# Two-Dimensional Qualitative Asset Analysis Method based on Business Process-Oriented Asset Evaluation

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**Abstract:** In this paper, we dealt with substantial asset analysis methodology applied to two-dimensional asset classification and qualitative evaluation method according to the business process. Most of the existent risk analysis methodology and tools presented classification by asset type and physical evaluation by a quantitative method. We focused our research on qualitative evaluation with 2-dimensional asset classification. It converts from quantitative asset value with purchase cost, recovery and exchange cost, etc. to qualitative evaluation considering specific factors related to the business process. In the first phase, we classified the IT assets into tangible and intangible assets, including human and information data asset, and evaluated their value. Then, we converted the quantitative asset value to the qualitative asset value using a conversion standard table. In the second phase, we reclassified the assets using 2-dimensional classification factors reflecting the business process, and applied weight to the first evaluation results. This method is to consider the organization characteristics, IT asset structure scheme and business process. Therefore, we can evaluate the concrete and substantial asset value corresponding to the organization business process, even if they are the same asset type.

**Keywords:** Risk management, Risk Analysis, Asset analysis, 2-dimensional qualitative analysis

## 1. Introduction

As the use of information technology (IT), which includes network, Internet and communication, etc., has increased, the potential risk for an organization to incur IT-related losses has also increased. The risk is the potential that a given threat will exploit vulnerabilities to cause loss or damage to an information system asset or its group [2, 3, 5, 6]. In particular, as the importance of security for the information system is realized accordingly, the interest of vulnerability and risk analysis is augmented [10, 11, 14]. To manage risk effectively, there must be an analysis of the overall risks on an organization's information system. This is a risk analysis. It identifies and assesses the risks to which the information system structure and its assets are exposed, and identifies and selects appropriate and justified security safeguards against risks [4, 8, 9]. It consists of asset analysis, threat analysis, vulnerability analysis and safeguard analysis.

Asset analysis is the first process for all risk analyses. It identifies the boundaries of the information system to perform a risk analysis, along with the resources and information that constitute it and evaluate the asset value. An asset is anything with value and in need of protection that could be briefly described as "what must be protected." It is the most fundamental and important step in risk analysis because it is based on all processes in risk analysis [3,4,5,6,12,13].

Although all risk analysis experts know about it, most of them couldn't present a concrete and substantial asset analysis methodology until now. It is a subjective and abstract process, but essential to perform an asset analysis considering the organizational characteristics, business and environment for correct risk analysis results. In particular, asset evaluation is a significant step in the decision to make operational tradeoffs to increase asset protection [4,5]. We studied a 2-dimensional qualitative asset evaluation, which reflects the characteristics and importance of an organization's business process. Thus, we applied the weight related to the organization's business process, to the assets. The weight elements are such items as department utilization, business contribution, user class, etc.

In Section 2 of this paper, we describe the general concept of asset analysis and the asset analysis method in the existent risk analysis methodology; Section 3 provides a 2-dimensional qualitative asset classification and evaluation with a new formula. Finally, we conclude in Section 4.

## 2. Asset Analysis

### 2.1 What is asset analysis?

An asset analysis identifies all assets within a risk analysis boundary, classifies all assets into the same kind

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of asset and assesses value of each asset. An asset is a component or part of a total information system to which an organization directly assigns value, and hence for which the organization requires protection [7,9]. The goal of an asset analysis is to identify the most critical or high-priority components of the organization so that they can be examined for vulnerabilities [5, 7]. Asset analysis consists of 3 steps: identification, classification and evaluation [3, 4, 6, 8, 12, 13].

- Identification: identify a component or part of the organization and total system or network to which the organization directly assigns a value to represent the level of importance to the business or operation/ operational mission of the organization.
- Classification: classify the objective of the risk analysis with the organization's scale and business purpose and environment that is identified through the established asset boundary. There are classifications by asset item and business process.
- evaluation: evaluate the asset value. These values represent the importance of the assets to the business of the organization. Asset evaluation based on the business needs of an organization is a major factor in the determination of risks encompassed by risk analysis and management.

## 2.2 The existent asset analysis method

We observed an asset analysis method of the existent risk analysis tool and methodology in the 4 viewpoints; identification, classification, evaluation and evaluation level.

### *2.2.1 ISO TR-13335*

This researches techniques for the successful management of IT security, and can be used to assess security requirements and risks. It also helps to establish and maintain the appropriate security safeguards, i.e., the correct IT security level [1, 2, 3].

- Identification: Define the boundaries of review such as IT asset, people, environments and activities.
- Classification: Classify the boundaries of review into asset types such as information/data, hardware, software, communications equipment, firmware, documents, etc.
- Evaluation: Evaluate by the cost of obtaining and maintaining the asset, and the potential adverse business impacts from loss of confidentiality, integrity, availability.
- Evaluation level: negligible (0) – low (1) - medium (2) – high (3) - very high (4)

### *2.2.2 BS 7799*

This is research to specify requirements for establishing, implementing and documenting information security management systems [6].

- Identification: Identifying all the assets associated with the business environment, operations and information.
- Classification: Information assets, paper documents, software assets, physical assets, people, company image, reputation, and services.
- Evaluation: Assign values by the cost of obtaining and maintaining the asset and the potential adverse business.
- Evaluation level: 3 examples presented
  - a distinction between low, medium and high
  - in more detail: negligible – low – medium - high - very high
  - a qualitative level of 1 (low) to 10 (high)

### *2.2.3 OCTAVE*

This gives the organization a comprehensive, systematic, context-driven approach to managing information-security risks [7].

- Identification: Identify information-related assets that are important to meeting the mission and business objectives of the organization by the following key questions.
  - What are the organization's important assets?
  - Are there any other assets that the organization is required to protect?
  - What related assets are important?
  - Which assets are the most important?
  - Why?
- Classification: Produce updated documentation to reflect the state of the present computing and physical infrastructures, including information, systems, software, hardware, and people.
- Evaluation level: low – medium - high

### *2.2.4 CSE MG-3*

This expands on the standards stated in the Government Security Policy, provides specific guidance for risk assessment, and safeguards the selection process throughout the information technology system lifecycle [8].

- Identification: Identify assets by the system description and the statement of sensitivity, which defines the sensitivity of the information within the system and the importance of the supporting services of the system.
- Classification: Hardware, software, interfaces, personnel, supporting systems and utilities, and access control measures
- Evaluation: Evaluate based on its replacement cost, its intrinsic value and the consequences, impact or injury resulting from asset compromise.
- Evaluation level: negligible – low – medium - high - very high

# 3. Two-Dimensional Qualitative Asset Analysis

## 3.1 Asset Analysis Process

The asset analysis process presented in this paper is as follows.

① All the organization's IT assets: examine and establish the boundary of the information system for the objectives of risk analysis.

② Asset type classification: classify the asset by type.
③ 2-dimensional asset classification: classify assets into assets related to business process factors such as department importance, business contribution, user class.
④ Quantitative asset calculation: calculate the asset cost by purchase cost, replacement cost, recovery cost and labor cost, etc.
⑤ Qualitative asset evaluation: evaluate the qualitative value using the conversion table.
⑥ Asset priority list: create an asset priority list using qualitative asset evaluation, and consider the CEO's opinion, because it may require special safeguarding of any asset.

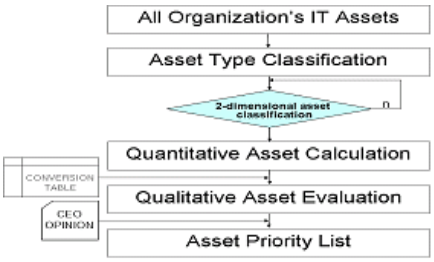


**Fig. 1.** Asset Analysis Process

### 3.2 Two-dimensional Asset Classification Method

Generally, the organization's information system structure is as following;

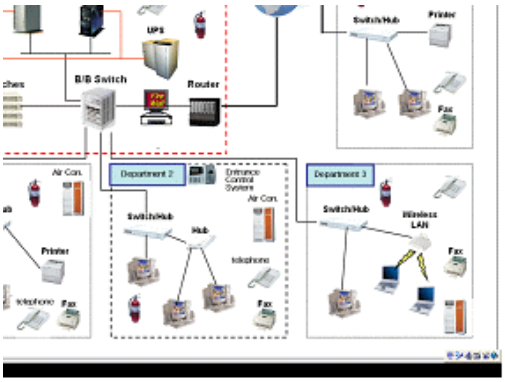


**Fig. 2.** General Information System Structure

We classify assets by asset type and using a 2-dimensional asset classification method with 2-dimensional classification factors in the general information system structure.

First, we classify assets into 7 type boundaries, one-dimensionally. For example, H/W, S/W, Network, Information, Application, User, Environment. Then, we reclassify the assets by 2-dimensional asset classification factors. The asset classification method presented in this paper considers that the asset value could differ according to department utilization, business contribution, user class, usage frequency, etc., even if the asset has same type. Namely, it has a different value between the financial department and the support department, even if it is the same kind of PC. In addition, it has a different value between a director's PC and a worker's PC, even if it is used in the same financial department.

Ex. 1) Department A's server B, application D used with job C, data G handled by user E.

Ex. 2) Application D that user uses for business B in department with system E.

The following table shows some examples of standards of specific classification factors for the 2-dimensional classification method.

**Table 1.** Examples of standards of 2-dimensional classification factors

| standard | description |
|---|---|
| Department utilization | department's IT utilization according to the organization business |
| Business contribution | Asset importance contributing to the organization on each business |
| User class | User class handling the information system |
| Usage frequency | Frequency with which the information system is used |
| Security safeguard | suitability of the security safeguard that is established against risk factors |

The following table shows the example of a 2-dimensional asset classification method which represents the relationship between the asset type and business process factors.

**Table 2.** Example of the 2-dimensional asset classification method

| Business Process Factors / Asset | | | Asset | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | H/W | | S/W | | Network | |
| | | | Disk | Ser Ver | Ms Office | Messenger | Router | Lan |
| Business Contribution | Dep Util. | User.1 | | | | | | |
| | | User.2 | | | | | | |
| | | User.N | | | | | | |
| | Dep Util. | User.1 | | | | | | |
| | | User.2 | | | Asset.N | | | |
| | | User.N | | | | | | |
| | Dep Util. | User.1 | | | | | | |
| | | User.2 | | | | | | |
| | | User.N | | | | | | |

### 3.3 Asset Evaluation Method

#### *3.3.1 The process of asset evaluation*

The 2-dimensional qualitative asset evaluation method is processing based on 2-dimensional asset classification factors.

① 2-dimensional asset classification list: List classified by 2-dimensional classification factors in the asset classification step.
② Tangible asset's quantitative calculation

The tangible asset value (TAV) is calculated with the purchase cost (PC), replacement cost (RC) and damage amount (DA). The DA means the damage amount which

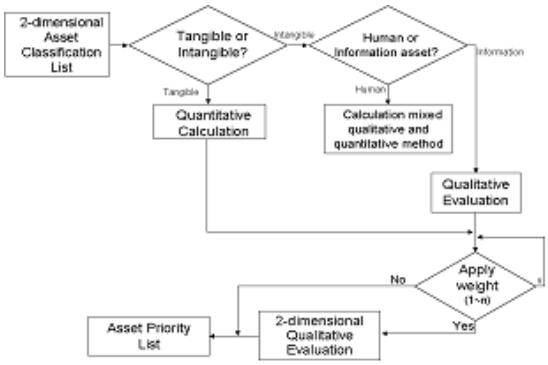


**Fig. 3.** The process of the 2-dimensional qualitative asset evaluation method

does not provide service to other organizations or individuals through interruption of the business connection during the replacement period, and the amount of loss that is incurred by failure to provide service.

TAV = PC + RC + DA
Here,
RC = (SP * HW) * RH

Support Personnel (SP) is the number of personnel to replace the product. The Hourly Wage (HW) is the wage per hour. A Replacement Hour (RH) is an hour spent in replacing the Information system.

DA = (DP * HW * RH) + LA

Damage Persons (DP) is the number of persons who cannot work during the failure to provide service. The Loss Amount (LA) is the loss cost that is incurred due to failure to provide service.

When the number of personnel is many, apply the following formula.

③ Intangible asset evaluation

- Human asset value (HAV)

Human assets are, for example, administrator, user etc, and are evaluated by expenses consumed on substitute backup personnel. Namely, this is a substitution cost for the manpower necessary to be a relevant business substitute, when human resources are not available due to retirement, walkout, vacation, etc.

HAV = SC
SC = (HW * SH) * TE

HW is the backup personnel's wage per hour. SH is a substitution hour. TE is the personnel training expense per hour.

Thus, HAV = (HW * SH) * TE

- Information Asset Value (IAV)

Information assets are, for example, information, data, manual, service etc., and evaluation by recovery expense (RE) and damage amount (DA). The RE is the cost for recovering or re-producing from backup, in case an information asset was lost by a user mistake, hacking, fire etc. The Engineer Number (EN) is the number of personnel necessary for recovery. The Engineer Time (ET) is the recovery hours per engineer.

IAV = RE + DA
RE = EN * HW * ET
DA = (DP * HW * RH) + LA

The Recovery Hours (RH) are the total hours spent in recovering information. When the number of personnel is large, apply the following formula.
Thus,

④ Conversion quantitative into qualitative value

In this paper, we converted quantitative value into qualitative value, using the conversion table. The reason for conversion is application of the 2-dimensional classification factor weight reflecting the business process. Risk analysis experts create a conversion table based on the organization's maximum and minimum quantitative asset value. The value level and scale were decided by international standard ISO/IEC JTC 1/SC 27 TR-13335. An example of a conversion method is as following;

**Table 3.** Example of a conversion table

| Qualitative value | | Standard of the asset physical cost |
|---|---|---|
| Level | Scale | |
| Very low | 1 | The asset physical cost is less than $100. |
| Low | 2 | The asset physical cost is $100~300. |
| Medium | 3 | The asset physical cost is $300~600. |
| High | 4 | The asset physical cost is $600~900. |
| Very high | 5 | The asset physical cost is more than $1,000. |

⑤ Application of weight

We applied weight to each asset according to the 2-dimensional classification factor scale. Weight can be applied from 1 to n reflecting an organization's characteristics, business process, requirement, etc.

2-dimensional classification factors are also classified into five levels, such as very low, low, medium, high, very high, and applied on a scale of 1~5. Usually, the level and scale can be classified in three levels (low, medium, high), five levels (very low, low, medium, high, very high) and seven levels (negligible, very low, low, medium, high, very high, extreme) according to the organization's condition, but we decided on five levels. The three-level is a depreciated estimation accuracy in that the extent of each degree is wide. The seven-level is unclear concerning each degree's classification standard.

In this paper, we selected two 2-dimensional classify-cation factors, such as department utilization and business contribution, but you can select many kinds according to the organization's requirement. a. Department utilization

**Table 4.** Evaluation standard of department utilization

| Dep. utilization | | Standard |
|---|---|---|
| Level | Scale | |
| Very low | 1 | Department which uses virtually no information system, and the business weight is less than 20% within the organization. |
| Low | 2 | Department in which business depends on the information system is low, and the business weight is 20 ~ 40% within an organization. |
| Medium | 3 | If using an information system, business is gone easy, and the department which business weight is 40 ~ 60% within the organization. |
| High | 4 | Most business is achieved due to the information system, and the department which business weight is 60 ~ 80% within the organization. |
| Very high | 5 | If an information system is not used, business achievement is impossible, the department which business weight is more than 80% within the organization. |

### *3.3.2 Business contribution*

**Table 5.** Evaluation standard of the business contribution

| Business cont. | | Standard |
|---|---|---|
| Level | Scale | |
| Very low | 1 | Business that uses virtually no information system, and doesn't influence in an organization operation. |
| Low | 2 | Business dependence on an information system is low, and the most basic business related to an organization. |
| Medium | 3 | If using an information system, business is gone easy, and it is usual, but business that must achieve certainly. |
| High | 4 | Most business is achieved using an information system, and business that is essential to the organization. |
| Very high | 5 | If not using an information system, business achievement is impossible, the most critical business related to an organization operation. |

⑥ 2-dimensional qualitative asset evaluation

we evaluated the quantitative asset value with a converted value using the conversion table and weight. In this step, we can evaluate the substantial asset value (SAV). If the converted value is CV, the SAV formula is as follows:

SAV = CV * W

W is weight using a 2-dimensional classification factor scale.

$$W = (w_1 + w_2 + w_3 + \cdots + w_n) \div n = \sum_{i=1}^{n} w_n / n$$

Thus,

⑦ Asset priority list: create an asset priority list using 2-dimensional qualitative asset evaluation results.

In this step, we must not overlook the CEO's requirement because there may be asset that must be specially protected in terms of the organization's business process.

Let's use the following table as an example. Furthermore, let's suppose that each asset's CV is Server (5), UNIX (1), and Firewall (3).

**Table 6.** Example of 2-dimensional qualitative asset evaluation

| | | H/W | S/W | Network |
|---|---|---|---|---|
| | | Server | UNIX | Firewall |
| R&D Department | DEP. Importance | | | |
| | Business Contribution | | | |
| Financial Department | DEP. Importance | | | |
| | Business Contribution | | | |
| Plan Department | DEP. Importance | | | |
| | Business Contribution | | | |
| Support Department | DEP. Importance | | | |
| | Business Contribution | | | |

Risk analysis experts decide the weight value with the evaluation standard of the 2-dimensional classification factor using the delpi method. Namely, the R&D department UNIX is more important than the Financial and Support Departments. And the Financial Department's firewall is more important than the Plan and Support Departments. If we perform in this manner, we can decide all the weight value. The result is as follows:

**Table 7.** Result of the weight value decision

| | | H/W | S/W | Network |
|---|---|---|---|---|
| | | Server | UNIX | Firewall |
| CV | | 5 | 1 | 3 |
| R&D Department | DEP. Importance | 5 | 5 | 2 |
| | Business Contribution | 4 | 5 | 1 |
| Financial Department | DEP. Importance | 4 | 2 | 5 |
| | Business Contribution | 5 | 1 | 4 |
| Plan Department | DEP. Importance | 4 | 1 | 4 |
| | Business Contribution | 3 | 2 | 2 |
| Support Department | DEP. Importance | 1 | 1 | 2 |
| | Business Contribution | 3 | 1 | 1 |

If we evaluate the asset value using the above table, each asset value result is as follows.

**Table 8.** Result of 2-dimensional qualitative asset evaluation

| Asset | CV | R&D | | Financial | | Plan | | Support | |
|---|---|---|---|---|---|---|---|---|---|
| | | W | SAV | W | SAV | W | SAV | W | SAV |
| Server | 5 | 4.5 | 22.5 | 4.5 | 22.5 | 3.5 | 17.5 | 2 | 10 |
| UNIX | 1 | 5 | 5 | 1.5 | 1.5 | 1.5 | 1.5 | 1 | 1 |
| Firewall | 3 | 2 | 6 | 4.5 | 13.5 | 3 | 9 | 1.5 | 4.5 |

If we evaluate the asset value by cost alone, the asset value is same with CV regardless of the organization business process. However, if we use the 2-dimensional qualitative asset evaluation method, we can evaluate the asset's substantial value according to the organization's business process, characteristics and environment. For example, UNIX has a more important value in the R&D department.

Using the example of the firewall, its substantial value is different with the above table according to department utilization, business contribution. Namely, a department which takes charge of finances from the organization's budget to employee salary can impose critical damage to the organization when intrusion happens. Thus, the financial department's firewall could be stronger than others.

We must reflect the CEO's opinion when we decide asset value with final effect. If the plan department creates a main plan of business in a certain period, this plan must not be leaked externally. Thus, the importance of a firewall increases because it must maintain security thoroughly during the period.

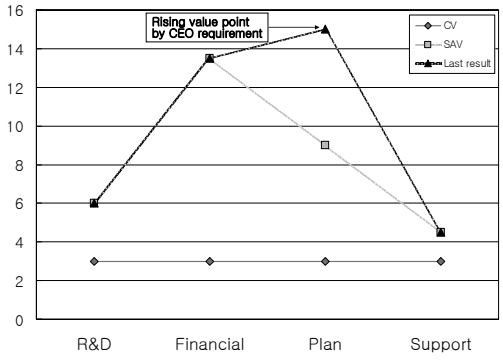


**Fig. 4.** Result of the firewall's value evaluation

## 4. Conclusion

This paper has presented a 2-dimensional qualitative asset evaluation method. The existent risk analysis tool and methodology do not present enough concrete and substantial asset classification and evaluation. In addition, the subjective opinions of risk analysis experts were mostly reflected, and physical asset evaluation method by cost was used. Thus, it could not derive the correct risk analysis result, and is difficult to establish a suitable security safeguard accordingly. In this paper, we reflected an organization's business process and established a two-dimensional qualitative asset evaluation method.

First, we classified assets by information system type in the asset classification method, and divided as two-dimensional method with specific classification factors to classify assets reflecting an organization's business process. Then, we calculated the asset's quantitative value and converted it into the qualitative value using the conversion table. We applied weight to the converted value (CV) according to the specific classification factor scale. In doing so, we can establish a priority for a component of the information system. Finally, we reflected the CEO's requirement concerning the asset value evaluation method because this is the core information system that maintains the organization's secrecy regardless of the physical asset value, which a risk analysis expert cannot know.

In the future, we are going to develop more systematic and concrete risk analysis methodology, applied with a 2-dimensional qualitative asset analysis method.

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