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Continuity of Operations Leadership Series for Government

Integrating Continuity of Operations (COOP) into the Enterprise Architecture

Technology Pillar

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Technology

Technologies are often thought of as solutions in the area of hardware and software exclusively. Actually, technology is a body of knowledge used to achieve objectives and to improve and facilitate the way people and things function. Technology can be anything that helps to advance a cause. In this sense, technology can be hardware or software, but it can also be processes, methods and tools. An organization advances in its use of technology, for instance, when it reengineers its processes and is able to achieve its objectives more effectively.

New technology doesn't just happen—it has to be invented and developed. Once it is available, organizations have to find it, adapt it to their environment and use it effectively. Technologies that are not used effectively may be more harmful than helpful.

Information Technology (IT) is a specific domain of technology. The IT Association of America (ITAA) defines IT as "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware." This definition states that the primary concentration is on computer-based systems, but the entire definition leaves room for other areas of science, research and technology. Implementation, support and management of IT require technologies from numerous fields. Most importantly, IT and science in general are expanding rapidly and are touching more and more areas and activities.

In the past, process technology was considered related only to manufacturing, but the concepts of Business Process Reengineering (BPR) have shown that processional processes are important technologies as well. From a process perspective, one critical question that needs to be addressed for Continuity of Operations (COOP) is whether normal operational processes can be utilized during COOP situations. In some cases different, streamlined processes may be required during COOP that will demand new or different information technologies.

A Technology Process

Technology, to be useful for normal operations and to support effective COOP situations, must be identified, verified and implemented. Organizations should implement a process for investigating new technologies and vetting them so that they find appropriate technologies. Technologies should never be pursued because they are considered the new thing or "state-of-the-art." Some organizations may shy away from research and development (R&D) efforts. Managers who are required to implement solutions may deem R&D as a "sandbox" where the technologists throw away money for fun. There may not be a need for true R&D for many organizations, but lab efforts or pilot programs may be needed in order to demonstrate concepts and capabilities. It may be possible to glean information and demonstrations from others, such as actual demonstration history in private industry, but in some cases, these efforts will have to be done in-house.

Identifying and utilizing relevant technologies is not an easy undertaking. There are many sources of technology advancement, and to some, there appears to be no order to the scientific efforts that abound. Government entities, universities and private industry are continuously looking for new and better technologies. Identifying the ones that are meaningful to an organization may be difficult, especially if it requires insight into everything that is going on in a particular field. To simplify the technology effort, organizations should develop a process for investigating and judging technologies and their value. Figure 1 provides a sample of such a process.

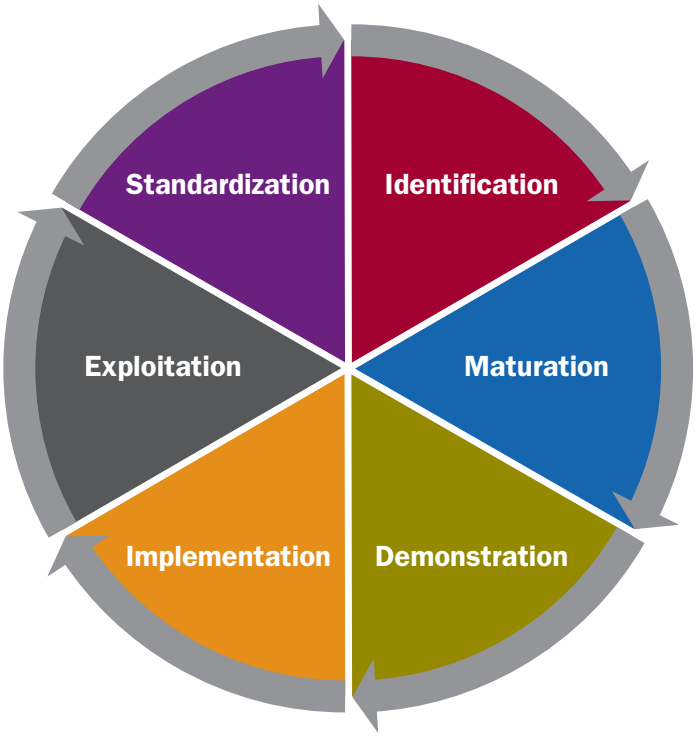

Figure 1: Technology Process

Some organizations will form technology committees to review technologies. These committees should track the progress of various technologies through the technology process and should be involved in making relevant technologies part of the organization's technical architecture and culture.

Identification

There are sources for technology and an organization can choose those sources upon which it will depend. The easiest approach is to let the technology come to the organization through private enterprise seeking to sell a capability. While this may be very typical, it is the least efficient means of acquiring new technologies. And while it may appear to cost nothing, there is considerable time involved. The reason this approach is so inefficient is that private enterprises may not understand the real nature of the problem the organization is trying to solve. They must sell the idea that they have the correct solution to match the organization's problem. In some cases, the fit is perfect, but this will normally be the exception rather than the rule. Most solutions will be replacements or upgrades to existing systems, but may not fit with current processes or organizational culture.

Another approach is to find relevant technologies through a Request for Information (RFI) process. This is highly effective since an RFI can be focused and can be made confidential so that vendors will provide insight into future advances. The difficulty with RFIs is that they are resource intensive for both the vendors who develop responses and for the organization that will evaluate them. Another issue with RFIs is that they normally precede procurement and may make vendors prepare for such an event, even if it is just a fact-finding mission. Most importantly is that if an organization uses RFIs often, without procurements, vendors will grow weary and stop responding or may respond with marking brochures.

Government research programs are also a good place to find out about future technologies. However, programs under the control of the National Science Foundation (NSF) or a department research effort such as those in the Defense or Energy departments will have very long lead times, if they ever come to the market. Agency programs such as Small Business Innovation Research (SBIR) can also provide some insights regarding ongoing effort to bring about new capabilities. SBIRs typically have a shorter time frame for bringing about a commercial capability.

Another approach to discovering new technologies includes university research efforts, which will be regularly detailed in professional journals and research dissertations. University efforts are often funded through grants and often relate to cutting-edge technology that can be deployed as a pilot in the near term.

To find technologies that are currently being prepared for the commercial market, the best source will be venture capital (VC) firms. VCs are trying to invest in new and innovative capabilities that will satisfy a market need in the near term.

Building relationships with vendors and VC firms can be very fruitful, especially if a department or agency is willing to share its requirements and future plans with these commercial entities. To do this, agencies should consider establishing a forum, such as a conference, for conducting open interchanges with vendors.

Maturation

Once a technology passes research criteria and has proven to be of some value, development of the technology must ensue. The technology, having been researched and evaluated from a scientific point of view, must be transformed into useful capabilities through engineering. As the engineering occurs, technology solutions are tested and improved in a maturing process that can take years.

As a technology matures, early adopters will begin to use the experimental forms of the technology. In some cases, this use will be concealed because the technology provides a competitive capability. However, the technology developers and their financial backers will be very interested in getting the word out about the technology and its capabilities.

Agencies should investigate these new technologies and measure their effectiveness in solving problems and improving efficiencies. Of interest is identifying when and where a technology is being used and what the impacts are.

Another key indicator of new technical capabilities and their rate of maturity will be an understanding of how much money is being spent on the technology and how much interest there is. One simple measure is to track conferences related to a technology and notice what organizations sponsor the event and how many attendees are present. Attending these same conferences will permit agency representatives to meet and exchange information with other attendees.

Demonstration

As a technology matures, there will be evidence of its use. Initially, this use may be in an advanced government program where a critical need exists. Eventually, however, the technology will be adapted for commercial use. Private industry will typically seek technologies that will add efficiencies to their efforts and yield greater productivity.

As private enterprises begin to utilize new technologies, agencies should engage with these industry leaders to better understand why the technology is of value and how it can be adapted to work for federal enterprises.

In fact, many integrators spend considerable efforts finding new technologies, vetting them and presenting them as solutions to federal organizations. Many of these opportunities will be identified in contract proposals or integrator meetings. Agencies should look to integrators to provide insight into how technologies can be adapted for their use.

Based on what is gleaned regarding new capabilities, agencies should bring the technologies in-house for a demonstration in their own environment. By developing a small pilot, a great deal of evidence can be gathered regarding how the technology will be used by the agency and how effective it may be. At first, in-house demonstrations and pilots will not show much, but as the technology is adapted and as the organization adapts to the technologies, better measures will begin to result.

Implementation

When a technology pilot begins to show that there is value in a new technology, the organization needs to evaluate the benefits of a larger implementation. This evaluation should be a comprehensive cost-benefits analysis or a business case study that can be evaluated by the organization's leadership. While a technology may have great promise, it will ultimately be judged based on how much value it brings for the cost and how it compares to other technology opportunities.

All technologies require investment and federal agencies have limited dollars to invest in new technologies and capabilities. Therefore, they will and must compare opportunities and select those that help them achieve their most important goals and that fit within their defined budgets. Even if it is proven that a new technology will reduce overall costs, the up-front cost of incorporating the technology may prevent it from being deployed.

The key is that technologies should only be deployed when they have proven their usefulness and when there are resources to implement them. From a COOP perspective, the identification of essential functions will go a long way in helping an organization decide which technologies are the most appropriate.

Exploitation

Once a technology has been implemented within an organization, it should be exploited to its fullest extent. Technologies begin to age the moment they are deployed and their value will be maximized if they are not used to the greatest extent possible.

If an organization has a technology committee, this committee should evaluate various implemented technologies to see how they can best be utilized. The committee should also measure the effectiveness of the technologies over time to see how closely the business case captured the essence of the technology's value. This information can then be used to determine how precise the business case analysis approach is and can possibly be used to improve it.

Standardization

Technologies proven to be of value to the organization need to be standardized. This standardization is typically implemented by making the technology part of the organization's technical architecture, which is a subset of the Enterprise Architecture (EA). The technical architecture does more than delineate the technology as a viable solution, but identifies it as a preferred solution. The technical architecture should also detail how the technology is to be implemented and under what circumstances. The key is to make sure that it is utilized correctly and provides the greatest value to the rest of the organization.

Standardization goes beyond incorporating a technology into the organization's EA. If a national or international standards body has not yet standardized the technology, the federal organization should, if at all possible, help it along this path. Many government organizations are represented on leading standards bodies and should promote technologies they find to be of value. The obvious reason for this is that commercial standards make a technology more universal and available. When a technology is more available commercially, it will get cheaper.

Technical Solutions

Technologies will fall into different categories. Since IT touches nearly every aspect of modern organizations, it is critical to understand what technologies are available. Some organizations are divided into functional or operational divisions. It is possible for certain aspects of their business efforts to be ignored because there is no direct funding line or there is no responsible program manager.

As essential functions are defined for COOP, the essential functions need to be decomposed. These decomposed functions can then be matched to technologies that can support them. In essence, technology taxonomy is needed so that there is a concerted effort to track all technology areas that can benefit the organization. This taxonomy will serve as a map of technology solution areas that need to be addressed.

Solutions Areas

Solution areas can be found across the spectrum of systems and services. As an example, Table 1 provides a high-level taxonomy of possible solution domains.

Primary	Secondary	Tertiary
Communications	Networking	Routing
		Switching
		Wireless
		Secure
		Remote Access
		Mobile
	Network Applications	
	Web Technologies	
	Telephony	Switched
		Cell
	Radio	
Data, Information, Knowledge	Backup, Storage, Retrieval	Database
		SAN
	Data Mining	
	Records Management	
Intelligence	Collection	
	Analysis	
	Dissemination	
Security	Physical Security	
	Cyber Security	Identification
		Authentication
Logistics	Identification	RFID
		Biometrics
	Location-Based Services	GPS
Management	Workflow	
	Infrastructure	
	Personnel	
	Program	
	Collaboration	
Process	Enterprise Architecture	Methods, Tools
	Life Cycle Development	Methods, Tools
	Systems Management	Methods, Tools
	Systems Engineering	Methods, Tools
	Technology	Methods, Tools

The solution taxonomy makes no implications regarding the types of solutions that are capable of supporting or solving different problems or risks. Additionally, the taxonomy represents only a fraction of the potential solution space.

Adaptive Technologies

The concept of adaptive technology is usually related to modifying technologies and systems to support its use by people with handicaps. From a COOP perspective, adaptation of technology relates to changing the use of the technology to support COOP operations. Some technologies will be implemented to serve an operational purpose during normal operations and then adapted to serve a different purpose during COOP operations.

Dual-Purpose Technology

Technologies can serve multiple purposes and can be modified or adapted to ensure that several problems can be solved or addressed simultaneously. Because COOP presents new and challenging problems, there may be cases where a single technology can be used for multiple purposes. Dual-purpose technologies, if implemented correctly, can save resources.

One view of dual-purpose technology is that it is integrated into the organization for day-to-day operations and then utilized in a similar or different fashion during COOP. This approach serves two purposes. First, the technology is reused and therefore may cost less to implement and maintain. Second, since personnel will be familiar with the technology, it can be more rapidly and effectively utilized. If a new and unused technology is deployed for COOP, it will be difficult to overcome the initial learning curve that exists with all technologies.

Dual-purpose technologies may be difficult to implement, especially in cases were a single technology is to be used by multiple, silo-oriented organizations. Careful consideration should be given to the types of technology to be used and the impact of not having dedicated capabilities assigned to each function.

Evaluating Solutions Through Modeling and Analysis

There are many different modeling techniques available to analyze technological solutions to organizational operations and COOP issues. Techniques exist that are very rigorous and require significant expertise. Some of the well-known modeling and analysis techniques are structured analysis; Unified Modeling Language (UML), which uses Object-Oriented Analysis (OOA); and Multi-Attribute Utility Assessment (MAUA).

Structured Analysis

Structured analysis is a method for analyzing organizational and system life cycle requirements and development specifications for system design and development. Structured analysis typically includes numerous techniques that use a “structured” process for developing models of the system being analyzed. Some of these techniques include:

- Context Diagrams
- Work Breakdown Structure (WBS)
- Process Flow Charts
- Data Flow Diagrams
- Event Trace
- State Diagram
- Decision Tables
- Data Dictionary

Structured analysis usually requires the use of multiple analysis techniques to provide different views of the systems being developed. An advantage of structured analysis is that the techniques are well known and therefore, understood by most system developers.

Unified Modeling Language (UML)

UML is a standardized set of analysis techniques that are combined to provide a rigorous object modeling framework. It is a general-purpose modeling language that uses graphical notations that are easily understood. The combined technique helps to create abstract models of complex systems that can be easily interpreted by analysts, designers and managers alike. The models incorporated in UML include:

- Use Case
- State Machine
- Activity Diagram
- Event Trace
- Timing Diagram
- Communications Diagram
- Entity/Component Diagram
- Object Diagram
- Package Diagram

UML is defined and standardized by the Object Management Group (OMG) and can be used to analyze any type of system, including hardware, software or information systems.

Multi-Attribute Utility Assessment (MAUA)

Multi-Attribute Utility Assessment (MAUA) is a technique that provides an analysis based on stakeholder weights with the objective of removing unrelated issues from the decision-making process. MAUA has been successfully used for over three decades to support decision making. As a decision support process, it is often implemented as part of a decision support system and its results are interpreted by decision makers. MAUA can be performed for any situation where there are multiple solutions to select from and those solutions have multiple attributes that need to be considered.

Based on predefined attributes and utilities, a system can be accessed through relatively easy mathematical analysis. In most cases, an alternative approach can be compared to other options, through a scoring system. Scores are normally calculated by summing the product weights and utilities for each attribute.

The advantage of MAUA is that stakeholders are involved early on in the process by helping to determine attributes and weights. Therefore, the outcomes are driven by the stakeholder rather than by the analysts. Once an analysis is completed, decision makers are given relative scores that can be judged based on the original input, giving them leeway to make adjustments.

Conclusion

Technology is not simply hardware and software. It is anything that helps people and organizations improve the way things are accomplished. IT is a defined type of technology, but it must include areas such as process, since effective organizations require an alignment between IT and processes. To be effective, nearly all processes depend on information technologies to store, retrieve, manipulate and analyze data and information.

Technology is continuously changing and for most organizations it is difficult to find new and innovative technologies. In many cases, organizations wait until a technology is fully commercialized before being able to take advantage of it. To find technologies, especially emerging technologies, organizations need a technology process.

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A technology process should identify appropriate technologies from multiple sources and track available technologies as they mature. Once a candidate technology has matured to a level that it can be demonstrated, organizations should validate the technology through demonstrations and pilots. If they are unable to demonstrate the technology directly, they should look to other organizations, perhaps in private industries, which have begun to deploy it and demonstrate its viability. Once demonstrated and an adequate business case made, the technology should be implemented. After implementing a technology, the organization should exploit it to its greatest extent possible, measuring its effectiveness and attempting to continuously improve it. Finally, the technology should be standardized as part of the technical architecture of the organization.

Finding technological solutions requires that organizations define their existing problems, including those imposed by COOP scenarios, and map pertinent technological solutions to those problems. Defining the problems and solutions through functional decomposition is critical to understand how essential functions will be accomplished. Likewise, it is necessary to create a technology solution taxonomy that can be used to match technologies with problems. In finding solutions, organizations should try to find technologies that can be used during normal operations and be used during or adapted for COOP operations.

Finally, organizations need to utilize modeling and analysis techniques to support the technology process. The problems that need to be solved are often so complex that it is difficult to identify all of the issues. Analysis techniques, such as structured analysis, UML, MAUA, and others can go a long way to identifying the critical issues that need to be addressed. Fundamentally, these tools will help organizations model their COOP environment, so that they can have a greater opportunity to find solutions before a crisis occurs.

About Juniper Networks

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