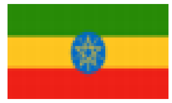

Ethiopian TVET-System

INFORMATION TECHNOLOGY SERVICE MANAGEMENT
Level V

Learning Guide

Unit of Competence: Research and Review Hardware Technology Options for Organizations

Module Title: Researching and Reviewing Hardware Technology Options for Organizations

LG Code: ICT ITSM5 M07 LO1-14

TTLM Code: ICT ITSSM5 TTLM7 01-14

MODULE DESCRIPTION:

This module covers to apply research skills in conjunction with reviewing hardware solutions, as part of an analysis of emerging technology.

LEARNING OUTCOMES:

LO1 Research vendors, suppliers and IT industry specialists
LO2 Evaluate and report on options

LO1- Research vendors, suppliers and IT industry specialists

Introduction

The relationship between information technology (IT) and economic organization can be quite complex, but the emerging area of "coordination theory" is beginning to provide a foundation for theory-building and empirical validation. We are still far from a complete understanding of the organizational impacts of IT, however. In particular, as numerous authors have argued, IT does not appear to have simply increased firms' reliance on market coordination, but rather to have engendered new forms of organization such as "networks" and "value adding partnerships", which involve close links with a relatively small number of suppliers.

The organizational implications of IT are increasingly the focus of research at the intersection of information systems and institutional economics. In this paper we study some aspects of buyer-supplier relationships with a theoretical model in the institutional economics tradition, following the impact of the number of suppliers on the social surplus and pursued the maximization of social welfare, we adopt the perspective of a buyer firm wishing to pursue its narrow self-interest in maximizing its profits unlike much recent research on the institutional impacts of IT. Since there are a number of situations in which internal production is not a viable (practicable) option, we start with the assumption that the decision to outsource has been made and proceed to analyze the optimal strategy for a buyer firm which must choose the number of suppliers it will employ. We show that looking at coordination costs alone can provide an incomplete picture; incentives must also be considered in a more complete analysis.

An industry analyst

An industry analyst performs primary and secondary market research within an industry such as information technology, consulting or insurance. Analysts assess sector trends, create segment taxonomies, size markets, prepare forecasts, and develop industry models. Industry analysts usually work for research and advisory services firms. Typically, analysts specialize in a single segment or researching the broad development of the market rather than focusing on specific publicly traded companies, equities, investments, or associated financial opportunities as a financial analyst.

An information and communications technology (ICT) industry analyst is a person, working individually or within a firm, whose business model incorporates creating and publishing research about, and advising on how, why and where ICT-related products and services can be procured (acquired), deployed and used.

Determining Suitable Suppliers and Vendors

Supplier Approval Process

Company requires all Suppliers to be approved prior to the issuance of contracts. All Suppliers must be approved by Company regardless of approvals by customers or other entities.

2.1 Supplier Assessment

The Supplier Approval Process may include the following:

a) Supplier Initial Assessment:- Company may request the Supplier to provide a copy of its quality management system certificate and/or complete a self-assessment of its business and quality management system and capabilities (i.e., quality, delivery, technology, cost, and continual improvement objectives).

b) Documentation Audit -In those cases where a Supplier's quality management system has not been certified by an accredited certification body, Company may request a copy of the Supplier's Quality Manual and supporting procedures (and perhaps internal audit reports) to determine if the Supplier's quality management system meets Company requirements.

c) On-Site Assessment: - Generally, when a Supplier is certified to a related standard by an accredited certification body, Company will not conduct an on-site assessment of the Supplier's quality management system against the same criteria. However, Company and/or its customers, due to product/process complexity or criticality, may elect to conduct on-site assessments of a Supplier's product or process capabilities. As a result, findings may be issued.

These assessments could include:

- Quality Management System (QMS) – if necessary, as a result of (or in conjunction with) product or process capability assessments, to determine whether the Supplier's quality management system meets one or more of the applicable standards, and is functioning effectively.

- Business and Manufacturing Operations – to determine whether the Supplier has the financial resources, production capacity, and other business resources needed to fulfill Company volume production needs and continuity of supply.
- Continual Improvement Initiative – to determine if the Supplier's culture, methods and skills are present to actively pursue continual improvement.
- Technology Assessment - to determine whether the Supplier has the needed technical resources, including production and inspection equipment, facilities, engineering resources, Company-specified computer-aided design language/format, electronic commerce capability, etc.
- Sub-Tier Supplier Control – to evaluate the effectiveness of the Suppliers sub-tier management processes and ensure that products or services procured from sub-tier sources and delivered to Company conform to all applicable organization requirements. All new organization calibration Suppliers require an on-site assessment by organization or its representatives for compliance to prior to approval. All new organization special process Suppliers require on-site assessment by organization, including personnel approved by Materials & Processes, prior to approval. Suppliers who have established a QMS in compliance with require a QMS audit by Company prior to addition of the Supplier to the organization.

Organization requires all Suppliers to be approved and listed on the organization Approved Suppliers List and/or Approved Process Suppliers List organization, prior to the issuance of contracts to the Supplier.

IT Hardware Supplier Checklist

This page is for the company's Designated Hardware Suppliers to use as a guide when preparing computer equipment quotations for organization staff members.

When preparing a quotation for a desktop, notebook or tablet system, suppliers must:

- Ensure the quotation and the Company order includes as a minimum a 3 year on-site warranty for desktop systems and a 3 year return to vender warranty for notebook/tablet systems.
- Ensure that the equipment is a 'Standard System Bundle' or approved model:
- Include all mandatory services in the quotation (eg. electrical testing and tagging, asset and warranty labeling, network registration, delivery, etc).
- Provide a quotation that is valid for 30 days.

When processing a purchase order, suppliers must:

- Obtain end user information.
- Check end user location.
- Check delivery address.
- Use organization code to generate the default workstation name.
- Sight a software license for any software that is **not** provided by the supplier or as part of the organization Standard Operating Environment (SOE).

Report any non-compliance of system specification to the person placing order and, if requested to proceed, report to Information Strategy and Technology Services (ISTS).

Prior to delivery, suppliers must:

- Install the organization's Standard Operating Environment (SOE) using the current image supplied by the Company.
- Check that the desktop/notebook/netbook/tablet system network name is correctly entered (Org2 code plus Blue Plate number).
- Ensure "Blue Plates" (asset tags) are secured to the equipment as per the document.

Note: Blue plates are only required for equipment plugged into the network requiring an IP (eg. blue plate for the PC but not needed for the monitor).

- Ensure warranty labeling is placed on equipment as per the document. Warranty labels must include Supplier Name, Serial Number, and Warranty Expiry Date.
- Affix any additional labeling required for leased equipment.
- Ensure all equipment and electrical cables are electrically tested and tagged.
- Request an IP address from the Company:
- _ Instructions to Obtain an IP Address

Note: Please allow at least two working days for an IP request to be processed prior to delivery.

Ensure OEM Windows license and installation disks are included with delivery. The supply of an OEM Windows operating system license and installation disks are a mandatory requirement. Supply of an OEM Windows license is a mandatory requirement of our licensing conditions.

When delivering equipment, suppliers must include labelling that shows:

- Purchaser's name.
- Delivery address.
- Purchase Order Number.
- Blue Plate Number.
- End user's name.

At delivery, suppliers must:

- Deliver equipment to a secure location.
- Ensure goods are signed for by the designated Company staff member.
- Perform Setup Testing if requested by purchaser.

Supplier Checklist for Server Systems

When preparing a quotation for a server system, suppliers must:

- Ensure the quotation and the Company order includes as a minimum a 3 year on-site warranty.
- Ensure that the equipment is a 'Standard System Bundle' or approved model
- Server Systems
- Include all mandatory services in the quotation (eg. electrical testing and tagging, asset and warranty labelling, IP registration, delivery, etc).
- Provide a quotation that is valid for 30 days.

When processing a purchase order, suppliers must:

- Obtain and include end user information on the purchase order.
- Check end user location.

- Check delivery address.
- Use Org2 code to generate the default server name.
- Sight a Company Software License Application form or Company License Certificate for a Microsoft Windows Server operating system.
- Report any non-compliance of system specification to the person placing order and, if requested to proceed, report to Information Strategy and Technology Services (ISTS).

Prior to delivery, suppliers must:

- Ensure "Blue Plates" (asset tags) are secured to the equipment as per the document.
- *Note:* Blue plates are only required for equipment plugged into the network requiring an IP (eg. blue plate for the PC but not needed for the monitor).
- Ensure warranty labelling is placed on equipment as per the document Placement of Company Labels (PDF). Warranty labels must include Supplier Name, Serial Number, and Warranty Expiry Date.
- Affix any additional labelling required for leased equipment.
- Ensure all equipment and electrical cables are electrically tested and tagged.
- Request an IP address from the Company:

Note: Please allow at least two working days for an IP request to be processed prior to delivery.

When delivering equipment, suppliers must include labeling that shows:

- Purchaser's name.
- Delivery address.
- Purchase Order Number.
- Blue Plate Number.
- End user's name.

At delivery, suppliers must:

- Deliver equipment to a secure location.
- Ensure goods are signed for by the designated organization staff member. Perform any on-site installation tasks as requested by purchaser.

Vendor

A **vendor**, or a **supplier**, in a supply chain is an enterprise that contributes goods or services in a supply chain. Generally, a supply chain vendor manufactures inventory/stock items and sells them to the next link in the chain.

The term vendors originally represented property vendors. However, today it means a supplier of any good or service. A vendor, or a supplier, is a supply chain management term that means anyone who provides goods or services to a company or individuals. A vendor often manufactures inventorable items, and sells those items to a customer.

Typically vendors are tracked in either a finance system or a warehouse management system. Vendors are often managed with a vendor compliance checklist or vendor quality audits. Purchase orders are usually used as a contractual agreement with vendors to buy goods or services.

Vendors may or may not function as distributors of goods. They may or may not function as manufacturers of goods. If vendors are also manufacturers, they may either build to stock or build to order.

- 'Vendor' is often a generic term, used for suppliers of industries from retail sales to manufacturers to city organizations. 'Vendor' generally applies only to the immediate vendor, or the organization that is paid for the goods, rather than to the original manufacturer or the organization performing the service if it is different from the immediate supplier.

1. How hardware vendors can help

- Hardware vendors could require that full low-level technical documentation be made available for the hardware that goes in to their products.

- This documentation should be made available in an unrestricted way as used to be common practice.
- Vendors could encourage the development of free software drivers for their hardware either by writing the drivers themselves or by supporting community development efforts.
- Vendors could work with the community to get these drivers included Vendors could offer \no operating system" as an option on all their systems, including consumer systems, and particularly laptops.
- When \no operating system" is selected, vendors should reduce the price of the system by the cost of the Microsoft OEM license.
- Vendors could offer some GNU/Linux distributions as an option on systems, including consumer systems, and particularly laptops. These systems should be tested for subsystem functionality like ACPI. Hardware vendors could resist pressure by the media companies to stifle this innovative culture, and actively lobby for laws that protect consumers' rights.

2. How will this improve the situation for the vendor?

- Hardware that is well-documented and supported by free software drivers will be significantly more useful to both the members of the free software community and the wider public. A reputation for hardware free of restrictions equates to positive product reviews, a stronger brand image and increased sales.

- Respecting the users' freedom is a mark of an ethical company.
- By selling and promoting more hardware without a pre-installed operating system, or with a GNU/Linux operating system, vendors will become less dependent on Microsoft. Millions of people are already using GNU/Linux systems. The free software community will undoubtedly support vendors that sell hardware without subjecting their customers to the \Microsoft tax." Lower costs to the vendor mean lower prices and increased sales.

- The free software community will lock to any vendor that protects the rights of the consumer by delivering \hardware free from restrictions." Vendors that sell equipment that is \defective by design" will see their sales and community support diminished.
- By steering clear of DRM hardware, vendors would also remain free to innovate, rather than having to clear every new product with Big Media.

Source information

The open-source hardware statement of principles and definition were developed by members of the OSHWA board and working group along with others. These documents were originally edited on the wiki at freedomdefined.org, which you can visit to see endorsements of the definition and to add your own.
Open Source Hardware (OSHW) Statement of Principles
Open source hardware is hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design. The hardware's source, the design from which it is made, is available in the preferred format for making modifications to it. Ideally, open source hardware uses readily-available components and materials, standard processes, open infrastructure, unrestricted content, and open-source design tools to maximize the ability of individuals to make and use hardware. Open source hardware gives people the freedom to control their technology while sharing knowledge and encouraging commerce through the open exchange of designs.

Open Source Hardware (OSHW) Definition

The Open Source Hardware (OSHW) Definition is based on the *Open Source Definition* for Open Source Software.
Open Source Hardware (OSHW) is a term for tangible artifacts — machines, devices, or other physical things — whose design has been released to the public in such a way that anyone can make, modify, distribute, and use those things. This definition is intended to help provide guidelines for the development and evaluation of licenses for Open Source Hardware.
Hardware is different from software in that physical resources must always be committed for the creation of physical goods. Accordingly, persons or companies producing items ("products") under an OSHW license have an obligation to make it clear that such products are not manufactured, sold, warrantied, or otherwise sanctioned by the original designer and also not to make use of any trademarks owned by the original designer.
The distribution terms of Open Source Hardware must comply with the following criteria:
1. Documentation : The hardware must be released with documentation including design files, and must allow modification and distribution of the design files. Where documentation is not furnished with the physical product, there must be a well-publicized means of obtaining this documentation for no more than a reasonable reproduction cost, preferably downloading via the Internet without charge. The documentation must include design files in the preferred format for making changes, for example the native file format of a CAD program. Deliberately obfuscated design files are not allowed. Intermediate forms analogous to compiled computer code — such as printer-ready copper artwork from a CAD program — are not allowed as substitutes. The license may require that the design files are provided in fully-documented, open format(s).

2. Scope : The documentation for the hardware must clearly specify what portion of the design, if not all, is being released under the license.
3. Necessary Software: If the licensed design requires software, embedded or otherwise, to operate properly and fulfill its essential functions, then the license may require that one of the following conditions are met:
a) The interfaces are sufficiently documented such that it could reasonably be considered straightforward to write open source software that allows the device to operate properly and fulfill its essential functions. For example, this may include the use of detailed signal timing diagrams or pseudo code to clearly illustrate the interface in operation.
b) The necessary software is released under an OSI-approved open source license.
4. Derived Works: The license shall allow modifications and derived works, and shall allow them to be distributed under the same terms as the license of the original work. The license shall allow for the manufacture, sale, distribution, and use of products created from the design files, the design files themselves, and derivatives thereof.
5. Free redistribution: The license shall not restrict any party from selling or giving away the project documentation. The license shall not require a royalty or other fee for such sale. The license shall not require any royalty or fee related to the sale of derived works.
6. Attribution: The license may require derived documents, and copyright notices associated with devices, to provide attribution to the licensors when distributing design files, manufactured products, and/or derivatives thereof. The license may require that this information be accessible to the end-user using the device normally, but shall not specify a specific format of display. The license may require derived works to carry a different name or version number from the original design.
7. No Discrimination against Persons or Groups :The license must not discriminate against any person or group of persons.
8. No Discrimination against Fields of Endeavor: The license must not restrict anyone from making use of the work (including manufactured hardware) in a specific field of endeavor. For example, it must not restrict the hardware from being used in a business, or from being used in nuclear research.
9. Distribution of License :The rights granted by the license must apply to all to whom the work is redistributed without the need for execution of an additional license by those parties.
10. License Must Not Be Specific to a Product :The rights granted by the license must not depend on the licensed work being part of a particular product. If a portion is extracted from a work and used or distributed within the terms of the license, all parties to whom that work is redistributed should have the same rights as those that are granted for the original work.
11. License Must Not Restrict Other Hardware or Software :The license must not place restrictions on other items that are aggregated with the licensed work but not derivative of it. For example, the license must not insist that all other hardware sold with the licensed item be open source, nor that only open source software be used external to the device.
12. License Must Be Technology-Neutral : No provision of the license may be predicated on any individual technology, specific part or component, material, or style of interface or use thereof.

LO2- Evaluate and report on options

Reviewing and Testing Hardware

Starting System Testing

The number of vendors we choose ranged from the largest system builders to the small, screwdriver shops. The criteria for being in the evaluation was to meet the list of basic requirements and send three systems for testing. We needed the systems for ninety days. In many cases, we did not need the systems that long, but it's good to have the time to thoroughly investigate the hardware.

Two of the three systems were racked, the third was placed on a table for visual inspection and testing. The systems on the tables had their lids removed, and were digitally photographed. Later the tabled systems would be used for the power and cooling tests and visual inspection. The other two systems were integrated into a rack in the same manner as all our clustered systems, but they did not join the pool of production systems. Some systems had unique physical sizing and racking restrictions that prevented our being able to use them.

Each model of system had a score sheet. The score sheets were posted to our working group's web-page. Each problem was noted on the website, and we tried to contact the vendor to resolve any issues. In this way we tested the system, the vendors willingness to work with us, and their ability to fix problems. We had a variety of experiences. Some vendors just shipped us another model, some worked through the problem with us, others responded that it was not a problem, and one or two ignored us. This quickly narrowed the systems that we considered manageable.

Throughout the period of testing, if a system was not doing a specific task it was running hardware testing scripts or run-in scripts. Each system did 'run-in' for at least thirty days. No vendor does 'run-in' for more than seventy-two hours, and this allowed us to see failures over the long term. Other labs reported that they too saw problems over long testing cycles.

We wanted to evaluate a number of aspects of all the systems. First, the quality of the physical engineering. Second, how well it operated and if it was stable. Third, measure a system's performance. Last, evaluate the contract, support, and vendor's responsiveness.

Physical Inspection

The systems placed on the table were evaluated by several criteria:

1. Quality of construction
2. Physical design
3. Accessibility
4. Quality of the power supply
5. Cooling design

Quality of Construction

The systems greatly varied in quality of construction. We found bent-over, jammed ribbon-cables, blocked airflow, flexible cases, and cheap, multi-screw access that were unbelievably bad for a professional product. There were poor design decisions, like a power switch offset in the back of a system that was nearly inaccessible once the system was racked. On the positive side of the experience, there were a few well engineered systems.

Physical Design:

This evaluation would include quality of airflow and cooling, rack ability size/weight, and system layout. Features such as drive bays out the front would also be noted. Airflow is a big problem with the hot x86 CPUs especially in restricted space like a 1U rack system. Some systems had blocked airflow or had little to no circulation. Heat can cause instability in systems and reduce operational lifetimes, so good airflow is critical.

Physical Construction:

Rigidity of the case, no sharp edges, how the system fit together, and cabling, are part of this category. These might seem small, uninteresting factors until you get cut by a system case, or have a huge percentage of 'dead on arrivals' because the systems were mishandled by the shipper and the cases were too weak to take the abuse. We have to use these systems for a number of years, and to have a simple yet glaring problem is a pain and potently expensive to maintain.

Accessibility:

Tool less access should be a standard on all clustered systems. When you have thousands of systems, you are always servicing some. To keep the cost of that service low, parts should be quickly and easily replaceable. Unscrewing and screwing six to eight tiny machine screws slows down access to the hardware. Also, parts that fit so one part does not have to come out to get to another part and easy access to drives are pluses. Some features that we did not ask for, like keyboard and monitor connections on the front of the case are o.k., but not really necessary.

Power

We tested the quality of the power supply using a Dranetz-BMI Power Quality Analyzer (see sidebar). Power correction is often noted in the literature for a system, but we have seen radically different measurements relative to the published number. For example, one power supply that was published to have a power factor correction of .96 actually had a .49 correction. This can have terrible consequences when multiplied by 512 systems. We tested the system at idle and under heavy load. The range of quality was dramatic and an important factor in choosing a manageable system.

The physical inspection, features, cooling and power-supply quality test weeded out a number of systems early. Getting these out of the way first reduced the number of systems that we had to do extensive testing on, thereby reducing the amount of time for testing in general. System engineering, design, and quality of parts ranged broadly. Moving to the next testing stage would also cull the herd and result in systems that we have been pleased to support.

Testing via Software

Run-In

Run-in (often called burn-in) is the process that manufacturers use to stress systems before they put them in the field. It is used to find faulty hardware. There are a number of open source run- in programs. One common program is the Cerberus Test Control System. It is a series of tests and configurable wrapper scripts designed originally for VA Linux System's manufacturing. Cerberus is ideal for run-in tests, but we also developed specific test based on our knowledge of system faults. We were successful in crashing systems with our scripts more often than using a more general tool such as Cerberus. Testing using programs developed from system work experience can be a more effective than using Cerberus alone, so consider creating a repository of testing tool.

Read the instructions carefully and realize that run-in programs can damage a system; you assume the risk by running Cerberus. Also, there are a number of knobs to turn, so consider what you are doing before you just launch the program. But if you are going to build a cluster, you will need to test system stability, and run-in scripts are designed to test just that quality.

Performance

There are a plethora of benchmark programs. The best bench-mark is to run the code that will be used in production just like it is good to run production code during run-in. This is not always possible, so a standard set of benchmarks is a decent alternative. Also, standard benchma rks establish a relative performance value between systems, which is good information. We do not expect a dramatic performance deference in commodity chipsets and CPUs, but there are performance differences when different chipsets/motherboard combinations are involved, which was the case in this testing trail.

Hardware, Software and Service testing and review

Pre-/post-launch product evaluation, usability testing and focus group services provide full competitive analysis, including media review score forecasting, SWOT analysis, design feedback and marketing insight from top industry experts.

- top industry critics
- diverse focus groups (enthusiast, consumer, Print/online/tv)
- actionable feedback
- Product design and features
- advertising and Marketing
- Positioning and Pricing

Organizational requirements

Requirements

A requirement is an attribute of a product, service or system necessary to produce an outcome(s) that satisfies the needs of a person, group or organization. Requirements therefore define "the problem." In contrast, "the solution" is defined by technical specifications.

Defining requirements is the process of determining what to make before making it. Requirements definition creates a method in which appropriate decisions about product or system functionality and performance can be made before investing the time and money to develop it. Understanding requirements early removes a great deal of guesswork in the planning stages and helps to ensure that the end-users and product developers are "on the same page."

Requirements provide criteria against which solutions can be tested and evaluated. They offer detailed metrics that can be used to objectively measure a possible solution's effectiveness, ensuring informed purchasing decisions on products, systems or services that achieve the stated operational goals. A detailed requirements analysis can uncover hidden requirements as well as discover common problems across programs and various DHS operating components. Detailed operational requirements will guide product development so that solutions specifications actively solve the stated problems.

We could save ourselves a lot of work if we jump straight to "the solution" without defining "the problem." Why don't we do that? Because if we take that shortcut we are likely to find that our solution may not be the best choice among possible alternatives or, even worse we're likely to find that our "solution" doesn't even solve the problem! Defining requirements and adhering to developing solutions to address those needs is often referred to as "requirements-pull." In this situation, user requirements drive product development and guide the path forward as the requirements dictate.
Technology push should not be ignored, but if the goal is successful transition to the field with acceptable risk, the technology being pushed must be compared with alternative solutions against

a real set of user requirements. Aside from assuring that the “solution” actually solves the “problem,” requirements driven design has a further advantage in that the requirements provide criteria against which a product’s successful development can be measured. Specifically, if the product was developed to address a set of quantified operational requirements, then its success is measured by Operational Test and Evaluation (OT&E) to validate that an end-user can use the product and achieve the stated operational goals.

The requirements and specifications are described below, first those that define the problem and then those that define the solution:

- Problem Definition

  - Mission Needs Statement (MNS) is required by the DHS Investment Review Process(Management Directive 1400, Appendix G) and is developed by the DHS sponsor (S&T’s customer) who represents the end users. The MNS provides a high-level description of the mission need (or, equivalently, capability gap), and is used to justify the initiation of an Acquisition program.

  - Operational Requirements Document (ORD) is also required by the DHS Investment Review Process and, like the MNS, is developed by the DHS sponsor. The ORD specifies operational requirements and a concept of operations (CONOPS), written from the point of view of the end user.

The ORD is independent of any particular implementation, should not refer to any specific technologies and does not commit the developers to a design.

- Solution Definition
  - Performance Requirements represent a bridge between the operationally oriented view of the system defined in the ORD and an engineering oriented view required to define the solution. Performance requirements are an interpretation, not a replacement of operational requirements.
  - Performance requirements define the functions that the system and its subsystems must perform to achieve the operational objectives and define the performance parameters for each function. These definitions are in engineering rather than operational terms.
  - Functional Specifications define the system solution functionally, though not physically. Sometimes called the “system specification” or “A-Spec,” these specifications define functions at the system, subsystem, and component level including:

    - Configuration, organization, and interfaces between system elements
    - Performance characteristics and compatibility requirements
    - Human engineering
    - Security and safety
    - Reliability, maintainability and availability

- Support requirements such as shipping, handling, storage, training and special facilities

- Design Specifications convert the functional specifications of what the system is to do into a specification of how the required functions are to be implemented in hardware and software. The design specifications therefore govern the materialization of the system components.

- Material Specifications are an example of lower-level supporting specifications that support the higher-level specifications. Material specifications define the required properties of materials and parts used to fabricate the system. Other supporting specifications include Process Specifications(defining required properties of fabrication processes such as soldering and welding) and Product Specifications(defining required properties of non-developmental items to be procured commercially).

Characteristics of Good Requirements

Requirements engineering is difficult and time-consuming, but must be done well if the final product or system is to be judged by the end users as successful. From the International Council of Systems Engineers (INCOSE) Requirements,

here are eight attributes of good requirements:

Necessary: Can the system meet prioritized, real needs without it? If yes, the requirement isn't necessary.

Verifiable: Can one ensure that the requirement is met in the system? If not, the requirement should be removed or revised.

Unambiguous: Can the requirement be interpreted in more than one way? If yes, the requirement should be clarified or removed. Ambiguous or poorly worded requirements can lead to serious misunderstandings and needless rework.

Complete: Are all conditions under which the requirement applies stated? In addition, does the specification include all known requirements?

Consistent: Can the requirement be met without conflicting with any other requirement? If not, the requirement should be revised or removed.

Traceable: Is the origin (source) of the requirement known, and is there a clear path from the requirement back to its origin?

Concise: Is the requirement stated simply and clearly?

Standard constructs: Requirements are stated as imperative needs using "shall." Statements indicating "goals" or using the words "will" or “should” are not imperatives.

Documenting and Submitting Information

Developing Operational Requirements (ORDs): Customer Input So far, we’ve discussed operational requirements but have not provided any insight into how to develop them. In an effort to provide a basic framework for the articulation and documentation of operational requirements, the Operational Requirements Document (ORD) was created. ORDs provide a clear definition and articulation of a given problem, providing several layers of information that comprise the overall problem. Using resources such as this book and the accompanying template, we have tried to simplify and streamline the process of communicating requirements. ORDs can be used in Acquisition, Procurement, Commercialization and Outreach Programs –any situation that dictates detailed requirements. It's clear to see that it's cost-effective and efficient for both DHS and all of its stakeholders to communicate needs clearly and effectively.

Let's first look at the contents of a typical Operational Requirements Document (ORD)

OPERATIONAL REQUIREMENTS DOCUMENT

1.0 General Description of Operational Capability

- 1.1. Capability Gap
- 1.2. Overall Mission Area Description
- 1.3. Description of the Proposed System
- 1.4. Supporting Analysis
- 1.5. Mission the Proposed System Will Accomplish
- 1.6. Operational and Support Concept
  - 1.6.1. Concept of Operations
  - 1.6.2. Support Concept

2.0 Threat

3.0 Existing System Shortfalls

4.0 Capabilities Required

- 4.1 Operational Performance Parameters
- 4.2 Key Performance Parameters (KPPs)
- 4.3 System Performance
  - 4.3.1 Mission Scenarios
  - 4.3.2 System Performance Parameters
  - 4.3.3 Interoperability
  - 4.3.4 Human Interface Requirements
  - 4.3.5 Logistics and Readiness

4.3.6 Other System Characteristics

5.0 System Support

5.1 Maintenance

5.2 Supply

5.3 Support Equipment

5.4 Training

5.5 Transportation and Facilities

6.0 Force Structure

7.0 Schedule

8.0 System Affordability

Appendixes

Glossary