SIMPLIFIED CBA CONCEPT AND EXPRESS CHOICE METHOD FOR INTEGRATED NETWORK MANAGEMENT SYSTEM

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ABSTRACT

The process of choosing and integrating a network management system (NMS) to an existing computer network became a big question due to the complexity of used technologies and the variety of NMS options. Most of computer networks are being developed according to their internal rules in cloud environments. The use of NMS requires not only infrastructural changes, consequently increasing the cost of integration and maintenance, but also increases the risk of potential failures. In this paper, conception and method of express choice to implement and integrate a network management system are presented. Review of basic methods of cost analysis for IT systems is presented. The simplified conception of cost benefits analysis (CBA) is utilized as a basis of the offered method. A final estimation is based on three groups of parameters: parameters of expected integration risk evaluation, expected effect and level of completed management tasks. The explanation of the method is provided via example.

KEYWORDS

Network Management; NMS; CBA; Integrated System; Cost Analysis; Efficiency Criterion

1. INTRODUCTION

It is early or late, but for any complexity computer network the updating process begins. This process changes not only the hardware of computer network but also its infrastructure. The software structure is changed, and functionality properties are changed too. This problem is described very nice in [1, 4]. The responsibility on these actions is an administrator. He makes the update operations according to the pre-determined network management concept. The basic principals of those concepts are considered in [1, 2]. The simplest schema of this concept according to [1] is FCAPS (Fault, Configuration, Accounting, Performance, and Security). The more complex schema is Microsoft Framework MOF 4.0 [3]. For the considered task we can use the simplest schema FCAPS and choose the Configuration Management functions. According to MS MOF 4.0 and Management functions (SMF) we can choose "Change and Configuration SMF". In the MS MOF 4.0 for C&C SMF we find a good description of the updating process for the change procedure and the descriptions of the correspondence responsibilities roles. The choose procedure for the alternative software elements is an administrator's decision.

For the existence computer network infrastructure any changes leads to changes of the computer network state. These changes carried out the “positive” (A) and “negative” (B) effects. As a result, for each $Soft_i$ (Software updates) there are unique evaluations (A, B). The figure 1 shows that the administrator has to chose the best optimal solution.

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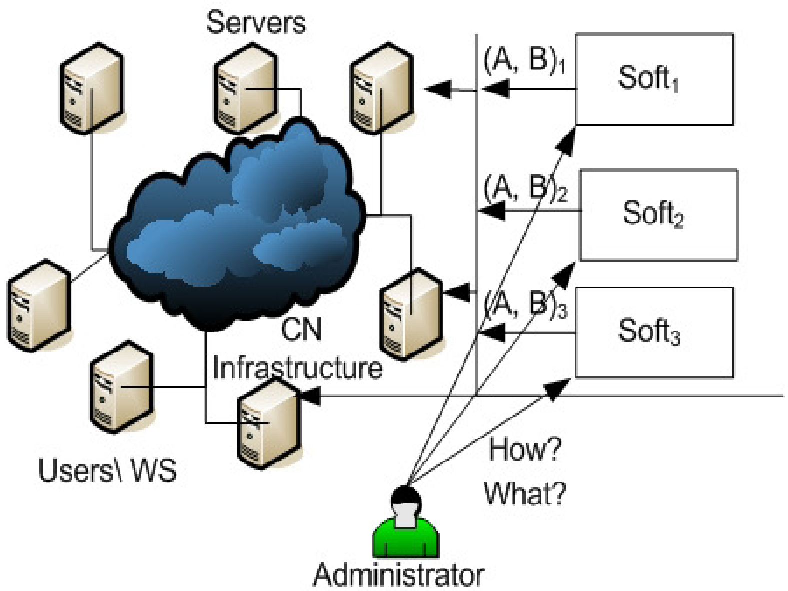

Figure 1. Choice solution for integrated software

And he has two main questions “How?” and “What?”. The question “How?” means the evaluation method for (A, B). The methodology questions of that task is considered in [5]. The question “What?” means the rules and criteria to chose the concrete system from the existence set. This choice is dependent on the type of software updating service or apps $Soft_i$.

Let’s consider the task when $Soft_i$= NMS (Network Management System). It means that the existence NMS should be changed or a new NMS should be implemented. The usage of management tools becomes actual, and it improves network administration, automated storage operations and management information analysis. The example of this tool is Network Management System (NMS) [1, 2]. The complexity of the managed system increases the complexity of the management system.

In this situation, infrastructural changes will not only increase the cost of integration and maintenance, but will also increase the risk of potential failures. Integration of the NMS may sometimes reduce the efficiency of the whole system as well.

Based on the above, the problem of estimating the efficiency of integrating the new network management system into an existing infrastructure of information space is actual. In view of certain situations, the decisions about the integration of a special system often must be taken rapidly. It depends on the real financial condition of the company. These solutions could be considered as an independent IT e-space [13] or within separate functions of network management frameworks. Such frameworks are financial management MOF SMF [3] or ITIL [16]. They are parts of the general complex concept of the functions and areas of network management frameworks.

As a result, the considered task is presented as Figure 2.

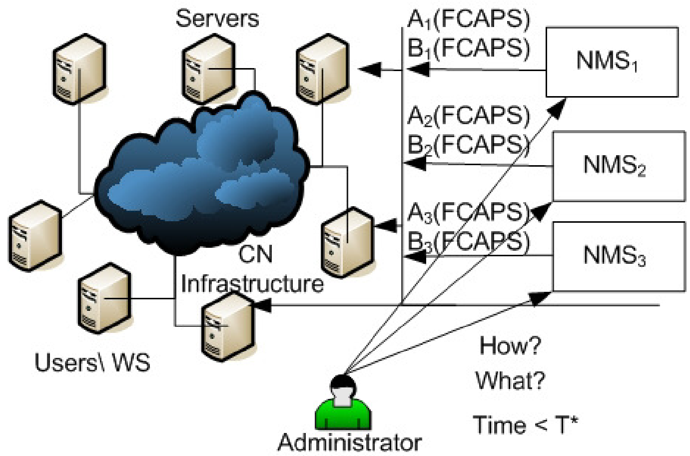

Figure 2 .Choice solution for integrated network management system

The questions “How?” and “What?” are remained open, but the choice of NMS could be done according to FCAPS demands. It means that the evaluation of “positive” and “negative” effects could be considered according to FCAPS concepts: A(FCAPS), B(FCAPS). The answers on the questions “How?” and “What?” are bound with the evaluation procedures of A(FCAPS), B(FCAPS). They belong to the area of efficiency and cost analysis for the implemented systems $Soft_i$. Additionally, there is the time restriction to make optimal decision (Time < T*).

In such cases, the availability of methods that allow justifying such a decision is actual.

Such methods and techniques are Total Cost of Ownership (TCO) [7], Total Benefits of Ownership (TBO) [8] and Return On Investment (ROI) [9]. These techniques were successfully used in assessing the effectiveness of new information systems implementations, for example, Cloud system [11] and Data Center.

Of course, these are good techniques, but they have one big disadvantage. Actually, they are the ultimate economic methodologies that require qualified experts, high research level and time expenses. Most of the techniques are based on three main approaches: estimation of costs associated with the implemented systems, estimation of implementation risk, and estimation of benefits.

Here are the examples of some popular techniques that can help estimate the impact of the new IT solution integration for complex information systems. For example, TCO [7] allows us to estimate the total costs, TBO [8] helps evaluate the benefits of such integration, IT IR (IT Integration Risk) [12] allows analysing and evaluating the risk, ROI (ROI) [9] allows evaluating the efficiency of an investment. In [19] proposed the several dimensions of complexity that have to be considered during the building of cost management model (CM), and found that, the reliability of the model is depending on the degree of complexity.

Out of all described concepts, two of them are the most widely used; namely TCO and TBO. Both concepts are based on the determination of the purchase price of an asset plus the costs of operation, but they possess opposite ideas under the hood. The TCO shows how the costs will increase after integration of a new system, whereas the TBO points to the benefits of the integration with the same system. The Cost-Benefit Analysis belongs to the ratio approach to decision-making processes [18].

Another popular concept is Cost benefit Analysis (CBA) [6, 7]. It uses two components; one of them considers the cost of integrated information technology and the problems that rise after the main system configuration change (e.g., additional cost and effort associated with the restructuring of the management, the staff adaptation period and so on.). The second one considers the advantages that we get after the system integration. It appears that the CBA is a more advanced approach for these tasks.

The article consists of the review part, formulation of the problem, description of the concept, description of the parameters, proposed method of analysis and examples.

2. EVALUATION CONCEPT

2.1. PROBLEM FORMULATION AND DESCRIPTION OF THE STUDIED OBJECT

2.1.1. THE AIM

The aim of the article is to identify the ways of express (simplified) selection of Network Management Systems implementation and their integration.

2.1.2. THE RESEARCH OBJECT

Assume that some company has deployed a computer network. There is a need for additional integration of specialized network management system. The question of the implementation or integration of complex (expensive) software is considered. At the same time, there are alternative ways to purchase one of several types of such software systems. Suppose there is an IT-department in the company. It is responsible for the network administration. The head of department should take the decision about integration in limited time.

2.1.3. PROBLEM FORMULATION

It is necessary to have a method (technique) that allows making the decision of the NMS systems selection from available alternatives. This method should be relatively easy to use. It should not demand additional specialist involvement from other departments or companies. The number of method parameters should be small, the criteria should take into account the level of solving the basic problems; the results of the analysis should be understandable for managers and the network administrator.

The basic approach of the problem solving is assessing the benefits of new system integration, estimating the level of existing problems, and resolving and assessing the possible problems arising from the new software (system) exploitation.

2.2. COMMON CONCEPT OF EVALUATION

Let us have three groups of criteria. The first group describes the level of probable risk ($E_r(NMS)$). It means that we highlight the most significant problems on administrator's mind. These problems could appear in the network after new system integration.

The second group covers the effectiveness of the network maintenance ($E_e(NMS)$). We suppose that after integration of the NMS, the general effectiveness is going to increase. In general the effectiveness is characterized as, $D_0 = E_1 / E_0$, $(E_1, E_0) \in [0,1]$, where E_1, E_0 are the current and basic variables. In this case, we use “time” and “money” as the main characteristics. This is a complex problem for direct values estimation, so we should use the indirect characteristics such as the maintenance of the network. We assume that if we improve the maintenance of the network, the main characteristics will be improved as well. The maintenance and efficiency will be considered for the independent management areas. There are several concepts of representation of management areas [1, 6]. In accordance with the concept based on the OSI RM (ISO) the management is divided into 5 areas or 5 basic management functions - FCAPS (Configuration, Performance, Fault, Accounting, and Security) [1, 2]. It should be noticed that the proposed division of Microsoft SMF MOF 4.0 suggests 18 functions [3]. In addition, there is also a TMN (ITU-T) [1, 2] classification.

The third group evaluates the completion level of the general solutions on the system integration ($E_f(NMS)$). It is possible that the integrated system will not solve all of the management problems completely, and after the purchase of the system, we will have to buy another one (This is an incomplete solution).

So that, instead of abstract "positive" (A) and "negative" (B) variables, we can evaluate the effectiveness levels, completion and probable risk. The task is as evaluation of values for *(Ee, Er, Ef)*.

The Figure 3 shows that the task became clear for administrator. Instead of the question "How?" he can use the evaluation procedures for each considered NMS.

Instead of the question "What?" he can use the analysis procedure and the set of criteria. All solutions will be conformed to FCAPS and MS MOF 4.0 (C&C SMF). All previous demands will be in force.

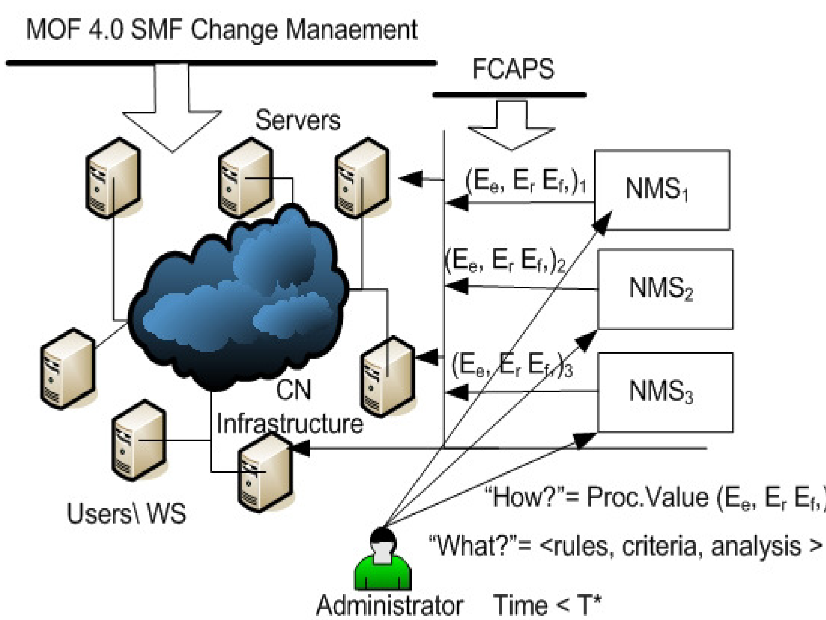

Figure 3. Choice concept for integrated network management system

The concept of a NMS comparison may be represented in the form of five stages:

1. Evaluation of the level of probable risk for the integrated system.
2. Evaluation of the benefits after system integration in the network maintenance.

3. Estimation of completion level after system integration.
4. Evaluation of the generalized criterion of selection expediency of the system to be integrated.
5. Estimation scale formation for comparative variables.

The generalized criterion should be an integrated variable. Estimation scale formation for comparative variables means that for all variables we should have a single scale. It should be with relative values on the interval [0, 2] with the control fixed points {0, 1, and 2} = {<bad>, <OK>, <good>}.

This approach allows getting the normalization and standardization of all variable values and makes them uniform.

3. EVALUATION CRITERIA

3.1. CRITERIA OF THE LEVEL OF PROBABLE RISK

Let us introduce four types of criteria for this group: load ($Load$), complexity of the administration (Adm), network security (Sec) and cost of ownership for the system (Cst).

"Load" means the approximate amount of traffic that is generated by the new system throughout on network. Actually, it is an evaluation of the additional network load, created by the service management traffic. It is determined as the total generalized estimate, based on the average load at the workstation $Load(WS)$, the average load at the segment $Load(Seg)$ and the average load at the server $Load(Ser)$.

$$\begin{cases} Load(WS) = \frac{1}{N_w}\sum_{i=1}^{Nw} Load(WS_i) \\ Load(Sg) = \frac{1}{N_g}\sum_{i=1}^{Ng} Load(Sg_i) \\ Load(Sr) = \frac{1}{N_s}\sum_{i=1}^{Ns} Load(Sr_i) \end{cases} \quad (1)$$

Where Nw, Ng, Ns are the number of workstations, segments, and servers, respectively.

$$\{Load(WS), Load(Sg),\ Load(Sr)\} \in \{(< low >, < medium >, < high >)\} = \{0,1,2\}, \quad (2)$$

$$Load(Net) = l_1 Load(WS) + l_2 Load(Sg) + l_3 Load(Sr), \quad (3)$$

with the criterion $Load(Net) \rightarrow \min$,

$l_1 + l_2 + l_3 = 1$, hence assuming same values of coefficients $l_1 = l_2 = l_3 = 1/3$ «Complexity of the administration» (Adm),is an expert estimation.

$$Adm \in \{< low >, < medium >, < high >\} = \{0,1,2\}, \quad (4)$$

with the criterion $Adm \rightarrow \min$.

The point is as follows. The integration increases the administration process and could increase the complexity of the base network and its infrastructure.

«Network security» (Sec) means that using another’s NMS reduces the security level. This is an expert estimation

$$Sec \in \{<low>,<medium>,<high>\} = \{2,1,0\}, \quad (5)$$

with the criterion $Sec \to \min$.

«Cost of ownership» is complexity estimation. It consists of three estimations: cost of purchase ($Cst(In)$), cost of deployment ($Cst(Use)$), and cost on supporting ($Cst(Sup)$).

Each of criterions $Cst(In)$, $Cst(Use)$, and $Cst(Sup)$ will be estimated by an expert.

$Cst(p) \in \{<low>,<medium>,<high>\} = \{0,1,2\}$, where $p \in \{<In>,<Use>,<Sup>\}$.

There are three types of estimation: 1) each criterion $Cst(p)$ is considered separately, 2) only one criterion is used, and 3) the average value of all criterions is used.

The type of estimation is given by parameter c_i .

$$Cst(Net) = c_1Cst(In) + c_2Cst(Use) + c_3Cst(Sup), \quad (6)$$

where $c_1 + c_2 + c_3 = 1$, hence assuming $c_1 = c_2 = c_3 = 1/3$. To exclude type of estimation, use $c_i = 0$. The criterion $Cst(Net) \to \min$.

Any system could be estimated by usage of the "*C*ost of ownership".

$$E_r(NMS) = r_1Load(Net) + r_2Adm(Net) + r_3Sec(Net) + r_4Cst(Net), \quad (7)$$

with the criterion $E_r(NMS) \to \min$,

$r_1 + r_2 + r_3 + r_4 = 1$, hence assuming $r_1 = r_2 = r_3 = r_4 = 1/4$.

3.2. GENERALIZED CRITERIA FOR THE EFFECTIVENESS

According to five Management areas (FCASP), it is recommended to use five criterions: performance (Pe), configuration (Ce), Fault tolerance (Fe), security (Se) and accounting (Ae).

In this group, "Performance" means the state of data performance (real throughput) in case of the integrated system usage. It is expected that the value of performance criterion will increase after the integration. This is an expert estimation.

$$Pe \in \{<not\ \text{changed}>,<changed>,<very\ high>\} = \{0,1,2\}, \quad (8)$$

with the criterion $Pe \to \max$.

"Configuration" means the fact of presence of Management configuration. Configuration is an expert estimation. The configuration management is optional. In case of presence, it could have different levels of depth and complexity, for example, logical and functional management configuration. In this case, it is "multiple".

$$Ce \in \{<no>,<\text{partially}>,<multiple>\} = \{0,1,2\}, \quad (9)$$

with the criterion $Ce \to \max$.

“Fault tolerance” means the improvement in the detection, prediction and prevention of possible failures elimination. It could be estimated by Minimum Time before Repairing (MTBR) or by reducing the number of faults. It is recommended to use an expert estimation.

$$Fe \in \{< no \text{ improving} >, < partially >, < very\ good >\} = \{0,1,2\}, \quad (10)$$

with the criterion $Fe \to \max$.

“Security” means that the integration of a new system will increase the security level. This is an expert estimation.

$$Se \in \{< no >, < partially >, < very \text{ good} >\} = \{0,1,2\}, \quad (11)$$

with the criterion $Se \to \max$.

“Accounting” means the possibility to maintain user access control and release control of personal QoS. This is an expert estimation

$$Ae \in \{< no >, < partially >, < very\ good >\} = \{0,1,2\}, \quad (12)$$

with the criterion $Ae \to \max$.

To sum up, we get estimation of generalized effectiveness criteria.

$$E_e(NMS) = e_1 Pe(Net) + e_2 Ce(Net) + e_3 Fe(Net) + e_4 Se(Net) + e_5 Ae(Net), \quad (13)$$

with the criterion $E_e(NMS) \to \max$.

$e_1 + e_2 + e_3 + e_4 + e_5 = 1$, hence assuming same values of coefficients i.e. $e_1 = e_2 = e_3 = e_4 = e_5 = 1/5$.

3.3. Completion Level Criteria

In general, this group can be represented by a list that does not coincide with the previous group; it will be more suitable when the lists are the same.

“Performance” is a number of criterions that characterize the problems, which are being resolved, and their level of completeness. Use the estimation

$$P_f \in \{< no >, < partially >, < yes >\} = \{0,1,2\}, \quad (14)$$

with the criterion $P_f \to \max$.

“Configuration” means the fact of solving the task of configuration management in the network

$$C_f \in \{< no >, < partially >, < all >\} = \{0,1,2\}, \quad (15)$$

with the criterion $C_f \to \max$.

"Fault tolerance" means the fact of solving the task of fault management in the network. Use the estimation

$$F_f \in \{<no>, <partially>, <all>\} = \{0,1,2\}, \tag{16}$$

with the criterion $F_f \to \max$.

"Security" *means* the fact of solving the task of security management in the network. Use the estimation

$$S_f \in \{<no>, <partially>, <all>\} = \{0,1,2\} \tag{17}$$

with the criterion $S_f \to \max$.

"Accounting" means the fact of solving the task of accounting management in the network. Use the estimation

$$A_f \in \{<no>, <partially>, <all>\} = \{0,1,2\} \tag{18}$$

with the criterion $A_f \to \max$.

To sum up, we get a generalized criterion that shows the level of problem solving completion.

$$E_f(NMS) = a_1 P_f(Net) + a_2 C_f(Net) + a_3 F_f(Net) + +a_4 S_f(Net) + a_5 A_f(Net) \tag{19}$$

$a_1 + a_2 + a_3 + a_4 + a_5 = 1$, hence assuming same values of coefficients i.e.
$a_1 = a_2 = a_3 = a_4 = a_5 = 1/5$.

3.4. Generalized Criterion

This final generalized criterion is estimated as the ratio of sums of efficiencies ($\mathrm{E_f(NMS)} + \mathrm{E_e(NMS)}$) to the criterion of expected risk $\mathrm{E_r(NMS)}$. Since the value of criterion $\mathrm{E_r(NMS)}$ could be equal to 0, use a biased estimate $(1 + \mathrm{E_r(NMS)})$. The final equation will be

$$Q(NMS) = (E_e(NMS) + E_f(NMS))/(1 + E_r(NMS)) \tag{20}$$

with the criterion $Q(NMS) \to \max$.

This final equation takes into account all criterions and allows to compare all decisions.

As a result, we have a convolution of the evaluations as it shown on Figure 4.

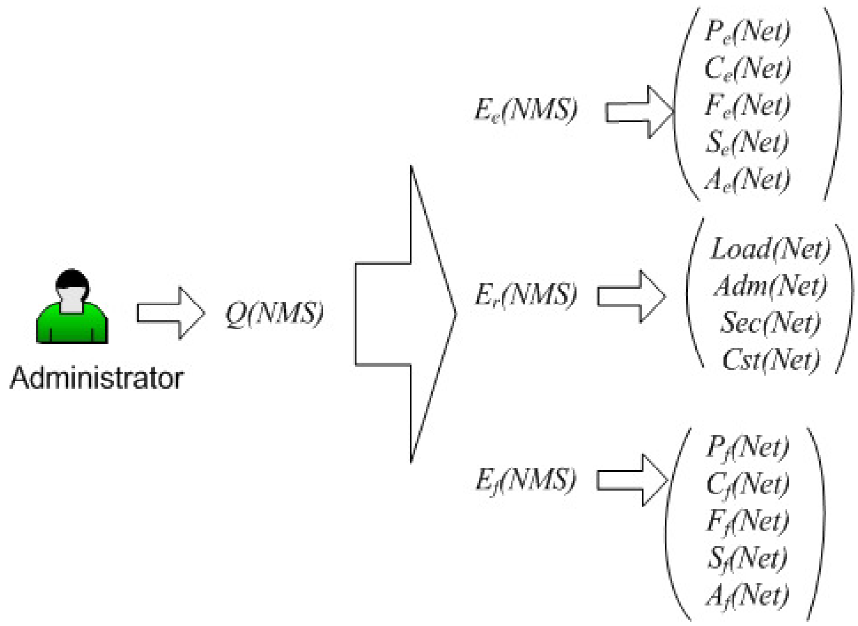

Figure 4. Convolution of the evaluations.

4. EVALUATION METHOD

The final method of estimation consists of six steps.

1. General analysis of all considered existing systems.
2. Evaluation of the level of probable risk for the integrated system. This step should cover the following points: the evaluation of the additional network load created by service traffic (1), (2), (3), the probable increase of complexity of administering process (4), the probable decrease of security level (5), cost evaluation depends on integrated system such as: cost of purchase ($Cst(In)$), cost of deployment ($Cst(Use)$), cost on supporting ($Cst(Sup)$) (6) and general estimation of probable risk $E_r(NMS)$ (7).

Figure 5 illustrates the flowchart for the method of “Evaluation of the probable risk level”.

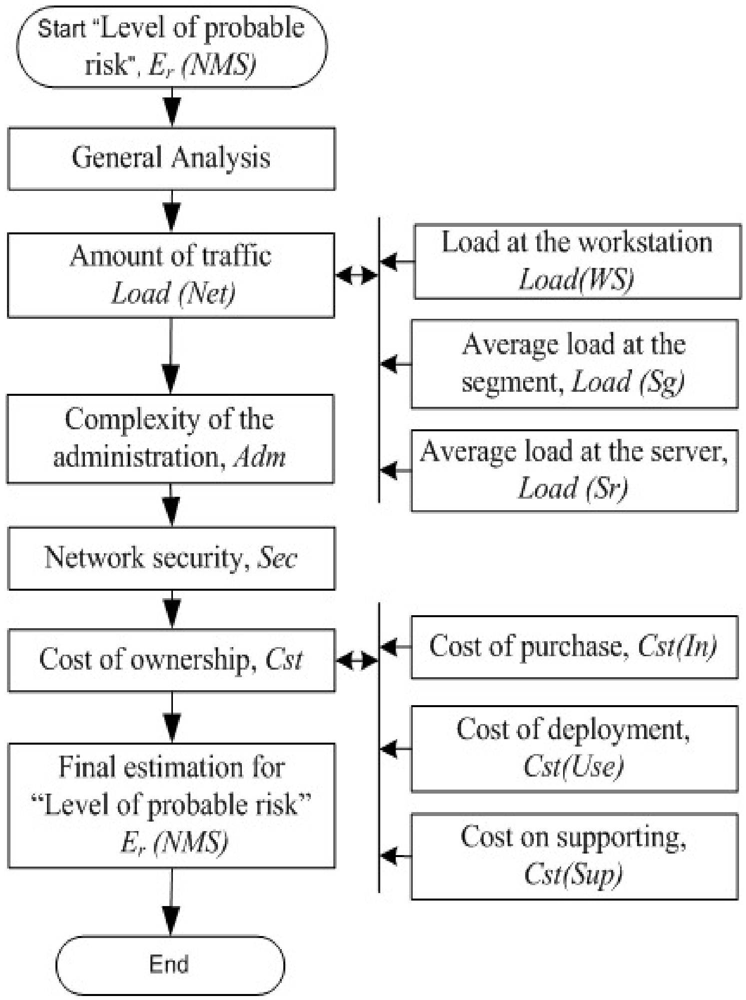

Figure 5. Flowchart for the method of "Evaluation of the probable risk level"

3. Evaluation of the benefits after integrating the system in maintaining the network. This step should cover the following points: the evaluation of the probable improving of performance (8), configuration management (9), network in general (10), security level (11), accounting for users (12) and evaluating the total value of expected efficiency $E_e(NMS)$ (13).

Figure 6 illustrates the flow charts for the method of "Evaluation of the benefits" (a) and "Evaluation of the completion level" (b).

4. Evaluation of the completion level after system integration. This step should cover the following points: the evaluation of the supporting level for performance (14), for configuration management (15), for fault tolerance (16), for security management (17), for user accounting (18), and evaluation of the total value of expected completion level $E_f(NMS)$ (19).

5. Evaluation of the total criterion value $Q(NMS)$.

6. Processing of the final analysis and decision making on selection of the system to integrate (20).
Figure 6 (c) illustrates the flow charts for general method.

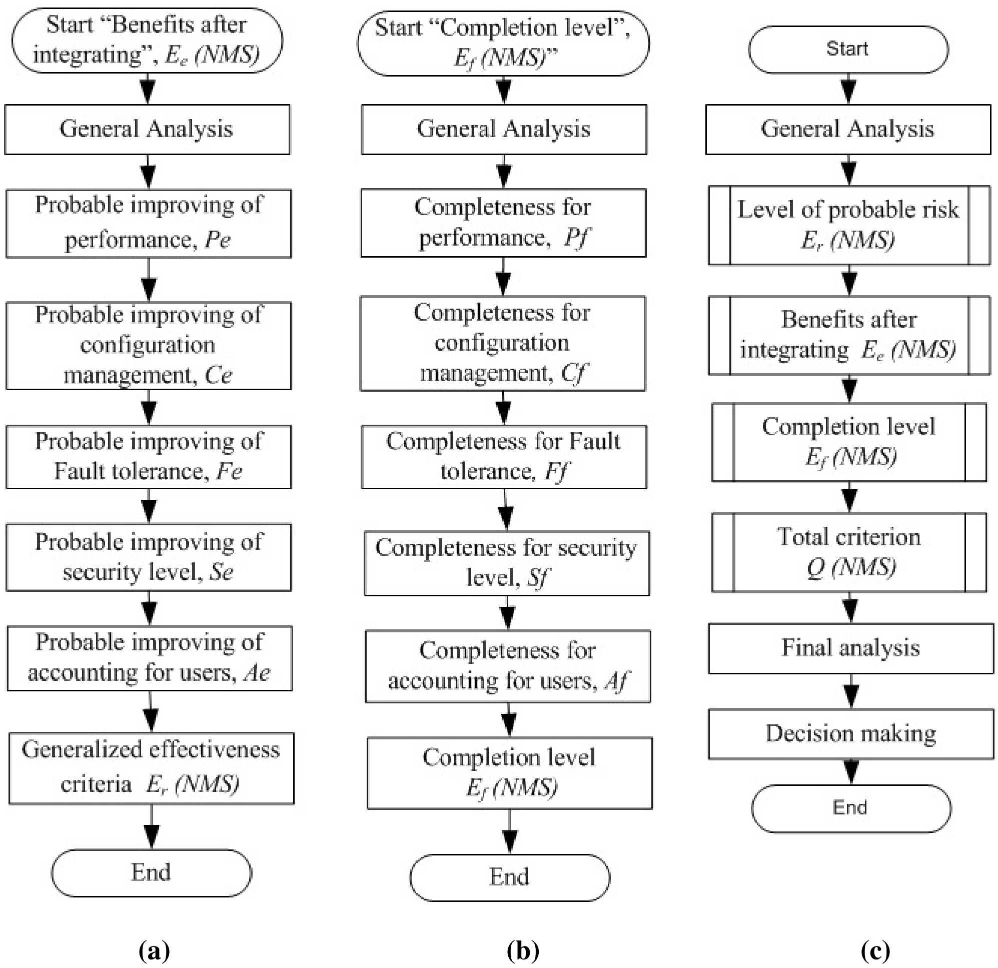

Figure 6. Flowchart for the sub-methods: (a) for "benefits after integrating", (b) for "completion level, (c) "the general method"

5. Analysis Of The Suggested Solutions

The backbone of the proposed method is based on the fact that this method and technique use expert assessment and express evaluation of the complex technical and cost criteria. They are oriented on the evaluation of total risk and benefits when there is a need of integration of a new information system to the existing infrastructure of a computer network.

The proposed method and the concept should be compared to CBA analysis [1, 2], or other methods of analysis, that are used for analysis of different information systems [10, 14, 15].
First of all, the proposed concept is a simplification of the existing one. There are three proposed groups of criteria. These are the main features of the proposed method. The assessment methodology is presented for each group of the criteria. In opposite to traditional methods [10, 7, 14, 15], it is proposed to use expert estimates. In this case, head of the IT department could make the evaluation process. There is no need to do detailed cost analysis. The proposed method is simple, flexible and allows performing the required analysis and justification in a short time. The number of criteria parameters in the method is small. The criteria take into account the basic

network management problems. The results of the analysis are clear for managers and the network administrator.

The proposed method is used for fast pre-assessment. TCO methods can be used as a supplement to make more extended evaluation. One more additional implementation of this approach is creating the different IT e-spaces [13]. This feature helps to manage infrastructure solutions.
The main features of the suggested solution are the following. Firstly, it offers a symbolic language that is understandable by all of office managers. This approach helps to form the development strategy of the computer network infrastructure, as well as to coordinate the strategy according to the company's financial plans and policy of financial management.

The common terms and categories for proposed conceptions are shown in Figure 7.

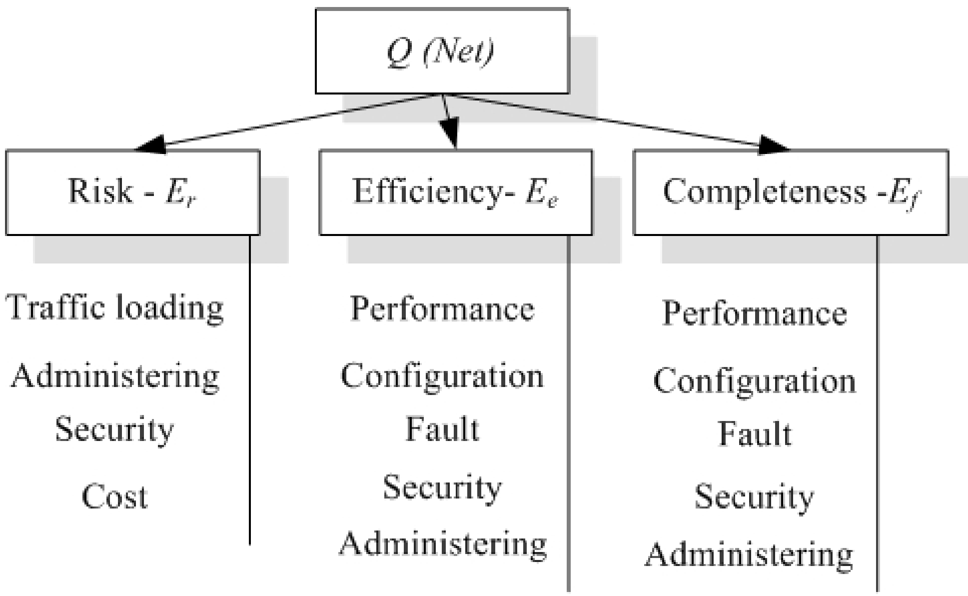

Figure 7. Schema of the methodology

Secondly, it offers a simple method of different solutions comparative assessment. This allows the network administrator to make a proper decision quickly for the required system selection. This situation is very typical in real life.

Thirdly, the proposed solution is focused on the integration of NMS, although it can be applied to the integration of any complex information system. In this case, however, it is necessary to review a set of criteria.

Why should we choose the estimation scale [0, 2] instead of [0.1]? This is the choice of the authors. We can affirm that values {0, 1, 2} are more suitable to interpret than fractional values. They are integer, but in general, it would be possible to use a scale [0, 1]. All of the arguments would stay in force.

For the final criterion, we should select a range [0, 4]. If we select a range [0, 2], we get the values close to 0.5. In this case, it is difficult to determine and interpret the difference between various values.
How do the changes of value for Er influence on the values of Q(NMS)? The diagram on the Figure 8 shows these with conditions *Er =(2, 1, 0)* and *Sum=Ee(NMS)+Ef(NMS)= (1, 2, 3, 4).*

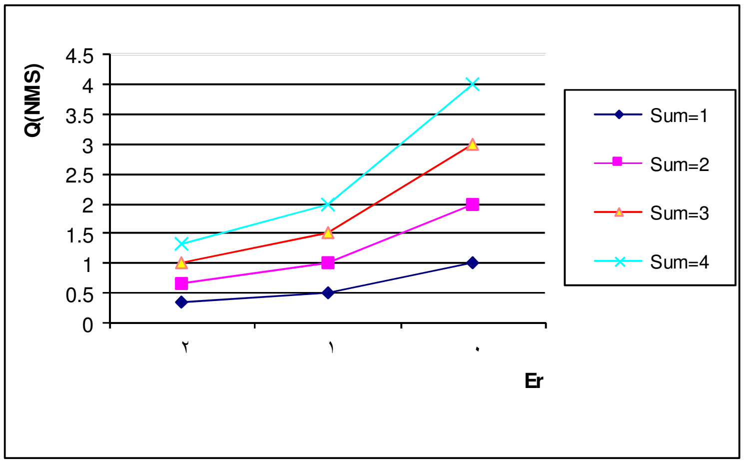

Figure 8. Diagram for *Q(NMS)* by changing *Er*

For the final evaluation we can chose the basic values as a classification of general estimation. These values are given in the Table 1.

Table 1. Basic values

Value	*Er+Ef*	*Er*	*Q (NMS)*
very bad.	0	2	0
bad	1	2	0,33
middle	2	1	1
good	3	1	1,5
best	4	0	4

The diagram on the Figure 9 shows the general estimation.

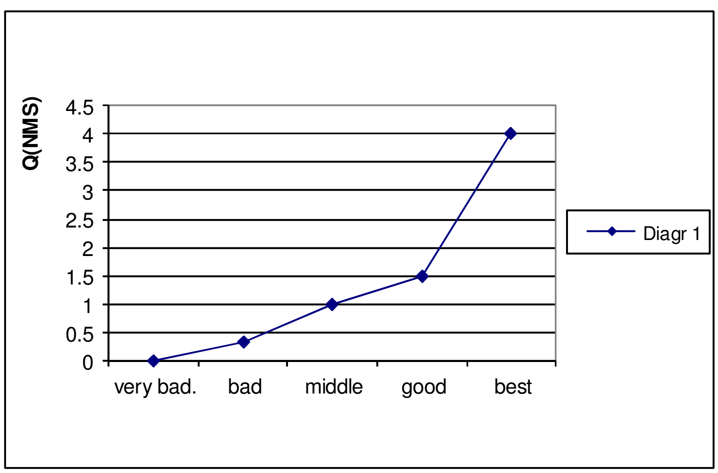

Figure 9. Diagram for general estimation *Q(NMS)*

Why does it put a limit on the number and type of criterions? The answer is that, all solutions are offered for specific systems, NMS.

6. EXAMPLES

6.1. USING THE CRITERIA OF LEVEL OF PROBABLE RISK

Suppose there are three systems: C1– a simple multifunctional system, C2– a multifunctional system, and C3– a full multifunctional system.

The first system does not make additional load on the network channels; $Load(Net) = 0\sum_{i=1}^{n} X_i^2$, does not change the existing network administration; process $Adm(Net) = 0$, does not change the existing level of security; $Sec(Net) = 0$ and has a low cost; $Cst(Net) = 0$. The total estimation is equal to $E_r(NMS) = 0$.

The second system is a different one. The load of service traffic is an average of $Load(Net) = 1$, the complexity of administration process is an average of $Adm(Net) = 1$, the level of security is an average of $Sec(Net) = 1$, and the cost is an average of $Cst(Net) = 1$. Therefore, the total estimation is equal to $E_r(NMS) = 1$.

Third system is a complex multifunctional system, perhaps like management platforms MS System Center or IBM Tivoli. This system has an additional impact on the existing network administration process and complicates it's $Load(Net) = 2$, $Adm(Net) = 2$. This can change the security level; $Sec(Net) = 2$, and has a high cost; $Cst(Net) = 2$. Thus, the final estimate of the expected risk is equal to $E_r(NMS) = 2$.

6.2. USING THE CRITERIA FOR THE EFFECTIVENESS

For the first system, we find that the benefits will not be significant and they will not change the performance, security faults or accounting criterion. Suppose that they are focused only on the collection and monitoring processes are related to the state of network configuration. Then, we have respectively:

For the first system,

$P_e = 0, C_e = 1, F_e = 0, S_e = 0, A_e = 0$ as total E_e(NMS)=0.2.,

For the second system,

$P_e = 0, C_e = 2, F_e = 1, S_e = 0, A_e = 1,$ E_e(NMS)=0.8.

For the third system,

$P_e = 1, C_e = 2, F_e = 1, S_e = 2, A_e = 2,$ E_e(NMS)=1.6.

6.3. USING THE CRITERIA OF THE COMPLETION LEVEL

The first system does not have high level of functionality, so the estimations will be:

$P_f = 0, C_f = 1, F_f = 01, S_f = 0, A_f = 0,$ E_f(NMS)=0.2 .

The second system can solve only some tasks for configuration and accounting management. Therefore, we have:

$P_f = 0, C_f = 1.3, F_f = 0, S_f = 0, A_f = 1$ as total E_f(NMS)=0.46. .

A third system can completely solve the problem of configuration management and other problems that have been solved in part. Therefore, we have

$P_f = 1, C_f = 2, F_f = 1, S_f = 1, A_f = 1$ as total E_f(NMS)=1.2. .

All results and the final estimation $Q(NMS)$ are shown in Table 2.

It can be seen that this technique does not allow directly specifying which system to choose, but it can help justify any choice.

Table 2. Comparative analysis

Name of Criterion	**Values for criterion**			**Goal**
	C1	**C2**	**C3**	
E_r(NMS)	0	1	2	Min=0
E_e(NMS)	0.2	0.8	1.6	Max=2
$E_f(NMS)$	0.2	0.46	1.2	Max=2
$Q(NMS)$	0.4	0.63	0.7	Max=4

If we choose the first system, we spend the least amount of money and make ourselves the least number of problems, but it solves a very small number of tasks. Often, it cannot give us the possibility of functional extensions. This is a good solution when the IT-Department is small.

If we choose the second system, we restrict ourselves to a partial solution of basic problems. This solution is good for common types of the administrative department: the risk is low and the problem is alleviated.

If we choose the third system, then deliberately and consciously we are switching to higher risks and costs, but the effect of the system integration will be much higher. This solution is good for the IT-administration department of a large corporation.

In real life, there are no such particular situations such as Systems 1, 2, and 3. The most values of criteria are very different, so in this case, the proposed method can be very useful.

The generalized criterion is effective for choosing an integrated system at the comparative analysis. It can be seen that the result is not very different in all three cases (Recall that for this method we have the border values Q = 4).

This means that in reality the overall efficiency dose not greatly increase because of the problems with integrating or implementing required systems and because of the incompleteness of final solutions.

7. DISCUSSION AND FUTURE WORK

The main advantage of the proposed method is the possibility of using it to make decisions at the real-time operational mode. It uses only the resources of experts. One question is valid – is there a risk of errors by experts? Yes, of course, the error is allowed, but the criteria are chosen in such way that the error be minimized.

It is expected to develop the proposed method to optimize the infrastructure of computer networks and extend these solutions for cloud systems.

8. CONCLUSION

The questions of express choice when integrating a new information system on the class of Network Management Systems was covered in this article. All solutions are valid for a complex computer network. A review of basic methods of IT systems cost analysis is discussed. The main results include the presentation of the concept and method of express assessment of new information system selection, which is going to be integrated to the existing one. The concept describes a general framework to solve the problem, the method and how to solve it. The results are scientific and novel.

General description of the scientific results can be presented in the following way. The simplified method for evaluation of the appropriateness of the selection algorithm, based on the expert express risk assessment of the system integration, was further developed. The level of the completion and success of the problem solution is accelerated as well. This method can help reduce the financial costs and decrease financial risk in integrating new systems.

The practical significance of the results is that they can be successfully used to solve problems of computer networks infrastructure management and in the assessment of different kinds of information system selection, not just the NMS ones. This reduces the investment risk and causes a reduction of financial costs in general.

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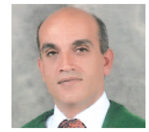

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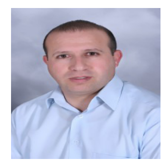

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