

CIRA perspective on risks within UnRizkNow - a case study

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Abstract—UnRizkNow is a community of practice for cyber security practitioners in Norway. It is imperative for the establishment of UnRizkNow to identify the underlying risks that can affect the normal operation of the community. This paper presents a study to carry out a risk assessment of UnRizkNow CoP using conflicting incentive risk analysis (CIRA) method. The main contribution of this research work is to identify and analyze the risks that can be obtained from the conflicts in the incentives of members and organizer in UnRizkNow. This paper also presents risk treatment plan in terms of incentives as suggested by CIRA method. The findings of this study are helpful to establish UnRizkNow community, and also for the researchers who want to analyze human risks in a system.

I. INTRODUCTION

Sharing and re-use of information improve both quality and cost effectiveness of the knowledge sharing activities. Therefore, communities of practice (CoPs) is gaining popularity among the professional practitioners recently. The focus of learning is strongly shifting towards online community-based modes of training in organizations [8]. Learning within a community is concerned with participation in the activities of creating, sharing and construction of knowledge. The learning that evolves from these communities is collaborative in nature, i.e. the collaborative knowledge of the community is greater than any individual knowledge [12]. However, many CoPs have failed because the community stakeholders had either insufficient idea about the benefits/incentives of being involved in such communities or the incentives perceived by them are conflicting in nature.

UnRizkNow is being formed as a community of practice (CoP) for the information security risk practitioners in Norway. UnRizkNow can play a key role in the promotion of learning and innovation in the field of cyber security risk in contemporary organizations. However, establishing and sustaining UnRizkNow is not a trivial task. There will be several stakeholders involved in the various activities associated with a CoP. The action of the stakeholders are often motivated by the incentives/ benefits perceived by them [18]. It may give rise to complex risks which are impractical to be expressed as a combination of likelihood (probability) and consequence. It is also difficult to obtain historical data to validate probability associated with the calculation of risk in the system. Conflicting incentives risk analysis (CIRA) specifies risks in

terms of conflicting incentives between the stakeholders. CIRA considers human factors in order to analyse risk in a system. Therefore, CIRA is a good candidate to assess underlying risks in UnRizkNow. We are particularly interested to answer the following research questions (RQ) in this study: (RQ1) What are the incentives of the *members* and the *organizers* of UnRizkNow community? (RQ2) To what extent can CIRA uncover the risks generated from conflicting incentives in UnRizkNow? (RQ3) What are the risk mitigation plans that can be designed using the concepts of CIRA method?

The main contributions of the work are: a) Explain the features of UnRizkNow CoP; its stakeholders and their incentives - Answers RQ1, b) Apply conflicting incentive risk analysis (CIRA) method to UnRizkNow to investigate the underlying risks - Answers RQ1, c) Identify risk scenarios that can be generated in UnRizkNow due to the conflict between the stakeholders - Answers RQ2, d) Suggest risk mitigation plans for the risk scenarios identified for UnRizkNow - Answers RQ3

II. BACKGROUND KNOWLEDGE

This section provides an overview of community of practice and CIRA method. The main features and objectives of a CoP is described along with the information on the necessary steps of CIRA method.

A. Community of practice (CoP)

The term 'communities of practice' [25] is fairly a new term to denote community-based learning method. However, the phenomenon referred by CoPs has very old existence. CoP [25] is a common way to engage people in sharing knowledge, discuss issues, and learn from others' experience to resolve several challenges in many organizations. The theoretical basis of communities of practice is provided by Wenger in [25]. According to Wenger, "Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly". CoP is well-suited for the development and sharing of knowledge and practices across divisions. A CoP mainly consists of three fundamental elements [25], [26]: A *domain* of knowledge creates common ground, inspires members to participate, guides their learning and gives meaning to their actions; The notion of a

community creates the social fabric for that learning. A strong community fosters interactions and encourages a willingness to share ideas. While the domain provides the general area of interest for the community, the *practice* is the specific focus around which the community develops, shares and maintains its core of knowledge. Members of CoPs learn from each other in the community and deepen their knowledge and expertise. Members of the CoPs are often termed as *practitioners* as they learn from peers through practice [5]. Communities mainly consist of people (stakeholders) who have some incentive to be a part of a given community of practice.

B. Conflicting Incentives Risk Analysis

Conflicting Incentives Risk Analysis (CIRA) is a risk analysis method which is developed by Rajbhandari and Snekenes [18]. This method is based on the idea of qualitative analysis. This risk can be intentional as well as unintentional. CIRA method identifies stakeholders, actions and perceived expected consequences that characterize the risk situation. In CIRA, a stakeholder is an individual that has some interest in the outcome of actions that are taking place within the scope of the significance. There are two classes of stakeholders: the strategy owner and the risk owner. Strategy owner is the stakeholder who is capable of triggering an action to increase his perceived benefit. The stakeholder, whose perspective is considered when performing the risk analysis, is a risk owner. Typically, each stakeholder has associated a collection of actions that he owns. CIRA focuses on the human-related risks which corresponds to understanding the incentives of the stakeholders that influence their actions. An incentive motivates a stakeholder to take an action to increase his expected/ predicted utility. Utility is the benefit as perceived by the corresponding stakeholder and it comprises of utility factors [2].

III. RELATED WORK

The basic concept of a community of practice is presented by Lave & Wenger [11], and by Brown & Duguid [7] in 1991. However, both the works could not provide a clear definition of a community of practice until Wenger [24] provided one in 1998. The significance of CoPs in terms of fostering knowledge management, exchange of expertise and information, collaboration within organizations has been described in [9], [13]. Wenger [25] mentioned that building trust among the members, sharing ideas across different organizational units, and respecting different national and international cultures of the members in a community are the biggest obstacle in establishing a distributed community of practice. There are several other challenges identified for establishing and sustaining COPs within organizations [21]. For instance, Bourhis et. al. [6] believed that finding common interesting topics for the members is the biggest challenge in a CoP; lowering barriers among the members to overcome 'information hoarding' problem [4]; recruiting the right members (experts, practitioners of the given domain) who have sufficient knowledge and enough time for social interaction [15]. Pronst et. al. [16] presented a study to highlight possible

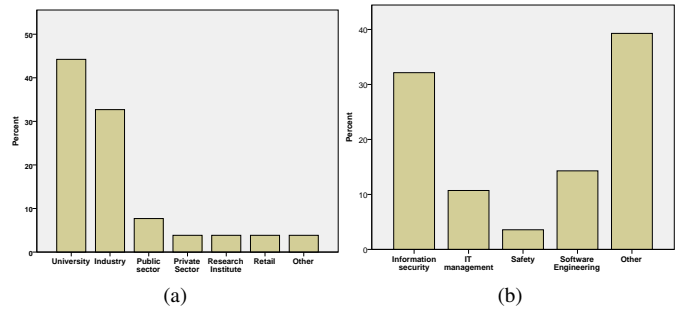


Fig. 1: Details of the respondents: (a) Affiliation (b) Domain

reasons behind the success and failure of communities of practice. They investigated 57 CoPs from major European and US companies. The survey revealed that weak one-to-one connections between the members, rigidity of competences, lack of identification in the network, practice intangibility are the main reasons of the failure. Conflicting incentive risk analysis (CIRA) is applied to a few cases to evaluate the human-centered risks [18], [19]. The application of CIRA to a more complex incentive system is done in the study [23]. The studies conducted using CIRA method are serving as a good starting point for this study. A pilot study is done with UnRiskNow to investigate the knowledge sharing behaviors of the students (members) on the community of practice [3]. The study examined the behaviors of the students and explained it using descriptive theories.

IV. RESEARCH METHODOLOGY

A. Survey instrument

An online quantitative questionnaire was created using LimeSurvey. The survey was hosted on our project domain [1]. The survey comprised of 17 questions (39 questions including sub-questions) in total that assessed various aspects of information sharing and previous experiences with CoPs. The survey was distributed online through several channels, see Table I. The survey was added to the official monthly mailing list of NorSIS, distributed to the members of NisLab through intranet and email. The questionnaire was available in both English and Norwegian languages. 7-point numerical rating scales were used (1-Not at all, 7-Extremely) for evaluative questions, and lists of possible answers were provided for categorical questions.

B. Respondents

A total of 52 respondents (43 males, 8 females, 1 undisclosed) volunteered to *complete* all the sections of the online survey. The majority of the respondents were between the ages of 25-34 years (34.6%). The majority (about 76.9%) of the respondents are affiliated with university, and industry (see Figure 1a). However, the survey did not include students as potential respondents as we are interested to get the opinion of the professionals for this study.

C. Data collection and data analysis

Data for this study is collected through an online survey, and literature study. The list of the stakeholders for a community of practice is designed using the literature [10], [14]. The incentives of the stakeholders are chosen based on the responses collected from the survey [1]. The survey was conducted in three phases between 28.11.2016 and 10.01.2017. The details of each phase in terms of duration, the medium through which the survey was distributed, no. of respondents, and number of complete responses are given in Table I.

TABLE I: Details of the data collection activity

Phase	Duration	Medium	Respondent
Phase1	28.11.2016-06.12.2016	NorSIS	13
Phase2	19.12.2016-10.01.2017	NISLab	19
Phase3	30.11.2016-19.12.2016	Email	17
		LinkedIn	3
Total	28.11.2016-10.01.2017	Online	52

We used IBM SPSS statistics 24 (NTNU licensed) to analyze the survey data. Out of 52 respondents, 28 respondents have already participated in a CoP, where as 22 members answered that they want to join a CoP. 2 respondents neither participated in any CoP, nor they want to participate. The domain of the CoP, that the people participated in, is given in Figure 1b.

Respondents have indicated their roles in the CoP that they participated in and also the role that they want to take in the future CoPs, Table II. The majority of the respondents are interested to participate in a community as a 'member'.

TABLE II: Distribution of the roles in CoP

Role in the community	Sponsor	Organizer	Member	Facilitator	Leader
Votes	2	5	43	5	3

The data set of the study is examined in terms of sample size, normality. The Null hypothesis is that sample distribution is normal. The data from the scale is examined via Shapiro-Wilk test in SPSS. The sig. value of the Shapiro-Wilk test is not greater than 0.05 for any data set. Hence, we rejected the null hypothesis and considered our sample data as non-normal. We used median or mode in order to compare the response, and assign a weight for the survey questions that involve answers on the numerical rating scale (1= Not at all, 7= Extremely). The mathematical model in our survey design assumes that the interval between values is not interpretable (i.e. the distance between 1-2 is not the same as the distance between 6-7). Therefore, calculating mean or standard deviation on the given data is not a suitable approach to build any conclusion.

V. CASE STUDY

This section presents a case study of UnRizkNow community of practice using the CIRA method. The objective of this section is to answer the research questions, RQ1 and RQ2. Firstly, an overview of UnRizkNow community is provided with an emphasis on the involved stakeholders, their roles, and incentives. Secondly, CIRA method is applied to UnRizkNow to find out the conflict in the incentives and potential risks it may cause.

A. Overview of UnRizkNow

UnRizkNow [22] is an Online Cyber Security Risk Management Community of Practice (CoP) for Cyber Security Risk Management (CSRM) practitioners in Norway. The objective of UnRizkNow is to identify relevant challenges that CSRM practitioners face in their field of interest and enable them to resolve these challenges by sharing knowledge in the form of ideas, answers, and experience. The *domain* of UnRizkNow is the area of shared expertise and of key issues in the field of information security management. The *community* consists of the Information Security practitioners working in small and mid-sized enterprises. The practitioners must be committed to a process of collective learning oriented toward achieving outcomes and improving practice. The members will *practice* the investigation of key questions, problems, and challenges faced by the practitioners; identification of resources and expertise, improving the subject knowledge through learning, and development of new processes, methods, and knowledge.

B. Analysis of UnRizkNow using CIRA

The following section describes the steps for conducting a risk analysis of UnRizkNow according to the CIRA method [18]. For the purpose of the present case study the possible misalignment of incentives between the community *Members* and the *Organizer* is investigated. The analysis focuses on general description of possible risk situations in a CoP context and employs a qualitative analysis similar to the one presented in [23].

Step 1. - Identify the risk owner: A community member is considered to be the risk owner.

Step 2. - Identify the risk owner's key utility factors: Based on the survey responses, four aspects of information sharing were considered as key utility factors for the risk owner. The selection was done by calculating the statistical mode for each of the presented factors, and one was selected from each differentiating categories. The key utility factors are as follows:

Improve knowledge: the motivation to gain a better understanding about the domain knowledge, make use of the information shared by community members.

Share experience to help others: refers to the intrinsic value of sharing valuable experiences for the benefit of others.

Handling of privacy and confidentiality: trust in the community and all stakeholders that the shared professional/private information is used confidentially and according to relevant privacy agreements.

Building reputation: refers to the esteem, recognition received from others in the community, achieved by presenting relevant skills and competence in the domain.

TABLE III: A strategy’s effect on the Utility Factors relative to their assigned weights

Statistical mode derived from survey	Weights	Effect on Utility Factors		
		Increase	Unaffected	Decrease
7	Very High	+5	0	-5
5-6	High	+4	0	-4
4	Medium	+3	0	-3
2-3	Low	+2	0	-2
1	Very Low	+1	0	-1

Step 3. - Given an intuition of the scope/system identify the kind/ classes of operations/ strategies which can potentially influence the above utility factors: The standard CIRA method distinguishes between *threat risks* and *opportunity risks* - the risk when the strategy owner is not motivated to take an action that would be beneficial for the risk owner [17]. However, we restricted the analysis to risks that are potentially harmful for the risk owner. The following strategies were identified as being capable of having a negative impact on the aforementioned utility factors: *Misuse of the community knowledge/information:* using the useful information shared by the members of the community for another purpose than that is mentioned in the policy without receiving consent or the disclosure of any secret information of the community members to unauthorized parties; *Diverting the purpose:* changing the topic or purpose of the community from the one that was told to the members while recruiting; *Selection of inappropriate members:* recruiting the irrelevant/unsuitable members for the community mainly for the purpose of projecting high presence of the members on the community and earning money in the form of membership fee. A person who is associated with other such community of practice is not allowed to join the community; *Improper incentive scheme:* overlooking the preferences of the community members when designing an incentive system, leading to unintended consequences or dissatisfaction [10].

Step 4. - Identify the roles/functions that may have the opportunities and capabilities to perform these operations: Even though various stakeholders might be able to implement some of the above mentioned strategies, in the present case study the Organizer is considered to be the strategy owner.

Step 5. - Identify the named strategy owner(s) that can take on this role: This step is excluded from the present analysis. Since UnRizkNow is in a pre-deployment phase, this role is not yet fulfilled by any individual.

Step 6. - Identify the utility factors of interest to this strategy owner(s): The following utility factors are considered to be relevant for the Organizer in the CoP setting: **Revenue:** Can be generated by collecting membership fees from members. A decision has to be made between increasing the num-

ber of members, or setting a higher membership fee. Promoting the community among the professionals, securing money from the sponsors. By selling the knowledge/technology designed in the community to third parties. **Reputation:** The Organizer is interested in establishing a good reputation in the business community.

Step 7. 8. 9. - Determine how the utility factors can be operationalized, how the utility factors are weighted by each of the stakeholders, and how various operations result in changes to the utility factors for each of the stakeholders: - A deviation from the standard CIRA procedure is that the identified utility factors are investigated qualitatively that allows to discover general risk scenarios that might emerge in Communities of Practice, whereas the standard procedure focuses on individual differences between the stakeholder’s perception of benefit. The investigation here aims to describe reasonable situations that might pose threat to the risk owner, not to analyse whether a given risk will actually manifest itself. Therefore, the operationalization of the utility factors is excluded from the present analysis. The mapping between the weights assigned to the utility factors and the direction of influence by any strategy is presented in Table III. The results from the survey served as input for defining the weights for the selected utility factors. Figure 2 shows the statistical mode for each aspect of information sharing. The selection was done such that they represent different levels of importance for the community members. Table IV illustrates the utility factors and their corresponding weights for both of the stakeholders, the four strategies identified as being capable of influencing these utility factors and their effect taking into account the utility factor’s importance.

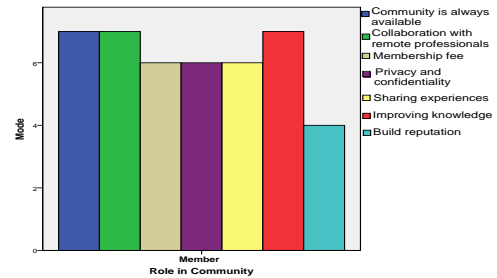


Fig. 2: Statistical mode for each aspect of information sharing investigated

Step 10. 11. - Estimate the utility, compute the incentives: As the operationalization of the utility factors was excluded from the analysis, estimating the utility is also omitted. However, it is possible to compute the incentives by investigating whether each strategy has the potential to cause an overall increase, decrease or no change in the sum of the weighted utility factors. The incentive is the potential loss/benefit perceived by each stakeholder when a certain strategy is triggered. A strategy with negative incentive is likely to be avoided by the strategy owner, as it lowers his overall utility,

TABLE IV: Overview of the incentives in relation to various strategies

Stakeholders	Utility Factors	Weights	Influence of strategies on Utility Factors			
			Misuse of the knowledge / information	Diverting the purpose	Selection of inappropriate members	Improper incentive scheme
Member	Improve knowledge	Very High	Unaffected (0)	Decrease (-5)	Decrease (-5)	Unaffected (0)
	Share experience to help others	High	Unaffected (0)	Unaffected (0)	Decrease (-4)	Decrease (-4)
	Confidentiality and privacy	High	Decrease (-4)	Unaffected (0)	Unaffected (0)	Unaffected (0)
	Build reputation	Medium	Unaffected (0)	Unaffected (0)	Unaffected (0)	Unaffected (0)
Change in utility			-4	-5	-9	-4
Organizer	Revenue	Very High	Increase (+5)	Increase (+5)	Increase (+5)	Unaffected (0)
	Reputation/ user satisfaction	Medium	Decrease (-3)	Unaffected (0)	Decrease (-3)	Decrease (-3)
Change in utility			+2	+5	+2	-3

while positive incentive suggests actions that are more likely to be triggered.

Step 12. Determine risk: Risk is considered to be the result of the misalignment of the incentives between the strategy owner and the risk owner. When the strategy owner is in a position to increase his utility while decreasing the risk owner's utility the latter stakeholder faces a risk. Each strategy can be analyzed by comparing the related incentives in order to estimate which action is more likely to take place i.e. what plans should be developed given the possible outcomes. The risk related to each strategy can be described as a number pair representing the magnitude of undesirability from the risk owner's perspective and desirability (e.g. strength of force that motivates the strategy owner) to trigger the corresponding action. In case of the "*Misuse of knowledge/information*" scenario the value is (-4, +2), for "*Diverting the purpose*" scenario (-5, +5), for "*Selection of inappropriate members*" (-9, +2), and for "*Improper incentive scheme*" (-4, -3). Scenarios 1-3 share the common characteristic that they all, to a different degree, can cause a potential loss for the community Member, while increasing the benefit of the Organizer. The fourth option is likely to result in avoidance by each stakeholder, as it would result in loss of utility for both parties.

Step 13. Evaluate risk: This step refers to the identification of risk acceptance and rejection criteria by the risk owner, as he has to determine whether the identified risks are acceptable or not. This step is not part of the present study due to the lack of named risk owner.

VI. DISCUSSION

A. Risk scenarios

The analysis highlighted how various operations influence the overall utility of both Members and Organizer of a Community of Practice. For the present case study only the Organizer is assumed to possess the capabilities to exert influence on the risk owner and his actions are determined by the desirability attached to each scenario. *Diverting the purpose of the community* is the only strategy that provides a clear and maximum benefit for the Organizer. This strategy might be implemented when the Organizer chooses to widen the scope of the community in order to increase the number

of active participants. The consequence of this strategy is that existing members could find it difficult to gather valuable knowledge from the community since a large amount of irrelevant information could easily reach unmanageable levels.

While both strategies (e.g. *Misuse of the knowledge/ information & Selection of inappropriate members*) provide an overall increase in benefit, they represent a more complicated situation where certain trade-off decisions have to be taken into account (i.e. the increase of a potential benefit decreases benefit according to another utility factor). For example the inclusion of an additional utility factor - representing the contingency of a lawsuit in case of a privacy breach - could provide a more detailed picture about the decisions that the strategy owner might consider. From the perspective of the Members the worst-case scenario is the *Selection of inappropriate members* as it would create the highest amount of loss interfering with the basic foundations of a CoP at the same time (e.g. community and domain).

B. Mitigation plans

In the context of CIRA, risk mitigation amounts to modifying the weights that the stakeholders assign to the relevant utility factors or to what extent actions modify the values of the utility factors [20]. For the identified risk scenarios different mitigation strategies can be utilized, addressing RQ 3. The risk experienced by the Member when the Organizer is tempted to play either "*Misuse of knowledge/information*" or "*Selection of inappropriate members*" strategies can be mitigated by identifying other possibilities for revenue generation or by increasing the importance of the other relevant utility factor (Reputation / user satisfaction). Focusing on long-term benefits as opposed to short-term gains might be useful, as it builds on the motivation to create a sustaining community that is well-known and reliable source of information within the domain. In case of "*Diverting the purpose*" strategy there are no other utility factors influenced on the strategy owner's side. Therefore, it is not possible to increase the weight of another utility factor. The risk could be mitigated by the introduction of an external regulator (e.g. Sponsor) being responsible for ensuring that the community is kept focused on the selected domain. In case of the fourth identified scenario there is

no need for risk mitigation as the stakeholders would be in agreement that this situation has to be avoided, therefore the Organizer can be expected to pay special attention to the development of a proper incentive scheme.

VII. RESEARCH LIMITATIONS AND FUTURE WORK

The response that we received from 52 participants surely provided an initial insight into understanding their preference with respect to the participation in a community of practice. However, the findings cannot be generalized to a large population because of the small sample size of the respondents. The choice of a numerical rating scale (1-7) to collect response also gave us a very limited options to compare the utility preferences and weigh them. We cannot calculate mean on a numerical rating scale as it is an ordinal scale. Therefore, we calculated median and mode to compare the responses for a given question. Calculating median or mode can provide only 7 (for the scale of 1-7) possible outcomes, and it is not sufficient to rank the responses. The application of CIRA method to UnRizkNow is limited to only 2 stakeholders i.e. member and organizer in this study. The list of strategies was not intended to be exhaustive, it's main purpose was to illustrate reasonable actions that are potentially undesirable for the community Members. Therefore, it would be necessary to extend the list to include a wider collection of possible actions that might be suitable for UnRizkNow community. For instance, this analysis did not include actions with direct impact on the Member's *Build reputation* utility factor. In practice, the risk scenarios are more complex as the utilities and strategies of all the stakeholders in the system should be taken into account. The next phase of the study will focus on more robust data collection approach with a focus to increase the sample size. A series of interviews will be conducted with the prospective users of UnRizkNow to understand their preferences and motivation to participate and share knowledge with others. The responses will help to design sharing rules and incentive scheme for the participants. Afterwards, an online platform will be launched as a working prototype of UnRizkNow and users will be invited to join and participate. The aim of this task will be to validate the designed sharing rules, incentive schemes, and effectiveness of UnRizkNow community in sharing knowledge and solving problems of the users.

VIII. ACKNOWLEDGMENT

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