pro-regulation side (PTA Chairman): University professor A
- One opinion leader for the anti-regulation side (freelance journalist): University professor B
- General participants: Students

Opinion leader	Constraint
Pro-regulation	Number of children's lives lost
	Number of children involved in the crime
	Number of people killed in crimes committed by children
Anti-regulation	The right to know
	Violations of freedom of expression

Table 6.Opinion Leaders and Constraint

6.2. PREPARATION

An MRC expert enters the risk analysis values into MRC-Studio that were described in Section 5. Also, at this stage, each of opinion leaders calculates the optimal solution using MRC-Studio. The solutions proposed by the opinion leader for the pro-regulation side is shown in Table 7. Their biggest priority was reducing the potential harm to youths caused by potential misuse of the Internet, and to that end, they adopted a number of the proposed measures. The solutions proposed by the opinion leader in opposition to regulation are shown in Table 8. The optimal solution was to proceed with the proposed measures while considering the associated legal problems

Table 7.Solution for the pro-regulation side

Constraints	Value	Calculated
Infringements of the right to know	Less than 30*	25
Violations of freedom of expression	Less than 20%	8
Number of children's lives lost	Less than 6 people	0.8 people
Number of children involved in the crime	Less than 200 people	38 people
Number of people killed in crimes committed by children	Less than 2 people	0.1 people
Adopted measures		1,4,6,8,10,11,12,13
Objective function		6,770,952,419 yen

*The relative value that the present value assumes 39

%The relative value that the present value assumes 23

Table 8.Solution for the anti-regulation side

Constraints	Value	Calculated
Infringements of the right to know	Less than 13*	13
Violations of freedom of expression	Less than 8%	3
Number of children's lives lost	Less than 10 people	4 people
Number of children involved in the crime	Less than 381 people	126 people
Number of people killed in crimes committed by children	Less than 2 people	0.8 people
Adopted measures		1,3,5,7,12,13
Objective function		3,204,521,234 yen

*The relative value that the present value assumes 39

%The relative value that the present value assumes 23

6.3. SELECT A POPULAR OPINION LEADER

Each opinion leader explains their optimal solution to the participants. The optimal solution that wins the most votes will then move on to be debated by the opinion leaders. In this experiment, the number of votes for the pro-regulation opinion leader was 8, and that for the anti-regulation opinion leader was 21, and so the anti-regulation leader was the one selected by the participants.

6.4. CONSENSUS AMONG OPINION LEADERS

- The opinion leaders next discussed the various solutions proposed by the group opposed to regulation. First, the pro-regulation leader proposed a solution with constraints with penalties. Table 9 shows the optimal solution as determined by the aforementioned conditions (optimal solution 1).
- The opinion leader of the pro-regulation group was satisfied with optimal solution 1, but the opinion leader of the anti-regulation group was not satisfied, because this solution included discussions of measures that included penalties. Therefore, the anti-regulation leader proposed an optimal solution that removes such measures (optimal solution 2, shown in Table 10).

Table 9.Optimal solution 1

Constraints	Value	Calculated
Infringements of the right to know	Less than 13*	12
Violations of freedom of expression	Less than 8%	4
Number of children's lives lost	Less than 10	1.9 people
Number of children involved in the crime	Less than 381 people	109 people
Number of people killed in crimes committed by children	Less than 2 people	0.2 people
Adopted measures		4,6,8,12,13
Objective function		2,389,361,246 yen

*The relative value that the present value assumes 39
%The relative value that the present value assumes 23

Table 10.Optimal solution 2

Constraints	Value	Calculated
Infringements of the right to know	Less than 13*	12
Violations of freedom of expression	Less than 8%	6
Number of children's lives lost	Less than 10 people	3.9 people
Number of children involved in the crime	Less than 381 people	119 people
Number of people killed in crimes committed by children	Less than 2 people	0.7 people
Adopted measures		4,7,9,12,13
Objective function		2,578,413,554 yen

*The relative value that the present value assumes 39
%The relative value that the present value assumes 23

6.5. VOTE ON TENTATIVE AGREEMENT

The general participants then voted on whether this tentative agreement was satisfactory. The results were 19 votes in favor and 9 votes in against. Thus, the stakeholders had come to a consensus on optimal solution 2.

6.6. CONSIDERATION ON THE FINAL AGREEMENT

As a result of the final combination of adopted measures, it was decided that PCs used by children must filter potentially harmful content, and that ISP and web site administrators are obliged to help in this effort. In addition, it was decided that the selection of harmful information should not involve the government, and that it is important to educate children on the dangers of the Internet. The solution proposed states that ISP and web site administrators must continue to help in this filtering effort, as well as focus on education. Also, the proposed measures do not call for filtering on mobile phones, only for filtering on PCs.

There were two main reasons for choosing not to enforce filtering on mobile phones. One reason was the strict limitation imposed with respect to "Infringement of right to know". The other reason, as outlined in Table 11, was that many more people use PCs than mobile phones to access the Internet, and therefore the stakeholders concluded that filtering measures should focus on PCs.

Table 11.Utilization of the mobile phone/PCs for access the Internet[13]

Age	Mobile phones	PCs
6-12 (n=1315)	31.6%	62.7%
13-19 (n=1566)	84%	92.1%

6.7. EVALUATION OF SOCIAL-MRC

In order to evaluate Social-MRC, a survey of the 24 Tokyo Denki University students who participated in the experiment as general participants was conducted. The statistical results of the survey are shown in Tables 12 and 13. Based on the results of the survey, we can conclude that the Social-MRC application procedure is an appropriate and valid candidate for creating a decision making system.

Table 12.Pre-survey

Q.1	How much do you know about the Multiple Risk Communicator?
Answer	1: 6 people 2: 11 people 3: 3 people 4: 4 people
Q.2	How much do you know about filtering information for children?
Answer	1: 2 people 2: 8 people 3: 12 people 4: 2 people

※1: Know well 2: Know somewhat 3: Know slightly 4: Don't know

Table 13.Post-survey

Q.1	Do you think the consensus building procedure used by Social-MRC is useful?
Answer	1: 0 people 2: 15 people 3: 6 people 4: 0 people
Q.2	Do you think that better agreement on the issue of information filtering for children is obtained by Social-MRC
Answer	1: 2 persons 2: 13 persons 3: 6 persons 4: 0 persons

※1：Agree 2：Slightly agree 3：Somewhat disagree 4：Strongly disagree

7. CONCLUSION

We have conducted risk analysis and consensus building experiments related to information filtering for children using a prototype of Social-MRC. Our results show that Social-MRC can effectively help support social consensus building efforts. However, the subjects for this experiment had previously participated in

MRC studies and thus were able to come to a consensus relatively easily. We would like to reach a wider audience, and thus we are considering introducing auxiliary tools in order to more readily incorporate people without any prior knowledge of MRC into the decision making process.

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