Scientific and Practical Cyber Security Journal (SPCSJ) 2(2):5-9
Scientific Cyber Security Association (SCSA), 2018 ISSN: 2587-4667

DECISION MAKING SUPPORT FOR FORMATION OF COMPLEX SECURITY INFORMATION PROGRAMS. THE DISTRIBUTION OF RESOURCES

Serhii Zybin
State University of Telecommunications, Kiev, Ukraine

ABSTRACT

This article, written for analysis of a support decision-making approach. This approach can be used for the formation of complex information security programs, taking into account the threats and risks. This approach is based on the introduction of models and risks in the hierarchy of objective tasks and the goal evaluation of the tasks. Under the threat, we understand a condition of the environment, impacts the efficiency of the task. Complex goal-oriented program is executed in this environment. Risk is defined as a result of a random event that is caused by the influence of external relative factors. The event is a situation arises that affects the execution program. Threat models and risks have been proposed. The risk model is a risk factor, which is a random process and has a special goal. The threat is simulated by a special program, which is entered in the hierarchy of goals.

The stages of decision support technology taking into account threats and risks are developed and presented. These stages are based on the method of goal-oriented dynamic estimation for the complex program to ensure information security. The problem of programs (tasks) relative effectiveness that set by a multitude of threats and risks is solved. The task of using counteraction means to threats and risks is solved.

This article is the continuation of the articles [1, 2] and is devoted to the distribution of resources.

KEYWORDS: security program, decision making, protection system, DSS, decision support system, evaluation, simulating, judgement.

Improving the quality and reducing the time of decision-making when managing complex technical and information systems is not possible at present without informational and analytical support. Means of intellectualization of decision-making processes are the most important and practically necessary in the field of information security and information technologies.

Development and maintenance of complex systems found problems that can be solved only on the basis of a comprehensive assessment and accounting of different nature factors heterogeneous connections, environmental conditions and other factors. So increasingly important in modern conditions is a question of quality and efficient decision-making.

Problem solving of the information security can be obtained with the use of decision support systems. Decision-making is a compulsory step in any purposeful activities. Thus in the conditions of limited resources of all kinds, and increase of activities is continuously increasing difficulty decisions that are made, and the requirements for their efficiency.

The complex program to ensure information security is a set of activities united by unity of global goals and shared resources [3, 4]. The main objectives of the complex program to ensure information security development is a selection of programs to be included in the complex program and the resource distribution between programs. This complex program to ensure information security usually can be scheduled for long intervals of time, so we need to evaluate the effectiveness of programs in a given time interval.

It is necessary to take into account the possibility of threats and risks during developing the complex program to ensure information security. Analyze their impact and on this basis provide for measures to counter them or eliminate them.

We need to solve the following problems in the formation of the complex program to ensure information security considering the threats and risks:

- we need to determine the quantitative characteristics influence of threats and risks to the effectiveness of the complex program to ensure information security;
- we need to identify quantitative rates of the performance program considering threats and risks;
- we need to divide resources between counter means of threats and risks, and programs with goal to increase information security.

Known methods for solving the first problem include the identification of risks. This is a qualitative analysis. Moreover, provide the probability estimation and the size of the possible damage. This is a quantitative analysis [5, 6]. However, the problem of estimation program effectiveness into account of risk cannot be solved and remains at the discretion of the expert. Moreover, the definition of damage in absolute terms is often impossible for the complex program to ensure information security. The [1] article is devoted by this issue.

The [2] article is devoted to complex program to ensure information security, taking into account the threats and risks. The method is a modification of a method for the goal-oriented dynamic estimation of programs and tasks on a time interval.

This article is the continuation of the articles [1, 2] and is devoted to the distribution of resources.

The goal consists in developing of the support decision-making approach for the formation of complex information security programs, taking into account the threats and risks. Moreover, we should work out mathematical threat models and risks, efficiency estimate approach, and approach for the distribution of resources.

The problem solving method of evaluating the relative effectiveness considering threats and risks kindly develop based on the methods to solve this problem without taking into account these factors. The most common methods today got a multicriteria evaluation of programs [7]. The area of their application delimited by two conditions that must be satisfied by a specific task.

The first condition is the existence of multiple criteria, each of which can estimate a separate alternative.

The second condition is the ability of decision maker to evaluate in some way each alternative on separate criterion.

The first condition in the majority cases for the formation of complex programs do not performs because there are significant differences in the nature of the programs included in complex program. The second condition is very problematic, since the selection of the optimal alternative or ranking of a large number of variants requires taking into account of estimates for a large number of related criteria. This situation occurs when making decisions for the formation complex programs.

Therefore, methods of decision support during the formation information security programs considering threats and risks can be developed by modification of the evaluation variants goal-oriented methods [3, 4, 7]. The relative effectiveness of the programs should be evaluated as a time function, given at the planning interval [5]. Therefore, the possibility of taking into account the time factor in the evaluation of programs is fundamental for decision-making support tasks.

The task of resource distribution is to determine the set of optimal resources, which maximize the degree of the goal achievement. An algorithm of resource distribution between threats and risks and programs aimed at increasing information security [8] is proposed. The task of resources distribution can be formulated as follows.

There is a set of information security tasks: $T = \{T_i\}, i = (\overline{1,m})$.

For each task, there is the degree of execution function, depending on the value of the resource $f(R_i / R_i^*), i = (\overline{1,m})$,

where R_i^* is required quantity of resources;

$\overline{R} = \{R_i\}$ is option set (quantity) of available resources.

The calculation of efficiency corresponds to the vector $\overline{R}$. $E(\overline{R}) = E(\overline{F})$, where $\overline{F}$ is vector of the goal achievement degree.

It is necessary to find a vector R_x in which $E(R_x) \to \max$, when $\sum_{i=1}^{m} R_i \le R_{\max}$ is limited, where $R_{\max}$ is the resource quantity of the task [9].

We use optimization methods to solve the problem of resource distribution under the analytic function $E(\overline{R})$. In this case, resource efficiency is $E(\overline{R}) = \sum_{i=1}^{m} E(R_i)$. It is necessary to find such a vector R_x in which $E(R_x) \to \max$, when $\sum_{i=1}^{m} R_i \le R_{\max}$ is limited. This task is an optimization problem with a linear target function, that is, the problem of linear programming. The universal method of solving linear programming tasks is a simplex method. It allows you to solve linear programming problems with any number of variables and with any set limits.

The process of applying the simplex method can be divided into three main stages:

1) The preparatory stage. The problem should be converted from the linear programming to the canonical type with the best constraints.

2) The computational stage. We need to construct sequential simplex tables.

3) The final stage. We need to write the optimal values of the variables and the optimal values of the target function.

In the absence of an algorithmic problem solution $E(\overline{R})$, the solution of the problem is unknown, but to solve the problem, you can use genetic algorithms. For this purpose, it is necessary to calculate the efficiency at each point of the function. The obtained results are characterized by probability and require significant time expenditures that can be attributed to disadvantages.

We formulate goals and setting the tasks for the development of an algorithm for the threshold function of the execution degree with a linear hierarchy of goals [10].

The following primary data is specified.

In order to provide an adequate description of the tasks of efficient resource distribution, it is advisable to take into account changes in the availability of resources and threats over time.

There is a set of tasks to ensure information security $T(t)=\{T_i(t)\}, i=(\overline{1,m})$.

For each task there is a function of the degree implementation, depending on the size of the resource $f(R_i(t)/R_i^*(t)), i=(\overline{1,m})$, where $R_i^*(t)$ is the required number of resources at the time, $\overline{R(t)}=\{R_i(t)\}$ is the variant of the plurality (quantity) of available resources.

The set of thresholds $S(t)=\{S_i(t)\}, i=(\overline{1,m})$ for the function *f* is set.

The efficiency of using resources equals $E(\overline{R(t)})=\sum_{i=1}^{m}E(R_i(t))$.

We need to find a vector $R_x(t)$, at which $E(R_x(t))\to \max$, when $\sum_{i=1}^{m}R_i(t)\le R_{\max}$ $\forall i:1\le i\le m$ is limited, an equation $f(R_i(t)/R_i^*(t))\ge T_i$ must be executed, where $R_{\max}$ is the number of resources of the task.

We create the restrictions $\forall i:1\le i\le m\ \exists\ f(R_i(t)/R_i^*(t))\ge S_i$ in the form $\forall i:1\le i\le m\ \exists$ $R_i(t)\ge S_i^*(t)$.

It is necessary to find $R_x=\{R_i\}, i=(\overline{1,m})$, such at which $f(R_1(t)/R_1^*(t))+f(R_2(t)/R_2^*(t))+...+f(R_m(t)/R_m^*(t))\to \max$, when $\sum_{i=1}^{m}R_i(t)\le R_{\max}$ $\forall i:1\le i\le m$ is limited, the equation $R_i^*(t)\ge R_i(t)\ge S_i^*(t)$ must be satisfied.

Step 1.

We insert the set of resources ratings $W=\{W_i\}, i=(\overline{1,m})$.

Then, the problem will look like the following view $f(R_1(t)/R_1^*(t))W_1+f(R_2(t)/R_2^*(t))W_2+...+f(R_m(t)/R_m^*(t))W_m\to \max$, with the limitation $\sum_{i=1}^{m}R_i(t)\le R_{\max}$ $\forall i:1\le i\le m$, and the equation $R_i^*(t)\ge R_i(t)\ge 0$ must be satisfied.

Step 2.

We get $\overline{R(t)}=\{R_x(t)\}$, at which $E(R_x(t))\to \max$.

Step 3.

We check the execution condition $R_i^*(t) \geq R_i(t) \geq S_i^*(t) \quad \forall i: 1 \leq i \leq m$ for all $\overline{R(t)}$ items. If the condition $\exists k: R_k < S_k^*$ is fulfilled, then *k*-th task is eliminated from the set of tasks and go to the step 4. If such elements are not found, then go to the step 5.

Step 4.

We will get a set of tasks $T_N = T / T_3$, where T_3 is the set of tasks that were received in the third step and which do not satisfy the constraints. After that, the transition to step 1 occurs.

Step 5. The end of the algorithm.

We get a vector S_x, as a result of the algorithm.

When the hierarchy has feedback, then the form of the efficiency function is nonlinear.

Conclusions

The task of resource distribution is to determine the set of optimal resources, which maximize the degree of the goal achievement. An algorithm of resource distribution between threats and risks and programs aimed at increasing information security is proposed.

The algorithm of resource distribution is proposed, when the function of the project execution stage is a threshold function. In this case, the hierarchy of goals is linear.

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