

An application of the Quality Function Deployment method to IT security

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Abstract

- ✔ QFD is an effective quality management approach and practical method.
- ✔ We have proposed a practical application of QFD to IT security.
- ✔ In our approach, QFD is used as a design approach to assure integrity of security solution, and it also covers the entire life cycle of the developed system to assure integrity of the operational system.



Problem

- To build and operate a secure IT system, security integration is very important.
- Each system has its proper integrity level, and we must assure the proper integration for that system at the specified integrity level or criticality.
- However, sometimes such integration work is ad hoc one.
- We need more systematic or robust procedures for such integration work. We also need **ONE visible image of security integration.**

Today's Image
[\(Previous day\)](#) [\(Next day\)](#)

Santa Fe
(Acquired on October 2)

Tallahassee
(Acquired on October 2)

Casa Blanca
(Acquired on October 2)

JAPANESE | [Guide](#) | [Site](#)

Welcome to
ASTER GDS Web Site
Earth Remote Sensing Data Analysis Center

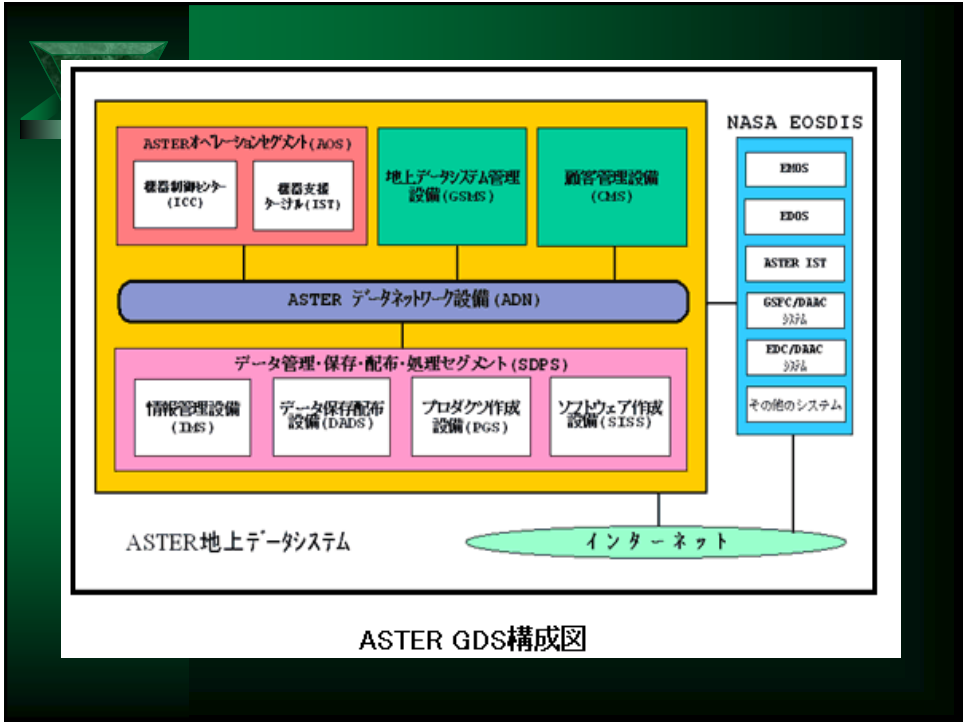
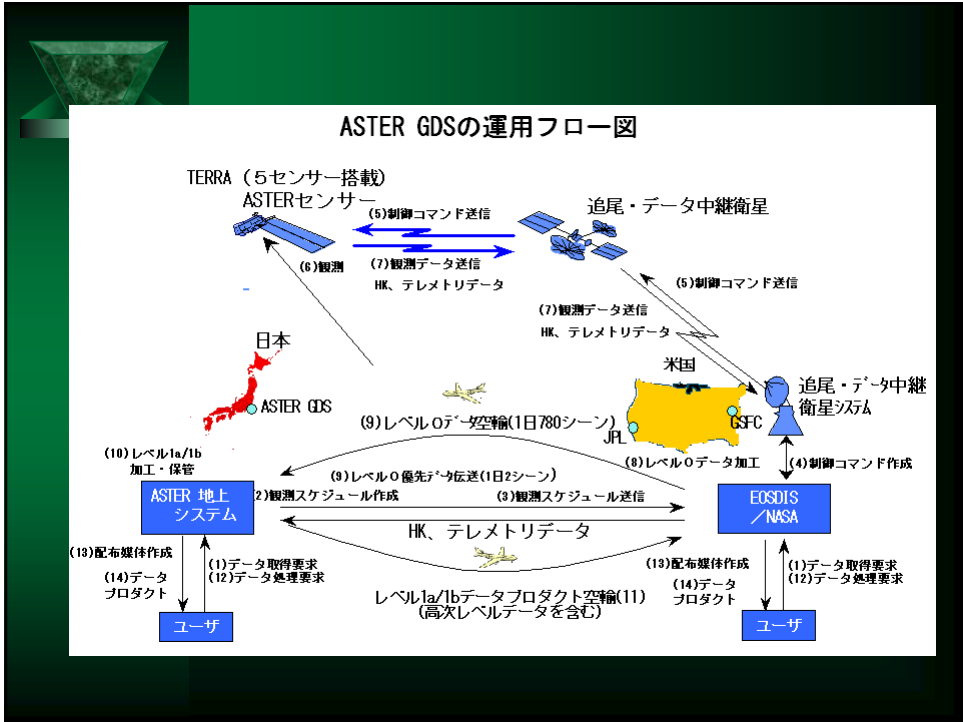
INFOMATION

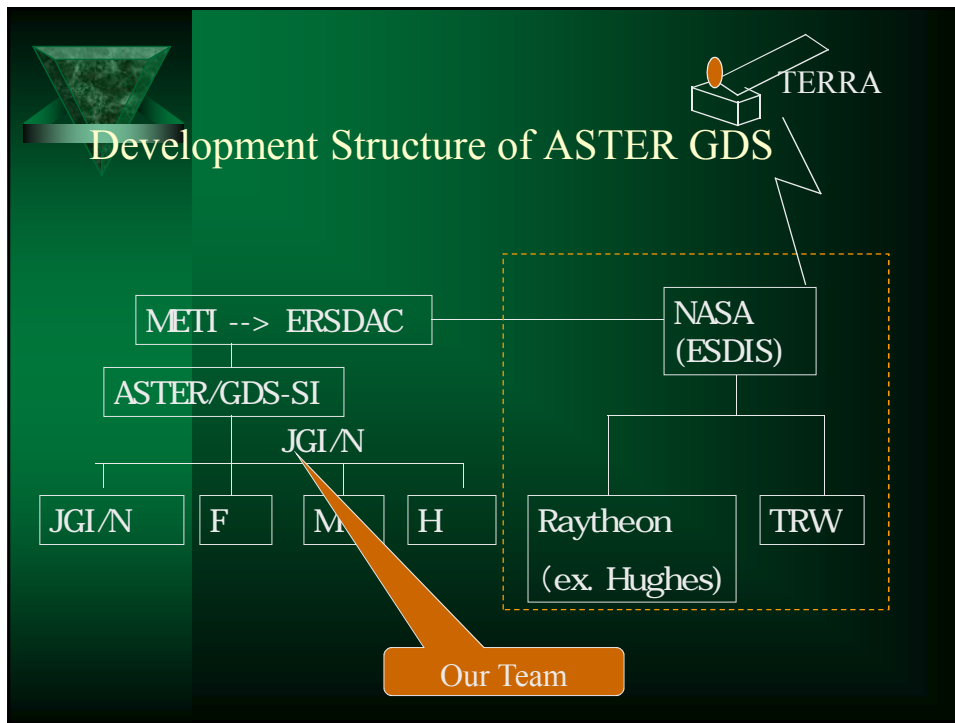
- ◆ The system is operating normally. (2004/10/7)

NEWS FLASH !

- ◆ The parameter updated information of Level1 was added to the release note. (2004/10/7)
- ◆ You came to be able to specify DVD ROM at **August 12** (2004/8/9)
- ◆ **Mail Notification Service started (2004/7/23)**
- ◆ The online user registration in "User window system" became possible. (2004/7/1)

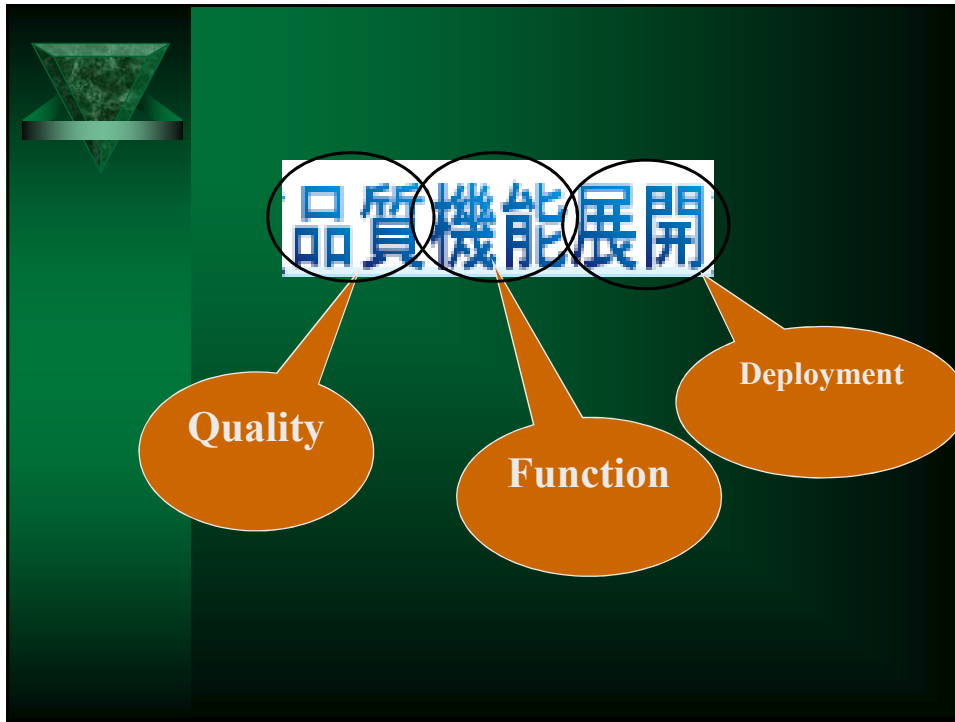
Entrance | Exhibition Room | Image Gallery | Seminar Room | Service Center | Product Service
GDS News | ASTER Project | New Images | Remote Sensing | Summary of Services | Product





What is QFD?

- ✓ The QFD method was proposed by Yoji Akao in 1960s as a practical method for quality management, and it is now recognized as one of effective and systematic quality management approaches, for example, in the quality management standard, QS9000 of the automobile industry.
- ✓ QFD is now one of JIS (Japan Industrial Standards).
 - JIS Q 9025 “Performance Improvement of Management Systems - Guidelines for Quality Function Deployment”

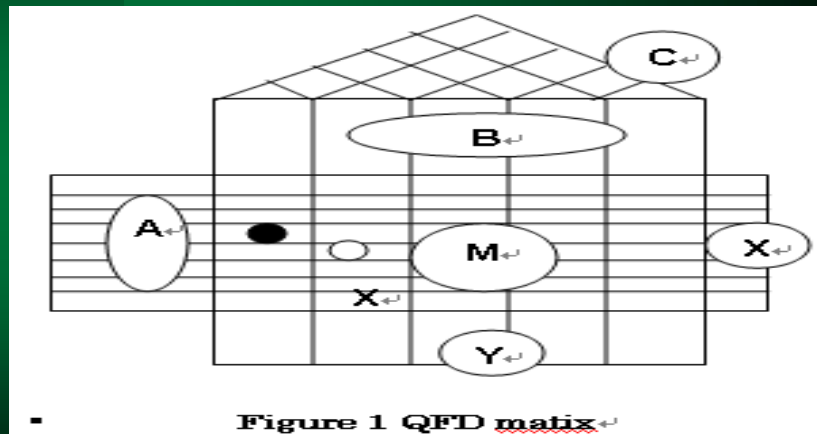


How is QFD used and evaluated?

✓ “Quality Function Deployment (QFD) is the systematic translation of the ‘Voice of the customer’ to actions of the supplier required to meet the customers’ desires, based on a matrix comparing what the customer wants to how the supplier plans to provide it. This basic matrix can be expanded to provide additional insight to the supplier, and cascaded to identify process parameters that must be controlled to meet the customer requirements. There are many varieties of QFD, and many variations of the charts used.” --Coppola, A. "Quality Function Deployment", START (Selected Topics in Assurance Related Technologies), Vol 4, Number 1, DoD Reliability Analysis Center (1997)



QFD Matrix



Point of Our Proposal-1

- ✓ We can use QFD matrixes as inventive deployment tools that convert the IT security requirements to design and operational details.



Point of Our Proposal-2

- ✔ In the original concept, QFD focuses on user requirement expressed by daily language. So the linguistic analysis is important at the start point. And practical purpose is to establish competitive difference from other company.
- ✔ However QFD has another aspect that it clarifies the relationship between customer/user requirements, design decision, and production process management issues. It is also an inventive approach to design a product based on user requirements and characterized with evaluated weights for design elements.
- ✔ We can use the latter aspect of QFD to IT security design and life cycle management issues



Existing Application Examples to Software or Security-1

- ✔ Some proposal and trial have been appeared in 1990s to apply QFD to software development.
- ✔ Many trials were performed in Japan to apply QFD to software quality. We omit here such works, and show English references.



Existing Application Examples to Software or Security-2

- ✓ Richard Zultner described “QFD and Designing Software” focusing the Voice of User, and using the concept of WHY-versus-WHAT matrix⁴). -- In the book “The QFD Handbook”
- ✓ Dan Zrymiak described an proposal “Software Quality Function Deployment – Modifying the ‘House of Quality’ for Software” applying software quality standard ISO/IEC 9126 to QFD in the software development field.
- ✓ These are focused on the issues of software quality and processes of requirement deployment or development of user requirements to the basis of preliminary and detailed design.



Existing Application Examples to Software or Security-3

- ✓ In the IT security field, some proposals have been appeared to apply QFD to a National Security issue and Homeland Security activities. As far as we know, these are general proposal or “call to arms”.



Input-1

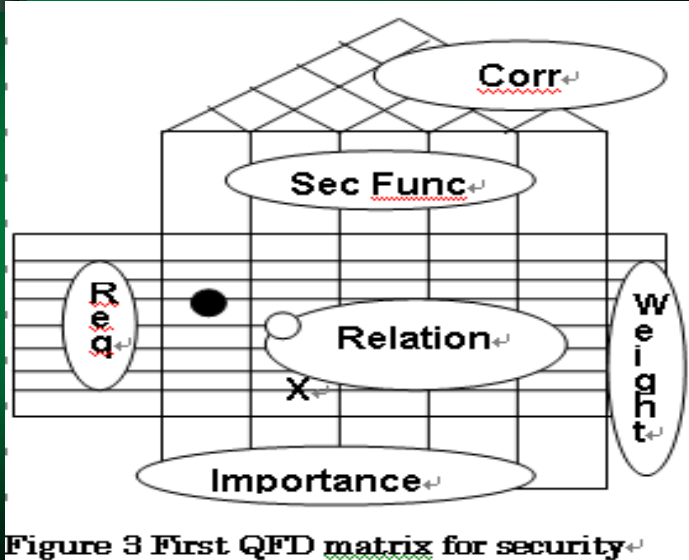
- ✓ Originally input part is a list of customers' wants and needs. List contents are derived from the voice of the customer ("VOC") which is verbatim information. VOC is the result of questionnaire, and is described using terminology in the daily life. They are gathered, classified and modified into technical user requirement items.



Input-2

- ✓ For security application, we can use specific user requirements on IT security as input of the first QFD matrix.
- ✓ In many cases, it may be desirable to add the result of risk analysis and professional consideration to the input list, because user requirements are not complete for security integration.

QFD Matrix for Security Application



Output (Deployment)-1

- ✓ The deployment part is originally a list of quality characteristics (or substitute characteristics) which are design requirements on product quality.



Output (Deployment)-2

- ✓ For security application, the deployment items are security functions in the various subsystems and operational procedures.



Relationship Matrix-1

- ✓ Originally, the matrix part is a relationship matrix of input and deployment. Typically elements of this matrix are represented with symbols, e.g. double circles, open circles, and Xs. For example, a double circle represents 5 points, an open circle represents 3 point, and an X represents 2 points with negative correlation.



Commonly used symbols

| symbol | point | Normal Meaning | For QFD |
|--------|-------|----------------|-------------|
| ◎ | 5 | Excellent | Significant |
| ○ | 3 | Good | Important |
| △ | 1 | Fair | Somewhat |
| × | -2 | Poor | Negative |



Relationship Matrix-2

- ✓ For security application, we can use the matrix part for describing requirement vs functionality relationship. Some security requirements relate with various functions, subsystems and operation procedures.



Weight Factor-1

- ✓ Additional parts have different forms and meanings for each different type of the QFD matrix.
- ✓ Typically, the part X in the figure 1 is a list of weight factors for needs, and the part Y is the resultant list of calculated importance factors for deployed characteristics.



Weight Factor-2

- ✓ For security application, we can calculate weight factors for security functions using QFD scheme. These factors may reflect the integrity level of the system. The integrity level is a requirement factor, and is to be translated into design elements.
- ✓ Significance or strength of security for each security function depends on resultant weight factors.





Weight Factor-3

- ✓ If you add any input requirement same as an existing one, easily you can double the resultant output value (significance value).
 - So, theoretically, this method involves difficult problem in it. Nevertheless, we can use it as a practical method.



Conflict (Correlation) Matrix-1

- ✓ The roof part of the House of Quality (C) is used for expressing correlation between B items. Correlation representation also uses symbols such as '+' (positive correlation) and '-' (negative correlation).



Conflict (Correlation) Matrix-2

- ✔ Some security functions and non-security functions may conflict each other in their performance. For example, user convenience at login process may be spoiled by security function for rigid protection at user authentication. Attached file of e-mail is convenient, but it may convey computer viruses. Such conflicts can be clarified and evaluated using the correlation matrix part of QFD.

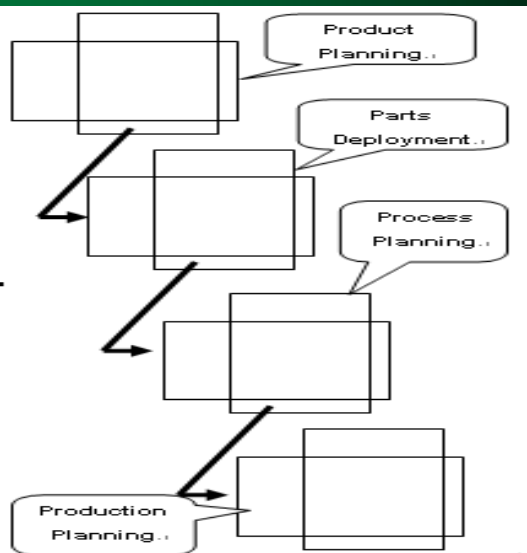


Cascading-1

- ✔ The basic matrix can be used to construct cascading matrixes as shown in figure 2. Cascade can be two phase one, three phase one, four phase one, thirty phase one, and so on. The input list of each cascading matrix is the deployment list of the preceding matrix.



Cascading-2



• Figure 2 Cascading DFQ matrices (Four Phase Model) ..



Cascading-3

- ✓ For example, input of the first QFD matrix is **customer requirements**. The deployment of the first matrix and input of the second matrix is **substitute quality characteristics**. The deployment of the second matrix and input of the third matrix is **part characteristics**. And the deployment of the third matrix and input of the fourth matrix is **manufacturing operations**. Finally the deployment of the fourth matrix is **production requirements**.



Cascading-4

- ✔ For security application, we can also use cascading QFD matrixes effectively to support system life cycle processes.
- ✔ The output of the first matrix in figure 3 is security functions. These functions must be designed, implemented, tested, integrated into a system, and operated in a specified environment. Such situation is the system life cycle process issue.



Cascading-5

- ✔ How we should treat a specific security function at the design process, at the implementation process, at the test process, at the integration process and at the operation process? These considerations should be clarified in the second QFD matrix.
- ✔ The input list of the second matrix is composed of security functions with some additions of non-security functions. The deployment list of the second matrix is composed of life cycle processes of the system.



Cascading-5



Test and Configuration Management-1

- ✓ We can use cascading of requirement-function and function-process relationship clarified in QFD matrixes as a naturally defined traceability matrix for security functions. Such traceability is useful for configuration/change management of security functions and for possible vulnerability analysis for software/system.



Test and Configuration Management-2

- ✓ We can also use these QFD matrixes as powerful reuse components for system developments. If you have security guidelines to be used for many similar systems, QFD matrixes once described may be used for similar systems with similar integrity level.



Test and Configuration Management

- ✓ Another cascading use of QFD is to design test process. The test process for the total system security is complex problem. One security requirement or function may relate with several test cases, and several security requirements/functions may relate with one test case. The QFD matrix can clarify such complex relationship. This matrix will succeed directly the first QFD matrix. See figure 4.



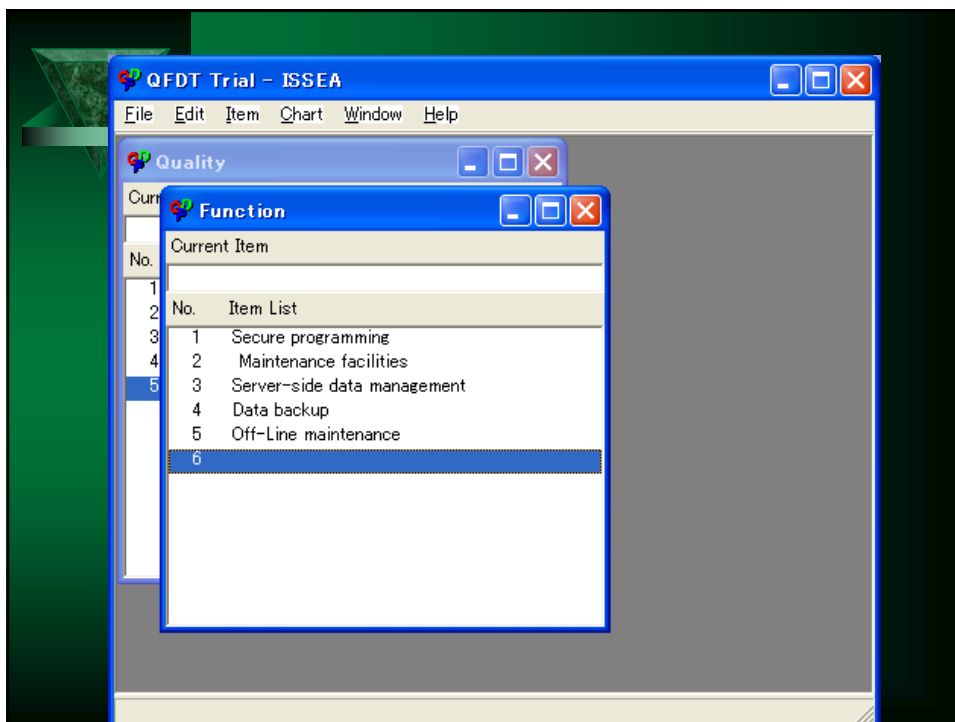
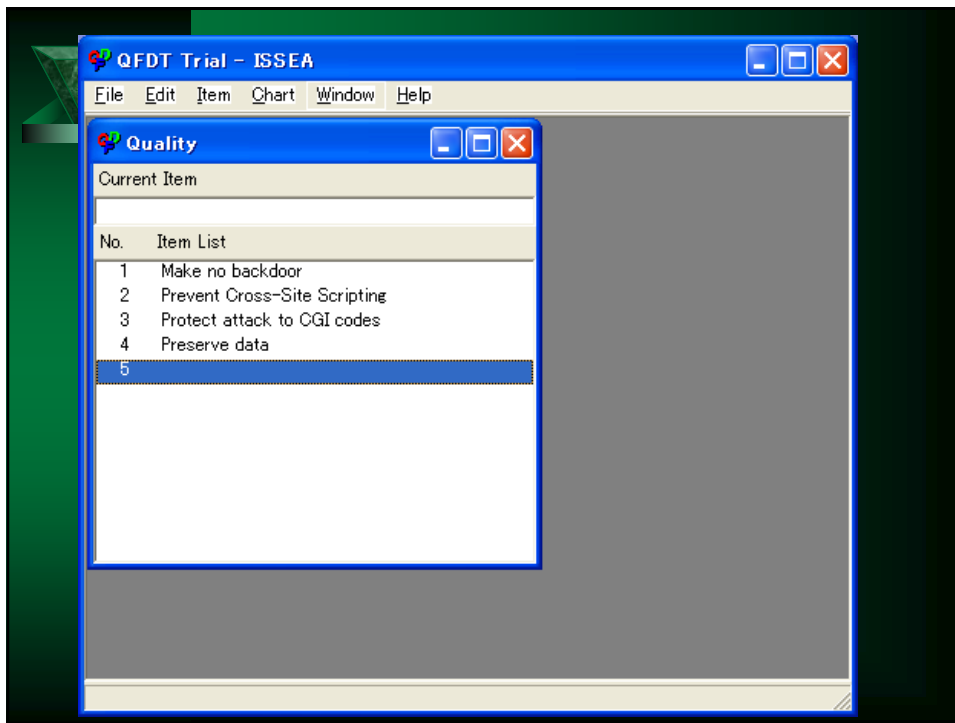
Text Matrix—Process Issue

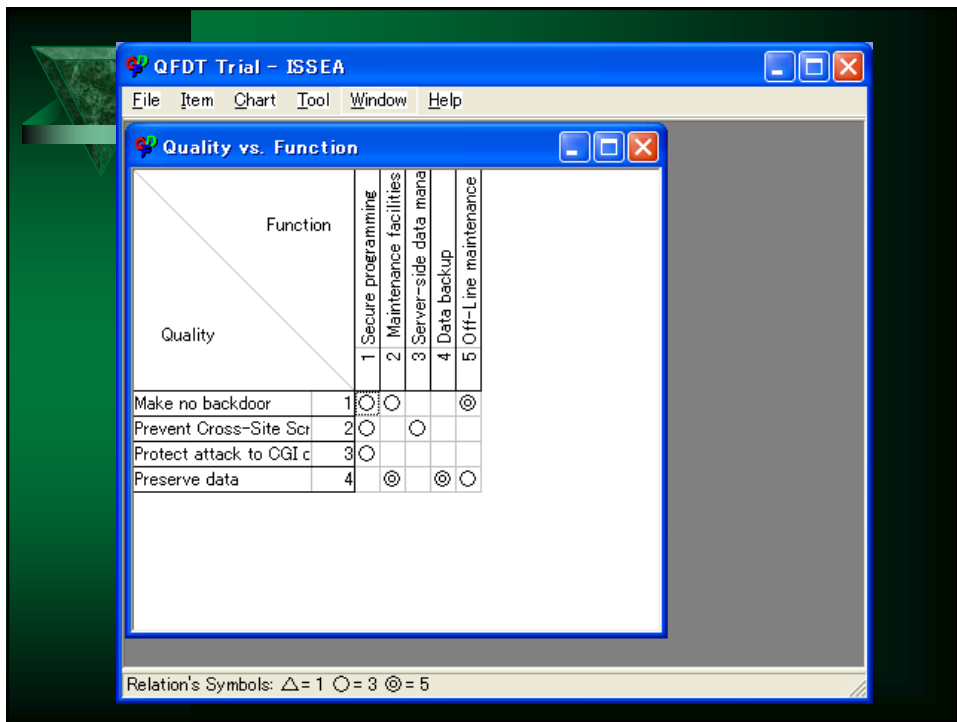
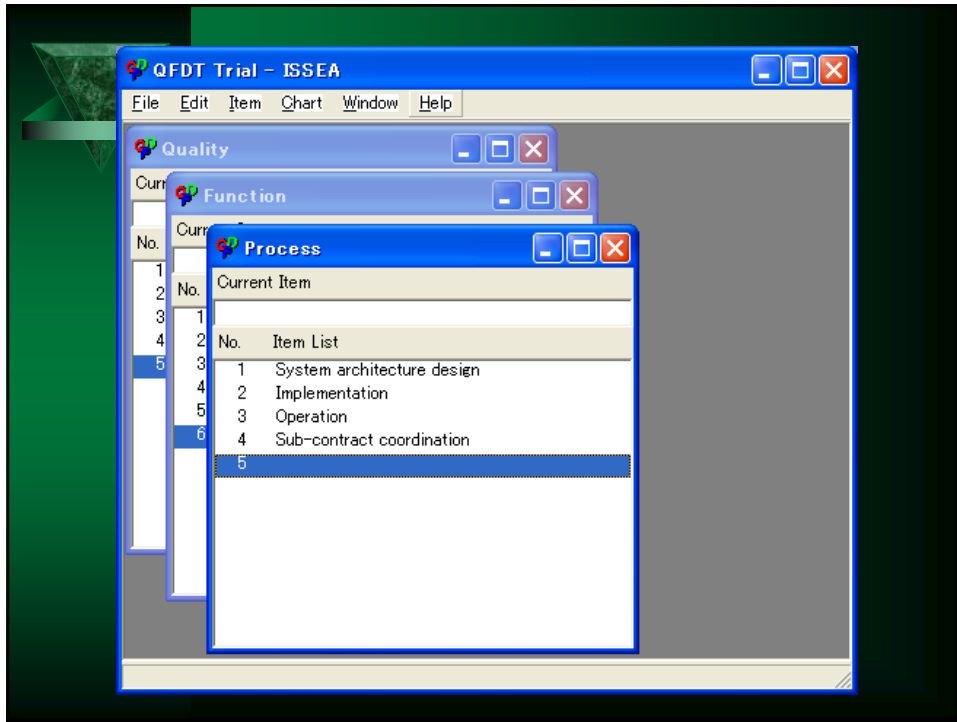
- ✓ This second relationship matrix may not be filled with symbols.
- ✓ This relationship may be represented using text, because we need description how a specific security function is treated in a specific process instead of importance that the function has with regard to the process.

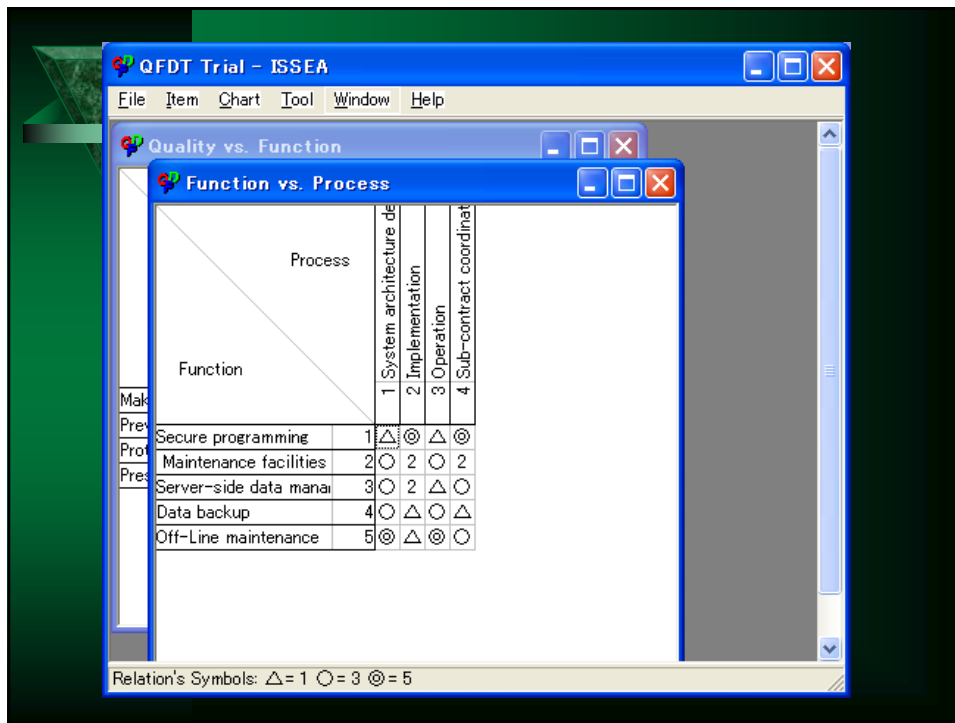


Simple Example

- ✓ See Tool (QFDT) Screen Images.







Example Input-1: CC PP/ST

- ✓ CC requires to identify functional requirements and assurance requirements based on security objectives.
- ✓ QFD can be used to support such identification process.



Example Input-2: Guidelines

- ✓ We can use control objectives in security guidelines or regulations as the first input for QFD matrix. Such guidelines include GMITS(MICTS), ISO/IEC 17799, NIST SP800-53, and agency specific guidelines.



Relationship to SSE-CMM

- ✓ We can use SSE-CMM processes as a template of system life cycle processes for a security related IT system.
- ✓ Security QFD can provide detailed and concrete actions in SSE-CMM processes.



Some Existing Support Tools

- ✓ “The QFD Handbook” provides a text base tool to support development of QFD matrixes.
- ✓ Shindo Laboratory of the Yamanashi University provides a support tool that is available from the Web site:
 - <http://www.is.esi.yamanashi.ac.jp/Intl/services/qfd/>



Future Expectation-1

- ✓ Here we have described outline of our proposal for QFD application to IT security.
- ✓ The core concept of our proposal is system security should be designed, implemented, integrated, tested and operated systematically.
- ✓ The cascading QFD matrixes will represent the system life cycle management of the systems’ security problems.
- ✓ Such observation and proposal should be examined repeatedly in real projects.



Future Expectation-2

- ✓ As for QFD matrix form, it is sometimes a very big diagram.
- ✓ However, QFD matrix is usually a sparse matrix, and we may treat it using techniques used in the numerical calculation field. Such improvement of diagram may be also required.
- ✓ Note: In some QFD application, so-called “numericalization method -- category three” is used. However we have no need to use this method in security application.



References

- ✓ 1) Akao, Y. “Check Points, Control Points and Evaluation Points”, *Quality Control*, JUSE, Vol. 15, Spring extra issue, pp42-48(1964).
- ✓ 2) Akao, Y. “Quality Function Deployment: Integrating Customer Requirements into Product Design”, Massachusetts Productivity Press (1990).
- ✓ 3) Coppola, A. “Quality Function Deployment”, *START (Selected Topics in Assurance Related Technologies)*, Vol 4, Number1, DoD Reliability Analysis Center (1997)
- ✓ 4) Zultner, R. “QFD and Designing Software”, *The QFD Handbook*, Wiley (1998).
- ✓ 5) Zrymiak, D. “Software Quality Function Deployment – Modifying the ‘House of Quality’ for Software”, library for Six Sigma, <http://software.isixsigma.com/library/contents/c030709a.asp>, (2003).
- ✓ 6) Mann, G.A., “The Application of QFD to a National Security issue”, 5th Symposium on QFD (1993)
- ✓ 7) Mazur, G.H., “QFD and The Office of Homeland Security”, 13th Symposium on QFD (2001)