Chapter 6
Information Systems Strategy: Architecture and Infrastructure

Managing and Using Information Systems: A Strategic Approach

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Learning Objectives

- Understand how strategy drives architecture which then drives infrastructure.
- Identify and define the three configurations for IT architecture.
- Define how business goals can be translated into IT architecture and then into infrastructure.
- Know the different types of frameworks used to design and build the IT architecture and infrastructure.
- Understand the importance of knowing the details of the existing architecture and infrastructure of the organization.

Real World Examples

- Over the past 10 years Valero Energy (gas/oil refiner) has experienced hyper-growth.
- Revenue has grown from $29 to $90 billion.
- This growth came with a mixture of disparate IT systems and applications.
  - Difficult and expensive to manage.
  - Not easily integrated into ERP system.
- IT architecture needed to be redesigned to meet future needs.
  - Flexible in design and able to grow with the company.
  - An SOA system was selected (SAP R/3 ERP).
  - 90 service components were built on the SAP platform.

Real World Example

- The new system was a hit!
  - Development costs were kept down.
  - One application saved the company $500K in fees.
  - New systems made operations more efficient and effective.
  - Managers were able to control the loading and unloading of tankers that was previously unavailable.

- Visit http://www.valero.com/ for more information on the company.

FROM VISION
TO
IMPLEMENTATION

From Vision to Implementation

- Architecture translates strategy into infrastructure (see Figure 6.1).
- The architect develops plans based on a vision of the customer of the system (or in this example a house) which is a blueprint of the companies systems.
- This “blueprint” is used for translating business strategy into a plan for IS.
- The IT infrastructure is everything that supports the flow and processing of information (hardware, software, data, and networks).

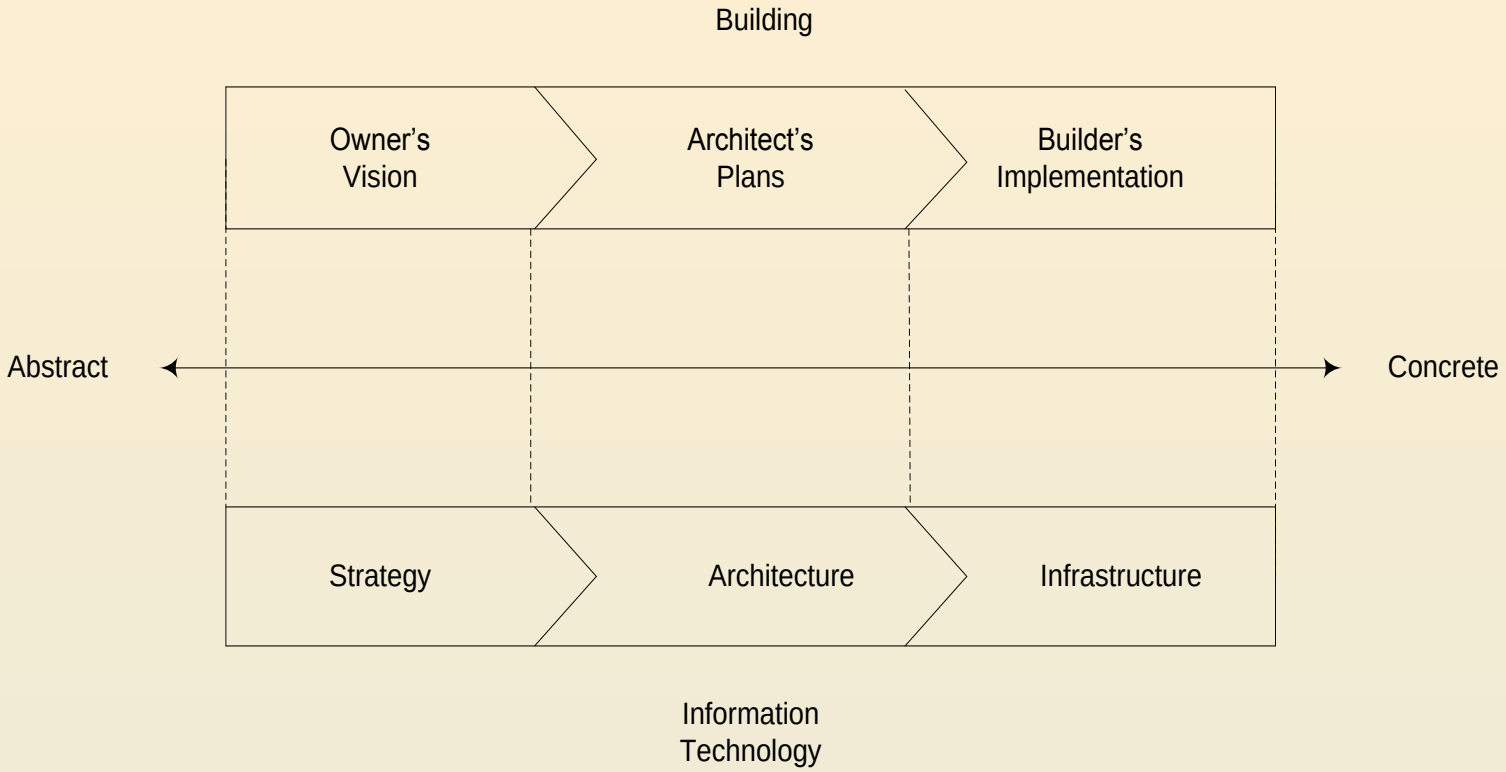

Figure 6.1 From abstract to concrete – building vs. IT.

The Manager's Role

- Must understand what to expect from IT architecture and infrastructure.
- Must clearly communicate their business vision.
- May need to modify the plans if IT cannot realistically support them.
- Manager MUST be involved in the decision making process.

THE LEAP FROM STRATEGY TO ARCHITECTURE TO INFRASTRUCTURE

From Strategy to Architecture

- Manager must start out with a strategy.
- This strategy must then be used to develop more specific goals as seen in Figure 6.2.
- Business requirements must be fleshed out for each goal in order to provide the architect with a clear picture of what IS must accomplish.
- Figure 6.3 shows how this detailed process is accomplished.

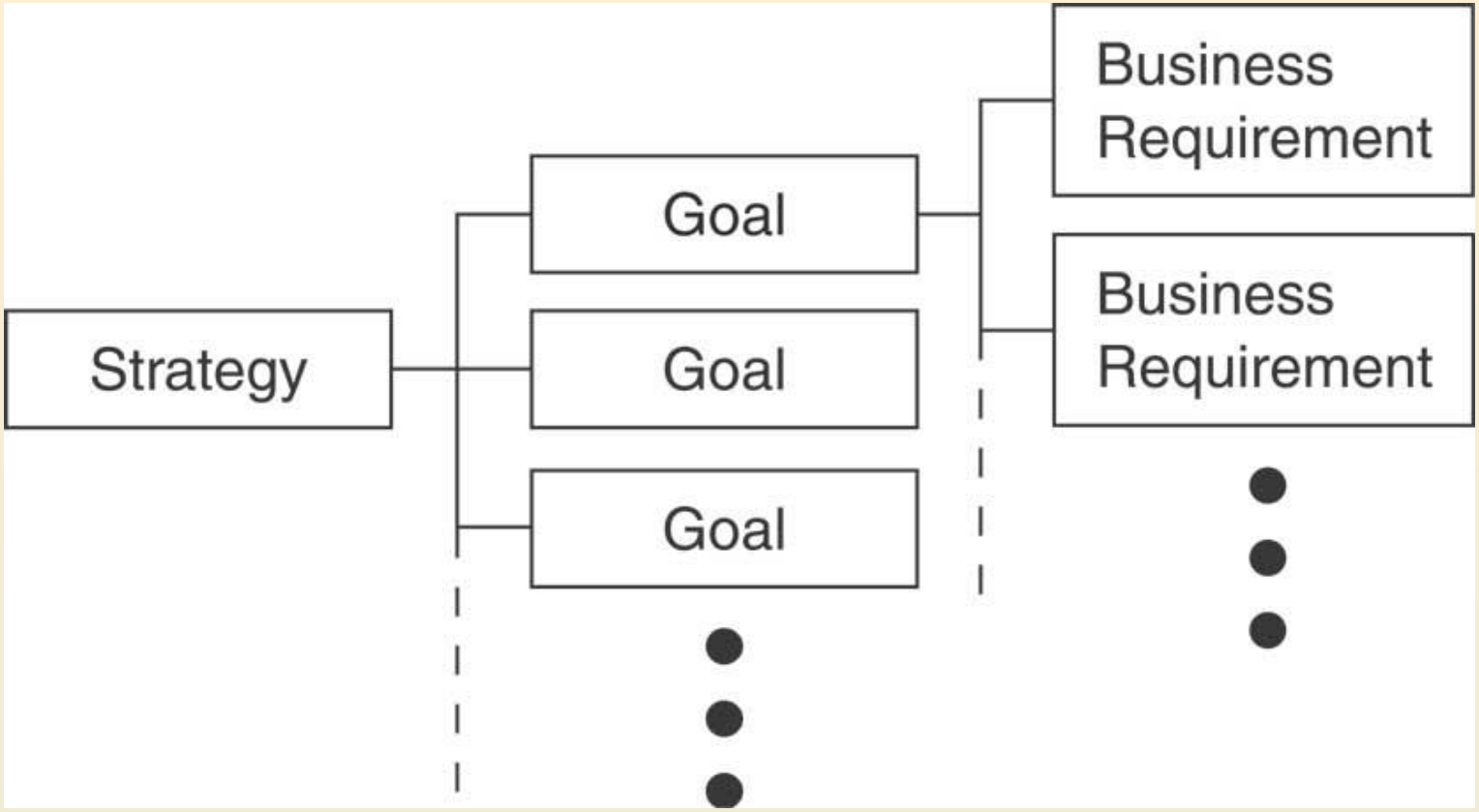

Figure 6.2 – From Strategy to Business Requirements

From Architecture to Infrastructure

- This stage entails adding more detail to the architectural plan.
- This detail comprises the actual hardware, software, data, and networking.
  - Figure 6.2 shows this phase.
- These components must be combined in a coherent fashion.
- Global level – focus at the enterprise level; Inter-organizational level – focus on communications with customers, suppliers or other stakeholders.

A Framework for the Translation

- Consider the following when developing a framework for transforming business strategy into architecture and then infrastructure:
  - Hardware – physical components.
  - Software – programs.
  - Network – software and hardware.
  - Data – quantity and format of data is of utmost concern.
- The framework that guides analysis of these components is found in Figure 1.9.
- Figure 6.3 contains questions that typify those asked in addressing architecture and infrastructure issues associated with each component.

A Framework for Translation

- Managers must begin with an overview that is complete.
- The framework must answer the what, who and where questions for each infrastructure component.
  - What is the specific type of technology?
  - Who is involved (individuals, groups, departments)?
  - Where is everything located?
- Table 6.3 shows the connections between strategy and systems.

Component	What		Who		Where	
	Architecture	**Infrastructure**	**Architecture**	**Infrastructure**	**Architecture**	**Infrastructure**
Hardware	Does fulfillment or our strategy require thick or thin clients?	What size hard drivers do we equip our thick clients with?	Who knows the most about servers in our organization?	Who will operate the server?	Does our architecture require centralized or distributed servers?	Must we hire a server administrator for the Tokyo office?
Software	Does fulfillment or our strategy require ERP software?	Shall we go with SAP or Oracle applications?	Who is affected by a move to SAP?	Who will need SAP training?	Does our geographical organization require multiple database instances?	Does Oracle provide the multiple-database functionality we need?
Network	What kind of bandwidth do we need to fulfill our strategy?	Will 10BaseT Ethernet suffice?	Who needs a connection to the network?	Who needs an ISDN line to his or her home?	Does our WAN need to span the Atlantic?	Shall we lease a cable or use satellite?
Data	Do our vendors all use the same EDI format?	Which VAN provides all the translation services we need?	Who needs access to sensitive data?	Who needs encryption software?	Will backups be stored on-site or off-site?	Which storage service shall we select?

Figure 6.3 Infrastructure and architecture analysis framework with sample questions.

Architecture Examples

- Three common configurations of IT architecture.
  - Mainframe – employs a large centralized computer that handles all of the functionality of the system.
  - Client/server - widely used and relies and clients that request services and servers that respond to these requests. The workload is shared and distributed.
  - SOA (Service Oriented Architecture) – where larger software programs are broken down into services which are then connected to each other (services could be web based, or in completely different physical locations).
- Managers must be aware each ones trade-offs.
- Figure 6.7 summarizes the characteristics of each of the architectures.

Other Frameworks

- Peer-to-peer – allows networked computers to share resources (no central server needed).
- Wireless (mobile) – can utilize a variety of wireless technologies (fixed microwave, wireless LANs, cellular, satellite links, etc.)
- Web-oriented architecture (WOA) – where significant hardware, software and possibly even data elements reside on the Internet.
  - Greater flexibility
  - Capacity-on-demand

ARCHITECTURAL PRINCIPLES

Architectural Principles

- Based on a set of principles, or fundamental beliefs about how the architecture should function.
- Architecture principles must be consistent with enterprise values as well as the technology used in the infrastructure.
- Number of principles vary widely.
- Should define the desirable behaviors of the IT systems.
- Figure 6.4 shows a sample architectural principles.

PRINCIPLE	DESCRIPTION
Ease of use	The IT architecture will promote ease of use in building and supporting the architecture, and solutions based on the architecture.
Single point of view	The IT architecture will enable a consistent, integrated view of the business, regardless of access point.
Buy over Build	Business applications, system components, and enabling frameworks will be purchased unless there is a competitive reason to develop them internally.
Speed and quality	Architectural decisions will be made with an emphasis on accelerating time to market for solutions, while still maintaining required quality levels.
Flexibility and agility	The IT architecture will incorporate flexibility to support changing business needs and enable evolution of the architecture and the solutions built on it.
Innovative	The IT architecture will support incorporation of new technologies and facilitate innovation.
Data Security	Data is protected from unauthorized use and disclosure.
Common Data Vocabulary	Data is defined consistently throughout the

FIGURE 6.4: SAMPLE OF IT ARCHICTURE PRINCIPLES

ENTERPRISE ARCHITECTURE

Enterprise Architecture

- The “blueprint” for all IS for the entire organization.
  - Specify how IT will support business processes.
  - Identifies core processes of the company and how they will work together.
- Four key elements:
  - Core business processes
  - Shared data
  - Linking and automation technologies
  - Customer groups

Enterprise Architectures

- Examples:
  - Zachman – goes farther by asking how, when, and why?
  - TOGAF (The Open Group Architecture Framework) – seeks to provide a practical, standardized methodology to successfully implement an Enterprise Architecture into a company.

OTHER MANAGERIAL CONSIDERATIONS

Understanding existing architecture

- Understanding existing architecture allows managers to evaluate the IT requirements of an evolving business strategy vs. their current IT.
- Plans for the future architecture can then be compared with the current infrastructure to help identify which components of the current system can b e used in the system being developed.

Relevant questions for managers:

- What IT architecture is already in place?
- Is the company developing the IT architecture from scratch?
- Is the company replacing an existing architecture?
- Does the company need to work within the confines of an existing architecture?
- Is the company expanding an existing architecture?

Strategic IT planning and legacy systems

- Managers usually must deal with adapting existing architectures as part of planning their new systems.
- In so doing they encounter both:
  - the opportunity to leverage the existing architecture and infrastructure and
  - the challenge to overcome the old system's shortcomings.

Working with Legacy Architectures

- The following steps allow managers to derive the most value and suffer the fewest problems when working with legacy systems:
  - 1. Objectively analyze the existing architecture and infrastructure
  - 2. Objectively analyze the strategy served by the existing architecture.
  - 3. Objectively analyze the ability of the existing architecture and infrastructure to further the current strategic goals.

Strategic Time Frame

- Managers must understand the life span of an IT infrastructure and architecture.
- They also must determine how far the strategy will extend into the future.
- Strategic time frame depends on industry-wide factors.
- Length of life of architecture depends upon how reliant the manager is on IT, and how advanced are being made in their field.
- Flexibility and agility will prove to be critical to an organization (Valero for example).

Assessing Technical Issues: Adaptability

- Can the architecture adapt to emerging technologies?
- Must be able to handle expected technological advances (storage and computing power).
- Consider both hardware and software.
- Guidelines for planning adaptable IT architecture and infrastructure:
  - Plan for applications and systems that are independent and loosely coupled rather than monolithic.
  - Set clear boundaries between infrastructure components
  - When designing a network architecture, provide access to all users when it makes sense to do so.

Assessing Technical Issues: Scalability

- Refers to how well an infrastructure component can adapt to increased, or in some cases decreased, demands.
- A network should be able to start small but grow as needed with little or no interruption.
- The system should be designed so that it will not be out grown by the company.
- The Jet Blue example shows how important scalability can be to a company.

Assessing Technical Issues: Standardization

- Hardware and software that adheres to industry standards should be adopted.
- Software packages should be compatible with each other (Microsoft Office suite).
- The manager needs to ask:
  - How easy is the infrastructure to maintain?
  - Are replacement parts available?
  - Is service available?
- Maintainability is a key technical consideration.

Assessing Technical Issues: Security

- Major concern for business and IT managers.
- Must protect key data and process elements of the IT infrastructure.
- Extends outside the boundaries of the company (such as customer data).
- Security measures will depend upon the infrastructure and architecture.
  - Centralized systems require protection around the core system.
  - Decentralized requires more complex security around each local system and the connections and data that pass between these systems.
- Managing security is often managing risk.

Assessing Financial Issues

- Evaluate on expected financial value.
- Can be difficult to quantify.
- Steps
  - Quantify costs
  - Determine the anticipated life cycles of system components
  - Quantify benefits
  - Quantify risks
  - Consider ongoing dollar costs and benefits
- Once completed manager can compute preferred discounted cash flow and payback.

Architecture vs Infrastructure

- Differentiating Between Architecture and Infrastructure
  - Figure 6.5 shows how architecture and infrastructure are evaluated based on the previous criteria.

	Applicability	
Criteria	**Architecture**	**Infrastructure**
Strategic time frame	Very applicable	Not applicable
Technological advances	Very applicable	Somewhat applicable
Adaptability	Very applicable	Very applicable
Scalability/Growth Requirements	Very applicable	Very applicable
Standardization	Very applicable	Very applicable
Security	Very applicable	Very applicable
Maintainability	Very applicable	Very applicable
Staff experience	Very applicable	Very applicable
Assessing financial issues: Net present value Payback analysis Incidental investments	Somewhat applicable	Very applicable

Figure 6.5 Applicability of evaluation criteria to discussion of architecture and infrastructure

FROM STRATEGY TO ARCHITECTURE TO INFRASTRUCTURE: AN EXAMPLE

TennisUp. fictitious case

- TennisUp, a supplier of tennis raquets, serves to illustrate the process of creating IT architecture and infrastructure.
- CEO Love Addin, is concerned because they can hardly keep up with demand.
  - Demand may end and he wants to ensure that TennisUp can respond to sudden changes in demand.
- The process includes four steps:
  - **Step 1**: Define the Strategic Goals
  - **Step 2**: Translate Strategic Goals to Business Requirements
  - **Step 3**: Apply Strategy-Architecture-Infrastructure Framework
  - **Step 4:** Translate Architecture to Infrastructure (see Fig 6.6 & 6.7).
  - **Step 5**: Evaluate Additional Issues

Step 1: Defining the Strategic Goals

- TennisUp's business strategy is to respond to possible changes in demand by creating a system that can respond to sudden changes in demand.
- The company's strategic goals are as follows:
  - To lower costs by outsourcing raquet manufacturing
  - To lower costs by outsourcing raquet distribution
  - To improve market responsiveness by outsourcing raquet manufacturing
  - To improve market responsiveness by outsourcing raquet distribution

Step 2: Translate Strategic Goals to Business Requirements

- Consider the first goal: outsourcing raquet manufacturing. How can the company's IT architecture support this goal?
- It must provide the following interfaces to its new manufacturing partners:
  - Sales to manufacturing partners: send forecasts, confirm orders received
  - Manufacturing partners to sales: send capacity, confirm orders shipped
  - Manufacturing partners to accounting: confirm orders shipped, electronic invoices, various inventory levels, returns
  - Accounting to manufacturing partners: transfer funds for orders fulfilled

Step 3: Apply Strategy-Architecture-Infrastructure Framework

- An architecture needs to be established.
- How to obtain, store, and use data to support those business requirements.
- Database designed to provide sales data to support sales applications.
- Database designed to support manufacturing applications – confirm orders shipped, manage inventory, etc.

Step 4: Translate Architecture to Infrastructure

- With architectural goals in hand, apply framework from beginning of chapter.
- Figure 6.6 lists questions raised when applying framework to TennisUp's architecture goals.
- Figure 6.7 lists possible infrastructure components.

Step 5: Evaluate Additional Issues

- Weigh the managerial considerations outlined in the second section of chapter.
- Weigh them against the same architectural goals outlined in step 2.
- Figure 6.8 shows how these apply to TennisUp (see text).

Component	What		Who		Where	
	Architecture	**Infrastructure**	**Architecture**	**Infrastructure**	**Architecture**	**Infrastructure**
Hardware	What kind of supplemental server capacity will the new EDI transactions require?	Will TennisUp's current dual CPU NT servers handle the capacity, or will the company have to add additional CPUs and/or disks?	NA	Who is responsible for setting up necessary hardware at partner site?	Where does responsibility for owning and maintaining EDI hardware fall within TennisUp?	Which hard-ware components will need to be replaced or modified to connect to the new EDI hardware?
Software	What parts of TennisUp's software architecture will the new architecture affect?	Will TennisUp's current Access database interface adequately with the new EDI software?	Who knows the current software architecture well enough to manage the EDI enhancements?	Who will do any new SQL coding required to accommodate new software?	NA	Where will software patches be required to achieve compatibility with changes resulting from new software components?
Network	What is the anticipated volume of transactions between TennisUp and it's manufacturing partners?	High volume may require leased lines to carry transaction data; dial-up connections may suffice for low volume.	Who is responsible for additional networking expense incurred by partners due to increased demands of EDI architecture?	NA	Where will security concerns arise in TennisUP's current network architecture?	Where will TennisUp house new networking hardware required for EDI?
Data	Will data formats supporting the new architecture be compatible with TennisUp's existing formats?	Which formats must TennisUp translate?	Who will be responsible for using sales data to project future volumes to report to manufacturing partner?	Who will be responsible for backing up additional data resulting from new architecture?	Where does the current architecture contain potential bottlenecks given changes anticipated in data flows?	Does the new architecture require TennisUp to switch from its current 10Base-T Ethernet to 100Base-T?

Figure 6.6 Framework application

Hardware	Software	Network	Data
3 servers: •Sales •Manufacturing •Accounting Storage systems	ERP system with modules for: •Manufacturing •Sales •Accounting •Inventory Enterprise Application Integration (EAI) software	Cable modem to ISP Dial-up lines for backup Routers Hubs Switches Firewalls	Database: •Sales •Manufacturing •Accounting

Figure 6.7 TennisUP's infrastructure components

FOOD FOR THOUGHT: CLOUD COMPUTING

Cloud Computing

- Cloud computing – replaces locally managed stacks of hardware and software with an Internet-based utility.
- Provides availability of entire computing infrastructure over the Internet.
- Initially were SaaS applications built with commodity technologies and open systems, but were too proprietary or application dependent (not widely adopted).
- Today the vision is a build-out of IT infrastructure that is increasingly useful.
  - Saleforce.com, Google, and Amazon.com.

Cloud Computing

- Users purchase computing capacity on-demand.
- Utility computing – where computing can be purchased as need arises or decreases.
- Managers can chose between using the architecture, a platform, or an entire application (like SAP).
- Provides significant incentives for handling peak or new computing needs.
- Business case for using includes:
  - Better managed server costs
  - Energy costs
  - Staff costs
- Managers must also understand the risks.

SUMMARY

Summary

- Strategy drives architecture.
- Enterprise architecture includes both IS architecture and the interrelationships in the enterprise.
- Three configurations for IT architecture are mainframe, client/server and SOA.
- The manager’s role is to understand how to plan IT in order to realize business goals.
- Frameworks guide the translation.
- While translating strategy to architecture and then to infrastructure know the state of the existing systems.