Building the Next Generation Enterprises

PISA

(Planning, Integration, Security and Administration)

An Intelligent Decision Support Environment for IT Managers and Planners

User Guide

Draft: May 12, 2008

NGE Solutions, Inc. (www.ngesolutions.com)

PISA QuickStart for the First Time Users

WHAT IS PISA?

PISA (Planning, Integration, Security, and Administration) is an intelligent decision support environment for IT managers and planners. It allows the users to quickly build models (scenarios) of an enterprise and then develop completely documented IT plans. PISA consists of a family of automated consultants (*Advisors*) that are organized in the following modules:

- **PLANIT (Planner for IT): d**evelops an IT plan at enterprise level, with rough estimates and documentation.
- **AIM (Architecture and Integration Module):** concentrates on more detailed issues of how specific components of the plan will fit together to form a functioning service oriented architecture (SOA).
- **SAM (Security and Administrative Module)** provides the security and administrative services to produce a complete and secure IT solution with project plans, extensive documentation and graphic support.

Suggestion: Use only PlanIT in your first session. Keep AIM for a later session when you have more time and energy.

Modes of Operation: Each advisor can be used in two modes:

- **Express mode**: the advisor is an expert system (it has most of the knowledge), the user has no/little knowledge. You invoke this mode by simply pressing the '**Continue**' key where available.
- **Explore mode**: the advisor is a decision support system, it has some knowledge and the user also has some knowledge. You use the advisor in a game playing format. This is done by selecting options, modifying results produced, etc.

Suggestion: Use the system in express mode as much as possible in your first session. What does it mean? Just go from one advisor to another as the system leads you and keep hitting the 'Continue' button after seeing the suggestions on each screen. This will very quickly produce a solution sketch that you can modify later.

GETTING READY

- Go to www.ngesolutions.com/pisa
- Download and review the 'PISA Overview' document .
- Click on 'Start Demo'. It will lead you to a signon screen. If you do not have a signon ID, click on "signup".
- The PISA demo works as an ASP – you do not need to install anything on your computer

SESSION 1: DEVELOPING AN IT PLAN FOR A SMALL COMPANY

- **Signon** to PISA by using your PW-ID.
- **Create a scenario** for a small company (less than 50 employees, 2 or 3 sites) in manufacturing, finance, or other company types supported.
- **Control Panel** is the nerve center of the system. It will lead you through various advisors by using a red arrow**.** Familiarize yourself with the control panel, tool help and other facilities on the top bar. Each page will show "?" – press it to get an explanation of the page.
- **Enterprise Modeler** will help you to create a model of the company. Use approximations where needed and hit 'Continue' after reading each screen. .
- **Application Advisor** will suggest the applications to be used by your company. For simplicity and speed, use ERP solutions but also use 'individual' solutions if you want. .
- **Platform Advisor** will suggest the computing platforms (computing hardware/software) to be used by the shop. Use defaults as much as possible ("Continue" key).
- **Network Advisor** will create a network configuration. Show the diagram of the suggested network.
- **Security Advisor** will analyze the security and develop security solutions. Take the simplest solutions.
- **Project Planner** will generate a work break down structure and a project plan for the project.
- **Generate the consolidated report** that summarizes the decision made by you and review it. .

Hints and Suggestions

- The tool is self-contained. It includes an extensive 'Explain' capability that serves as an online tutorial. The Explain is accessed by clicking on the '?' button on any screen.
- It is best first to create a rough model and then create a more detailed model.
- In case you get stuck, hit logout (top bar), log back in, and access the scenario you were working on. You should be able to proceed without any problems (famous last words!).
- Rarely you may get an error 'Application Error'. In case of this error, click on 'home' (this will take you to the Control Panel from where you can proceed). In case, nothing else works, logout and restart the session with the profile you are working with.

SESSION 2: EXPLORE IT PLANNING FOR A LARGER COMPANY

Use PLANIT to develop a complete IT plan for a larger (300 employee) company of your choice. Produce a composite report after working with the following PISA advisors (you may use the Explore mode to modify suggested value, enter your own suggestions, etc):

- Enterprise Modeler
- Application Advisor
- Computing Platforms Advisor
- Network Advisor
- Security Advisor
- Project Planner

This will produce a detailed consolidated report.

Session 3: Use AIM to Develop and Evaluate an Integrated Architecture based on SOA (Service Oriented Architecture)

Use AIM to develop a better understanding of how one application (e.g., order processing) can be architected and integrated with other applications based on SOA (Service Oriented Architecture) principles.

Getting Ready:

- Read the PISA overview document before proceeding. You should read the PLANIT as well as AIM sections of the overview document before getting started.
- Create a 'scenario' for a company and work through the system.
- Create an IT plan through PlanIT by using session 1 or session 2 instructions (session 1 recommended) . This should develop an overall IT plan.
- PISA is 'supposed' to be self explanatory. Use the tutorials, guides and other help materials. For explanation of what is going on, click on '?' (it appears on every screen).

Create an integrated solution by using AIM.

- **Invoke AIM** from the Control Panel (Yellow Arrow)
- **Business Problem Explorer (BPE)** will help you to select an application to be integrated with its surrounding apps. Choose something like online purchasing system to investigate some interesting situations. BPE will ask you to define the type of integration project (choose "pilot project").
- **Intelligent Requirements Generator** will guide you to quickly generate a requirements document for online purchasing. Use different options in the interviews to develop an understanding of the integration problem (i.e., how many apps are interfacing, what type of apps are these, etc).
- **Intelligent Architecture Advisor** will lead you through various steps and will generate an architecture document, based on SOA, for online purchasing. Run through various options in the interview to understand the different integration strategies (e.g., remote hosting, data warehousing) and their impact on the different SOA architectures and patterns.
- **Integrated Solution Advisor** will evaluate the selected architecture in terms of cost, performance, and security. This advisor will also provide information about cost-benefit analysis and gap analyis between present method of operation to future method of operation). Review the report produced to understand various options.

After these three sessions, you can use the system for a wide variety of scenarios.

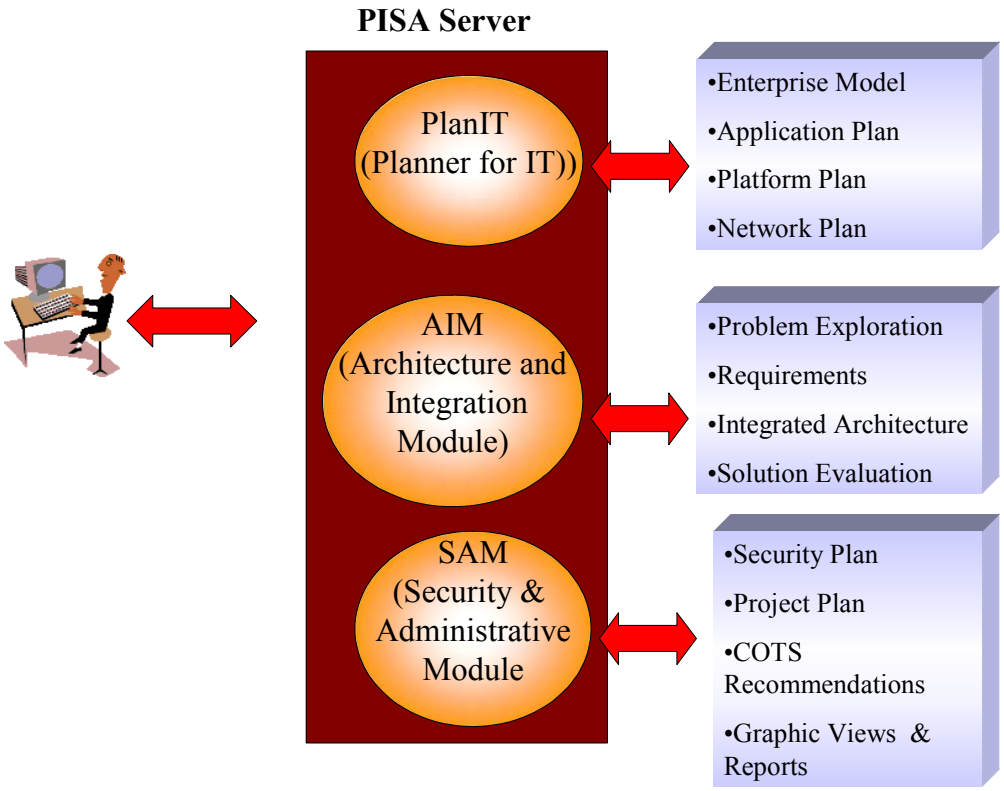
Contents

Acronyms and Glossary of Terms

API	Application Programming Interface
ASP	Application Service Provider
ASP	Active Server Pages – A Microsoft technology for building server side code
B2B	Business to Business
B2C	Business to Consumer
B2E	Business to Employee
B2G	Business to Government
BSP	Business System Planning
CAD	Computer Aided Design
CAM	Computer Aided Manufacture
COTS	Commercial Off-The-Shelf
CPU	Central Processing Unit
CRM	Customer Relationship Management
DSL	Digital Subscriber Loop
EAI	Enterprise Application Integration
EB	Electronic Business
EC	Electronic Commerce
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
FTP	File Transfer Protocol
GUI	Graphical User Interface
I/O	Input/Output
IP	Internet Protocol
ISP	Internet Service Provider
IT	Information Technology
LAN	Local Area Network
MAN	Metropolitan Area Network
Mbps	Million bits per second
MOM	Message Oriented Middleware
OS	Operating System

PGP	Pretty Good Privacy
PKI	Public Key Infrastructure
QoS	Quality of Service
SCM	Supply Chain Management
SET	Secure Electronic Transaction – a security standard
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol – part of Web Services
SQL	Structured Query Language
SSL	Secure Socket Layer
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
UDDI	Universal Description, Discovery and Integration - a registry for Web Services
VAN	Value-Added Network
VPN	Virtual Private Network
VXML	Voice extensible Markup Language
WAN	Wide Area Network
WAP	Wireless Application Protocol
WLL	Wireless Local Loop
WML	Wireless Markup Language
WS	Web Services
WSN	Wireless Sensor Network
XML	eXtensible Markup Language

PISA at a Glance



- PISA is an intelligent decision support environment that helps modern enterprises plan, integrate and secure their IT (information technology) systems.
- PISA, based on academic and industrial research, consists of a family of advisors that collaborate with each other through a common knowledgebase to recommend IT solutions for the modern enterprises.
- Working with PISA is like working with a team of experts who guide the users through a series of decisions about IT planning, integration, and security.
- The current focus of PISA is on small to medium businesses (SMBs). However, the system can be, and has been, used to address IT problems of a particular site or business unit of large organizations. We will extend the scope of PISA to larger organizations in the future.

SECTION A: CONCETUAL OVERVIEW

1. WHAT IS PISA?

PISA (Planning, Integration, Security, Administration) is an intelligent decision support environment that helps businesses plan, integrate and secure their IT (information technology) systems. At present, PISA is intended for small to medium businesses (SMBs) but can be used for offices and divisions of larger businesses also. It provides a family of intelligent advisors that collaborate with each other to help the businesses make the following crucial decisions without knowing the intricate technical details:

- What business processes do I need to automate my business?
- What are the various automation strategies and which one should I use when?
- What type of business applications will support my automation efforts?
- What are the different commercially available packages that could be of value to my business?
- What type of computing platforms do I need to support these applications?
- What type of network will be needed to support my business?
- Where does wireless network technology fit into my networking picture?
- What type of commercially available networking technology is suitable to handle my workload?
- How can I secure my business and technical assets?
- What type of vulnerabilities exist in my system and how can they be addressed?
- What type of security audit checklist will be needed for my business?
- How will the solutions be architected to make sure that everything works together?
- How a given application can interwork with its surrounding applications by using SOA (Service Oriented Architecture)?.
- What is the estimated cost of transitioning to SOA and how can this cost be justified in business terms?
- How to develop and evaluate an SOA plan in terms of cost, performance and security.
- How can to transition an application or a group of apps to SOA through replacement or gradual migration strategies?
- What is the impact of outsourcing an application through rental, remote hosting, or other outsourcing scenarios?
- How to develop a data warehouse for business intelligence and understand how it fits into the overall enterprise architecture.
- Given a future business situation, what type of SOA services, configurations and platform should be used in terms of outsourcing, renting, remote delivery of services, and extended enterprise scenarios?

PISA attempts to answer these questions by using inferences, best practices ("patterns"), and collaboration. Each advisor solves one problem (e.g., the Network Advisor suggests a network

configuration) and then collaborates with others through a common model. The model is refined and expanded as the advisors work to develop a solution. The answers produced by one advisor are used by others to produce yet more solutions based on additional interviews. Working with PISA is like consulting with a team of experts who collaborate with each other to solve your business problems. The results produced by PISA can be modified by the users to handle special situations. For example, the Network Advisor suggests a network configuration and then passes it over to the Security Advisor to secure it.

The PISA Environment, conceptually shown in Figure 1, provides automated support for all stages of IT planning, integration and security projects (e.g., enterprise modeling, application planning, network planning, security planning, project planning, architecture analysis, solution evaluation). At the heart of PISA, as shown in Figure 1, is the knowledgebase (KB) that contains an extensive patterns repository. The KB is used by the PISA advisors that are segmented into three modules (see Figure 1):

- **PlanIT (Planner for IT)** concentrates on IT planning projects and develops a plan at the enterprise level (see Section B).
- **SAM (Security and Administration Module)** provides security and administrative services for the entire PISA system (see Section C).
- **Architecture and Integration Module (AIM)** focuses on how SOA can be used to architect and integrate the various components to form a functioning system (see Section D).

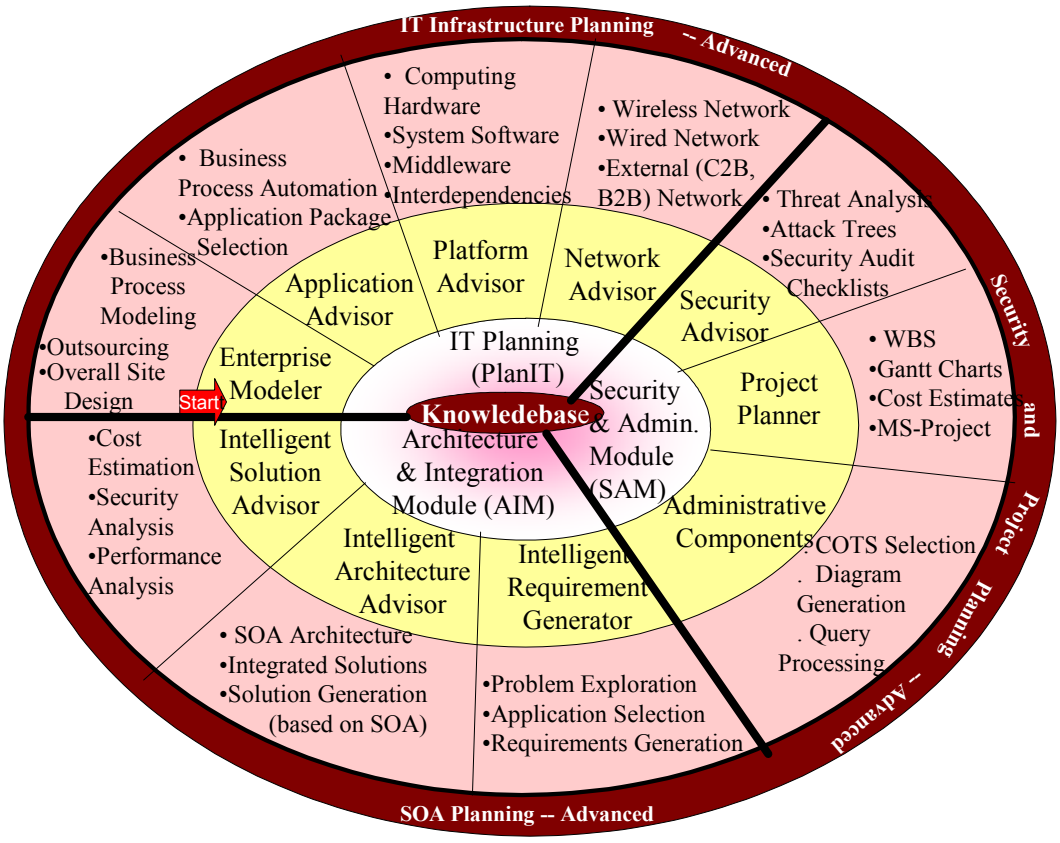


Figure 1: The Conceptual Model of PISA

Each PISA advisor, as shown in the outer circle of **Error! Reference source not found.**, supports a specific stage and collaborates with other advisors to produce plans. For example, the Network Advisor supports network planning stage and collaborates with the Security Advisor to develop a security plan that includes a secure network. The outermost circle ("the PISA crust") represents

the **Advanced Capabilities Module (ACM)** that accepts the outputs produced by the PISA basic advisors and then helps the users to invoke detailed simulation and analysis tools, if needed (see the sidebar on Advanced Capabilities Module (ACM) below).

To understand the sequence in which these advisers are invoked, start from the Enterprise Modeler ("Start" arrow in Figure 1) and follow the circle clockwise. Specifically, the PlanIT advisors do the following: the Enterprise Modeler develops a model of an enterprise, the Application Advisor develops an Application plan, the Platform Advisor develops a computing platform plan, and the Network Advisor builds a network plan. The SAM advisors develop a security plan, a project plan, and provide other administrative services. The AIM advisors develop an integrated architecture plan based on SOA. The advisors are not strictly sequential – different advisors can be invoked in different sequences to fit the type of project you are working on. However, some things have to be done in sequence. For example, you cannot secure a network before developing a network plan (naturally!). The PISA Control Panel, discussed later, guides the user through what can be invoked when.

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Advanced Capabilities Module (ACM): Getting into More Details

The focus of the basic PISA advisors (PlanIT, SAM and AIM) is to minimize user effort by extensively using defaults and patterns. Naturally this approach is not suitable for all situations. In many cases, more detailed analysis is needed requiring more effort but providing more complete and accurate information. This is where ACM enters the picture – it accepts outputs generated by the Basic PISA system and shows how it can be used for detailed modeling and analysis. ACM expands the basic capabilities of PISA by:

- Allowing users to modify the output produced so far by using XML tools.
- Suggesting how users can do more detailed analysis by using existing modeling, simulation and analysis tools.
- Suggesting how users can develop their own tools by using outputs generated by the basic PISA system.

ACM is a relatively new module and we are in the process of developing the following capabilities:

- Advanced Business Process Analysis: business process modeling and workflow analysis
- Advanced Network Analysis: simulation analysis through tools such as Opnet
- Advanced Security Analysis: detailed attack tree and risk analysis
- Advanced SOA Analysis: detailed evaluation of SOA-based architectures

IMPORTANT: ACM is intended for more technically savvy people, especially knowledge of XML is required because all outputs produced by basic PISA are in XML.

2. Background Information and PISA Objectives

Background Information

PISA has been developed by a team of business and IT experts with backgrounds in business strategies, business process re-engineering, computing platforms, wireless and wired networks,

system security and auditing, system architectures and integration. The tool was developed due to the knowledge gained by us in a large number of consulting, research management, strategic planning, and architecture assignments in different industry segments. During our consulting and research practice, we made the following observations:

- Many tools are currently available and keep growing for software developers. .
- However, most organizations are outsourcing/buying/renting software and concentrating on IT planning, integration, security & administration (PISA) processes.
- Unfortunately, there are virtually no tools available to support the PISA processes.
- Many SMBs have a serious problem because they do not possess in-house expertise to make these decisions
- Most IT problems in the digital age require a team of experts that collaborate with each other to solve real-life problems. Thus integrated tools that collaborate with each other are better than fragmented standalone tools.

Based on these observations, we developed a set of collaborative advisors that behave as a team of experts to develop IT plans with integration and security in mind. PISA is designed as a 'workbench' for IT managers and planners to provide a quick, inexpensive and vendor neutral solution to the serious and recurring problems in IT planning, integration, security and administration. We tested PISA on some initial assignments and expanded it based on our experiences. We have also used PISA to support different IT courses. At present, PISA is available as a beta system only and will be available as a commercial product in the future.

Objectives of PISA

- Provide high quality vendor neutral consulting help.
- Instead of fragmented tools, integrate all advisors around a common knowledgebase. This minimizes user effort in using the system. For example, the network advisor stores its results in the knowledgebase – these results are used by the security advisor to develop network security (the user does not have to spend hours defining her network).
- Provide guidance in addition to information. Our slogan is "Not only Information – Guidance".
- Educate the user, in addition to guidance, so that the user can make well informed decisions in the future. Towards that goal, PISA includes many mini-tutorials, explanations, justifications, and guides (see the sidebar "Help Facilities in PISA").
- Produce a combination of expert advice, decision support, and intelligent assistance as needed. This facilitates 'quick and dirty' answers when needed and detailed investigations where appropriate
- Heavily rely on *inferences and observations* to reach conclusions instead of asking too many irrelevant questions
- Use *patterns* to employ the best practices and successful experiences instead of every possible point in the solution space
- Exploit latest developments in integrated intelligent systems including patterns, components, wireless networks, Web Services, service-oriented architectures, integration platforms, and security approaches.

Intended Audience

This system, and this document, is intended primarily for IT managers and IT analysts. We are specifically positioning PISA as a "friend" of the IT managers by educating them so that they can communicate effectively with consultants and IT staff.

The system has been designed so that the questions are very business and end-user oriented, however some recommendations produced are technical (naturally). Thus this system does require some basic understanding of IT concepts. Although end users can use, and have used, this system successfully by taking advantage of the tutorials and guides, additional time should be allocated for that.

It should be also stated that this system is not directly intended for software developers – its primary goal is IT planning and architectures. Once again, PISA has been used by many software developers very successfully, however it does not at present go to the level of software implementation details commonly needed by programmers.

Help Facilities in PISA

- **Explanation of Screens:** Click on  in any screen to view these explanations.
- **Mini-tutorials:** Each Advisor starts with a mini-tutorial on the topic (first page of every Advisor).
- **Diagrams.** The output produced by Advisors is converted to diagrams for ease of understanding. To see a graphic view of the output, click on  when it appears (usually at the bottom of some screens).
- **Summary Reports**. The results of each Advisor are presented in a summary report at the end of each Advisor. In addition, a Consolidated Report is generated at the very end of the session.
- **Justification**: A justification and explanation of recommendations is provided through a  button.
- **Glossary**: A glossary of terms is provided (top bar of every screen)
- **Guides and Helper Applications:** These are provided as concise tutorials to educate you on some topics where appropriate. Examples of these guides are the **SMB Guide, Outsourcing Guide, and Automation Strategy Guide.**

3. How to Use PISA?

For the First Time Users

To use PISA in its current form, please go to the PISA site (www.ngesolutions.com/pisa). The PISA home page provides a great deal of information about this system. A logon ID and password is needed to use the system. Follow the "Start the Demo" to register and use the PISA. Each user ID is used to create a separate area. You can create different models ("profiles") in your area to represent different scenarios. The login ID and password are used to provide access to your area.

Starting the Interview

The user starts an interview by signing in. The user interview, after signing in, is guided through a control panel shown in Figure 2. The system automatically determines which advisor you can invoke through a red arrow. In a normal session, the advisors are automatically invoked in the pre-defined sequence suggested by Figure 1 (i.e., Enterprise Modeler -> Application Advisor -> Platform Advisor, etc). However, a user may invoke other advisors as they become available (indicated by a yellow arrow). ACM can be invoked anytime for more detailed analysis. Each advisor, when invoked, produces a model and then returns control to the control panel. As shown

in **Error! Reference source not found.**, the links to the results produced by advisors used previously ("generated models"), if any, are also shown.

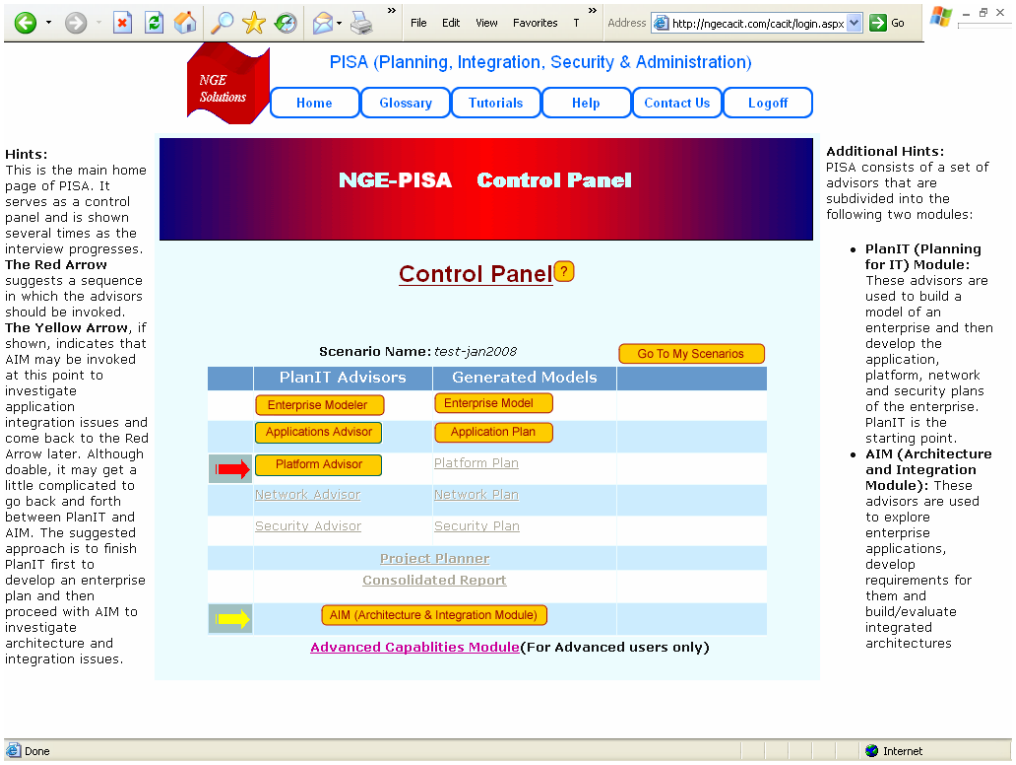

Figure 2: Sample PISA Control Panel

Typical Usage Scenarios

Although still in its development stages, PISA has been successfully used in more than 400 experiments in academic and industrial settings. In fact, PISA can be used to develop, secure and evaluate IT plans and integrated architectures for a wide range of real-life business situations. Table 1 illustrates a few business situations in terms of the following two broad factors:

- Business services (new or existing)
- Organizational units (new or existing)

As illustrated in this table, the PISA capabilities can be used in a wide range of practical situations that cover new or existing services for new or existing organizational units. Additional and innovative examples are envisioned as more experience with PISA accumulates.

Table 1: Usage Scenarios for PISA

	Organizational Units (New)	**Organizational Units (Existing)**
Business Services (New)	**S1**: New services(s) for a new site **Examples:** • Setting up a new company (this	**S2:** New services(s) for an existing site **Examples** • Offering a new business service

	means that new IT infrastructure is needed consisting of applications, networks, platforms, etc) • Setting up a new site or division of an existing company (e.g., setting up a new sales office overseas) **How to Use PISA:** • Use Planit and SAM to develop an IT plan that shows the applications, networks, etc. • If needed, use AIM to understand how the new site will work with existing one**s**	(e.g., consulting, hardware repair) at an existing site • Data exchange between companies (B2B) • B2B trade (e.g, Supply Chain, emarkets) between partners **How to Use PISA:** • Use Planit and SAM to develop an IT plan that concentrates on business processes that are influenced by the new services. • Use AIM to understand how the new services, especially applications, will work with existing
Existing Business Services	**S3**: Existing automated services(s) for a new site **Examples:** • Outsourcing an existing application to a new company • Providing existing applications (e.g., CRM) at a new branch office • Supporting existing (updated) network services at a new site • Providing existing platform services (e.g., install servers) at a new site • Offering existing security services (e.g., firewalls, vulnerability analysis) at a new site **How to Use PISA:** • Use Planit and SAM to develop an IT plan for the new site by just concentrating on those services that are needed at the new site. • AIM is not needed (could be used to understand outsourcing issues)	**S4:** Existing automated services(s) for an existing site Examples: • Migrating from existing system to an SOA-compliant architecture. • Integrating an application with several internal and external applications • Eliminating a BP and estimating the impact • Automating a manual BP • Documenting a current configuration. • Validating an existing platform, network and security plan **How to Use PISA:** • Use Planit and SAM to document the IT plan for the existing site by just concentrating on those services that are being impacted. • Use AIM to understand how the updated/impacted applications will work with existing ones

In addition, it has been used to support the following academic courses:

- IS for managers (core MBA courses)
- Network design courses
- IS security and auditing courses
- Systems analysis and design courses

- Enterprise architectures and integration courses

For more information about using PISA for academic courses, please see the 'PISA in Classroom' document at www.ngesolutions.com/pisa/documents.

Using PISA Advisors in Express or Explore Modes

Each PISA advisor can be used in two modes:

- **Express mode**: the advisor is an expert system (it has most of the knowledge), the user has no/little knowledge. You invoke this mode by simply pressing the 'Continue' key where available.
- **Explore mode**: the advisor is a decision support system, it has some knowledge and the user also has some knowledge. You use the advisor in a game playing format. This is done by selecting options, modifying results produced, etc.

A user can use one advisor in express mode and the other in explore depending on the problem and the background of the user. For example, a user who knows a great deal about networks but very little about enterprise applications may use the Network Advisor in explore and Application Advisor in the express mode. In the following assignment, you can use the advisors in any mode you want.

4. MOVING AHEAD

PISA demonstrates the technical and business feasibility of computer aided consulting. The focus on SMBs is deliberate to allow development of complete solutions. Future research and development directions include a wide range of activities to make the existing platform into a valuable tool for SMBs. Stay tuned!

A great deal of additional information and documentation about PISA can be found at the website www.ngesolutions.com/pisa.

We are open to suggestions (drop us a note at nge@ngesolutions.com) – we love to hear from you. Please indicate 'PISA' in email heading.

SECTION B: IT Planning through PlanIT

5. PLANIT OVERVIEW

Businesses face numerous challenges in using IT. The main challenge is that these businesses increasingly rely on sophisticated information technologies such as the Internet, wireless networks, Web technologies, numerous application software packages, different types of security solutions, and a multitude of system software packages such as database managers, utilities, .Net framework, and the like. Many businesses, especially SMBs, lack in-house expertise to properly plan the IT infrastructure needed to support the business. Consider, for example, a small startup company with 30 employees -- it needs to decide what to automate, what automation strategy to use, what type of applications packages to buy, what to rent and from where, what to outsource and how, what type of computing platforms to buy, whether to use wireless networks or not, and how to secure the company assets. These are difficult decisions, especially in the current highly fluctuating business and technology landscape. PISA-PlanIT, henceforth referred to as PlanIT, helps with these IT planning decision through the following advisors:

1) Enterprise Modeler helps the user to create an enterprise model that captures the important aspects of a company such as company type, company size, company sites, outsourcing decisions, etc.

2) Application Advisor helps the user develop automation strategies and suggests the business applications that will support different automation strategies.

3) Platform Advisor suggests computing platforms ("hosts") on which the applications will reside.

4) Network Advisor suggests a network configuration that includes wireless as well as wired networks.

In addition, the following security and administrative components support PlanIT:

5) Security Advisor secures the applications and the hosts on the network.

6) The COTS (Commercial-off-the-Shelf) Advisor populates a Techbase that serves as a repository of commercially available solutions.

7) The Diagram Generator creates visual representations of the various solutions.

8) The Project Planner develops a project plan based on the decisions made in the previous advisors.

9) The Intelligent Document Generator produces reports at the end of the interview.

The system invokes the advisors based on a systematic planning methodology, shown in Figure 3, that walks the user through various stages of building an enterprise model, establishing automation strategies, developing a computing platform and a network plan, and outlining a security plan. The advisors help the users through various stages as shown in Figure 3. The stages of this methodology and the role played by the advisors is explained in the following sections. AIM will be explained in section D.

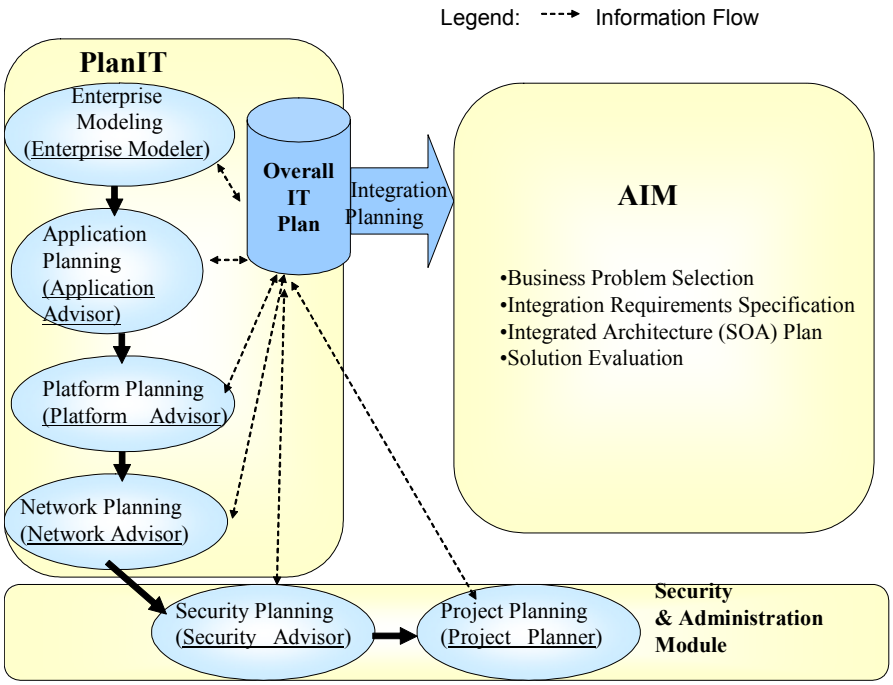

Figure 3: IT Planning Methodology Used by PISA

6. An Illustrative Example

Consider, for example, a small manufacturing company, let us call it "XShop", with 70 employees and offices in New York, Chicago and Atlanta. We will use this example to illustrate the steps of the methodology and also to show how intelligent decisions are made by PISA advisors through inferences, patterns, and collaboration. The same example is used later to explain the methodology steps in more detail.

- An enterprise model is built to show what business processes (BPs) are needed by the company and where they are conducted. Most BPs can be inferred. For example, the company will need to provide manufacturing and design processes in addition to the sales, marketing, and internal business processes such as human resources.
- An automation strategy (what BPs need to be automated and how) is needed. Some business applications that automate the business processes can be inferred. For example, a small company may need only one or two application packages to support most of the business processes.
- The type of computing platforms needed by the company can be determined through inferences. For example, desktops may be needed by the regular employees but powerful machines may be needed for CAD workers.
- Many aspects of the communication network that interconnect various business units and the computing platforms can be inferred. For example, the company may have workgroups such as business processing, manufacturing, and sales. Each one of these workgroups may be a LAN segment that is interconnected through a corporate backbone. Some workgroups, such as manufacturing plants, may use wireless networks extensively.
- Some security requirements can also be inferred. For example, manufacturing companies have different security requirements than financial institutions.

This example illustrates how the three principles (inferences, patterns, collaboration) are used by the intelligent advisors. Specifically, given basic information about a business, many inferences about the business processes, applications, networks, platforms, architectures, security, and performance are reached without lengthy and unnecessary user interviews. These inferences do not lead to complete solutions but instead produce sketches (patterns) that can be later refined through additional questions or they can be overridden. For example, the computing platforms as well as computing networks inferred above are too sketchy and need to be refined through additional questions. Finally, there is a need for collaboration between the plans generated. For example, the network plan and the computing platform plan are used as an input to the Security Advisor (you need to know what you are securing). The basic philosophy of PISA is that high level inferences can be used effectively to produce patterns that are refined successively through minimal interactions with the user. This makes the user experience in developing a solution short and sweet. PISA can reduce the time it takes to develop IT plans from several weeks to a few hours.

7. Build an Enterprise Model (Enterprise Modeler)

The Enterprise Modeler allows each user to create a model of the company to capture essential information such as company type, company size, workgroups (WGs), company sites, and allocation of WGs to sites. This model is used to infer business processes (BPs) because each industry has a set of commonly used BPs. It also captures business process outsourcing (BPO), a common way of conducting business at present. The profiler uses a step-by-step approach consisting of:

1. Create your own company model by specifying the company business, size, and sites

2. Decide which business function (high level business process) takes place at each location.

3. Include business process outsourcing. In the case of business process outsourcing, some BPs take place at the outsourced site.

4. Assign employees to sites. The number of employees at each site helps determine the type and "intensity" of work performed at each site.

5. Build and review the organization model that represents a high level view and can be saved (as a profile) to influence later decisions.

Figure 4 shows a sample enterprise model that is developed for XShop. In addition to the three company sites, it also shows an outsourced site because the company wants to outsource some BPs. The model shows what BPs are performed at what sites (e.g., marketing in New York, human resource management at an outsourced site, and manufacturing in Chicago).

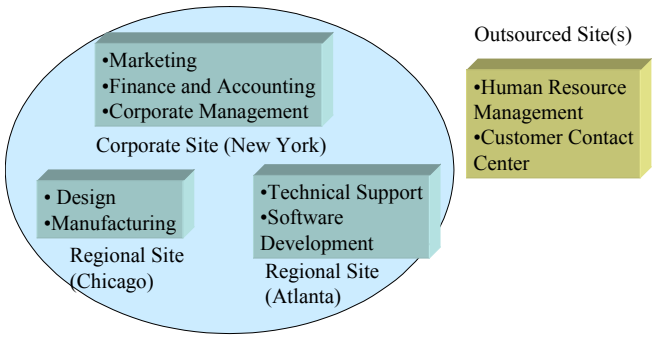

Figure 4: A Sample Enterprise Model

8. AUTOMATION STRATEGIES (APPLICATION ADVISOR)

The Application Advisor suggests an application plan to automate the BPs based on the enterprise model developed by the profiler. This advisor is a very powerful tool that allows a company to develop an automation strategy with different options of buy, rent, outsource development, build in-house, or re-use/re-engineer existing applications. This advisor also helps the user in building an implementation strategy that shows how automation strategies could be implemented. For example, it helps the user to select the COTS (commercial-off-the-shelf) application packages that can be bought and suggests an application service provider (e.g., Corio and SAP) for rental and outsourcing. Implementation strategies are facilitated through a COTS Advisor that collects information about commercially available solutions. This advisor uses the following steps:

1. Choose the business processes (BPs) for your business that will support the high level business functions (e.g., marketing) for your company. This creates a customized list of BPs for your company.

2. For each BP, identify which ones will be done manually, which ones will be automated. In addition, for the automated BPs, determine an automation strategy(buy, outsource development, inhouse development, or reuse). For example, if inventory management is to be automated then you can either buy an inventory management application package, or rent an inventory management service from an application service provider (ASP), etc

3. For each option, explore the commercially available solutions (e.g. for buying, investigate and select the inventory management application packages available in the marketplace).

4. Summarize the various decisions made to produce an application plan. The user can save the application plan created (as a profile) to influence later decisions in platforms, networks, and security.

Figure 5 shows a sample result produced by this advisor for the XShop. This example shows that the company will buy a CRM package, rent an online purchasing system from an ASP (Application Service Provider), outsource development of the billing system, build its own MRP (materials Requirement Planning System) and re-use the existing inventory management system.

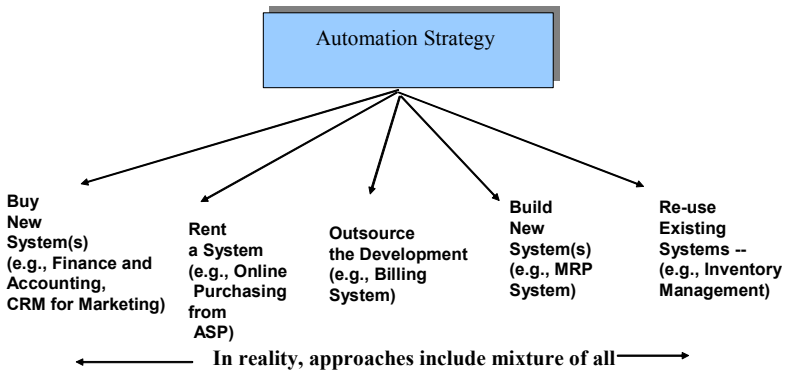

Figure 5: Example of an Automation Strategy

9. COMPUTING PLATFORM PLANNING (PLATFORM ADVISOR)

The Platform Advisor goes further by suggesting a computing platform plan that will "host" the applications selected previously. It performs three major functions. First, it recommends

computing platforms for each site based on the role of the employees (manager, secretarial staff, professional staff, etc) and the type of activities performed at that site. Second, it performs interdependency analysis by allocating the application packages to the platforms that support them (e.g., allocate Windows-based software to the Windows machines, not Linux). Finally, this advisor helps the company estimate the number of application servers based on a centralized versus distributed application processing model. In a centralized model, all applications processing is done on one large machine (or a few machines in the same room) at one site. In a distributed model, each workgroup or site could use their own application server for local application processing. This advisor also uses the industry type and size information to determine a "platform pattern", i.e., more powerful machines are needed by engineers than clerks. This advisor uses the following steps[1]:

1. Determine computer platforms, including servers, that will support the automation strategy and the application plan for each workgroup (WGs) in the company.

2. Allocate applications to computing platforms in each WG.

3. Show how wireless/wired platforms and software/hardware interdependencies come into play. (can a Windows application run on Linux platform, can an IIS server be installed on an XP machine, etc.)

4. The computing platform plan is reviewed and saved by the user for later decisions.

Figure 6 shows a sample computing platform for the XShop. The applications have been allocated to four types of computing platforms that consist of a mainframe, an NT server, a laptop, and a handset (cellular phone or PDA). Each computing platform consists of computer hardware (e.g., Pentium processor), an operating system (e.g., Windows NT), some system software (e.g., MS Access), and middleware (e.g., MS OLE or Microsoft .NET Framework). These computing platforms are interconnected through a network that is defined later by the Network Advisor.

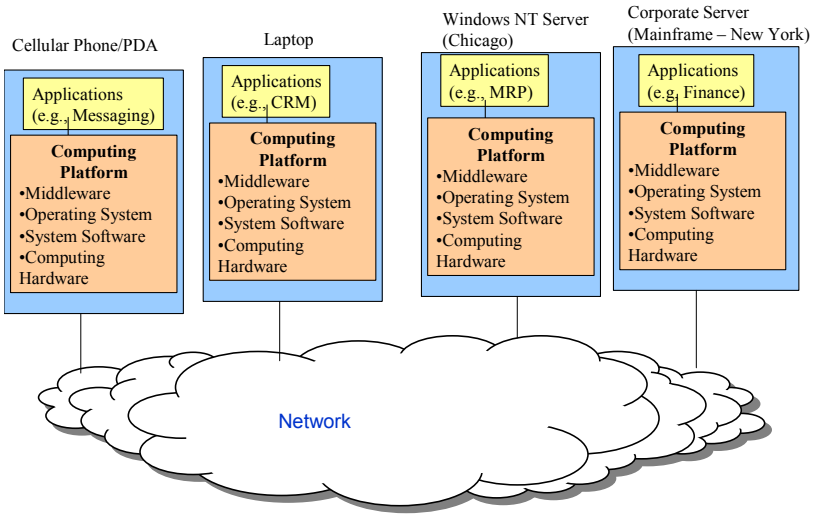

Figure 6: A Sample Computing Platform

[1] The current version may not fully support all these steps.

10. NETWORK PLANNING (NETWORK ADVISOR)

The Network Advisor suggests a network plan that interconnects the computing platforms by using wireless as well as wired network elements. This advisor also performs three major functions. First, it infers the workload at each site by using inferences based on the OM that has been already constructed by the other advisors. Second, it suggests a network configuration and estimates bandwidth needed by using queuing network models. For example, it determines capacity of network devices inside the buildings and estimates bandwidth of connections between sites depending on the type of connection (wired/wireless) and the distance between the sites. Finally, it suggests the type of connections and the commercially available network solutions between local offices, regional office, and the Public Internet by consulting with the COTS Advisor. At the core of NA is a decision tree that guides the users to different types of wireless/wired network choices. This decision tree walks the users through the following steps:

1. Estimate a workload model based on the previous models

2. Determine a network plan (a network layout) based on the estimated workload model. This plan consists of:

   - A logical view that shows a conceptual network layout

   - Commercial products that translate the logical network model to a physical network plan

3. The user can modify the workload and come up with different network plans. This will help the user to develop different network plans for different scenarios. The final network plan shows the applications, the computing platforms, and the interconnecting network. This can be saved as a profile for additional decisions.

Figure 7 shows a sample network plan for XShop that could be generated by the Network Advisor. This network is generated to interconnect the computing platforms and the applications residing on these platforms generated previously. As can be seen, the advisor suggests different types of wired/wireless networks and also suggests network interconnectivity devices (NIDs) such as access points, routers, and base stations.

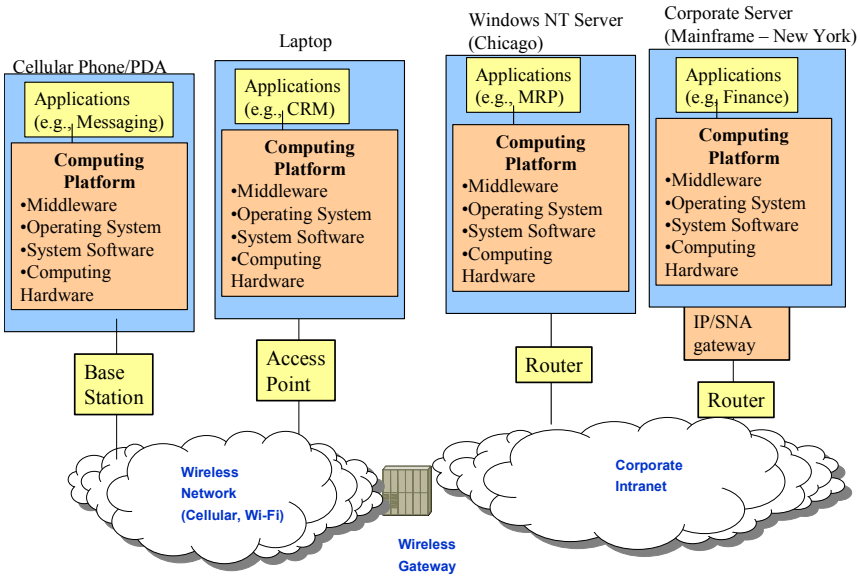

Figure 7: Sample Network Configuration

SECTION C: Security and Administration Tools

PISA provides a set of security and administrative tools that support all advisors. Here is a brief summary of each.

11. Security Planning (Security Advisor)

The Security Advisor suggests a security plan that can be used to secure networks, databases, applications, platforms, and other objects produced so far. In particular, this advisor starts with the model of the network produced by the Network Advisor and infers some security requirements from the business processes being supported by various computing platforms. The user is also guided to secure some sensitive objects such as corporate databases. The main work of this advisor is to conduct a thorough security analysis based on attack trees. The goal is to identify security weaknesses by constructing and launching attack trees. For example, the user picks a "critical" object such as a sensitive database and then launches attacks that could compromise the database. Each attack is triggered if a pre-condition is enabled. For example, a database cannot be read by a network sniffer or wireless antenna if encryption is being used. Thus, if encryption is used (precondition is disabled), then the database privacy attack cannot be launched. .The attack tree analysis reveals areas of weaknesses for the different objects. This advisor uses the following steps:

1. Estimate security requirements and develop an initial security solution by securing individual components of the system (databases, applications).

2. Launch attacks against the initially secured system by using attack trees. This analysis shows the vulnerabilities of the system.

3. Develop a more comprehensive security plan that protects against the attacks. The final security plan shows how the applications, the computing platforms, and the interconnecting network can be secured. This can be saved as a profile for additional decisions

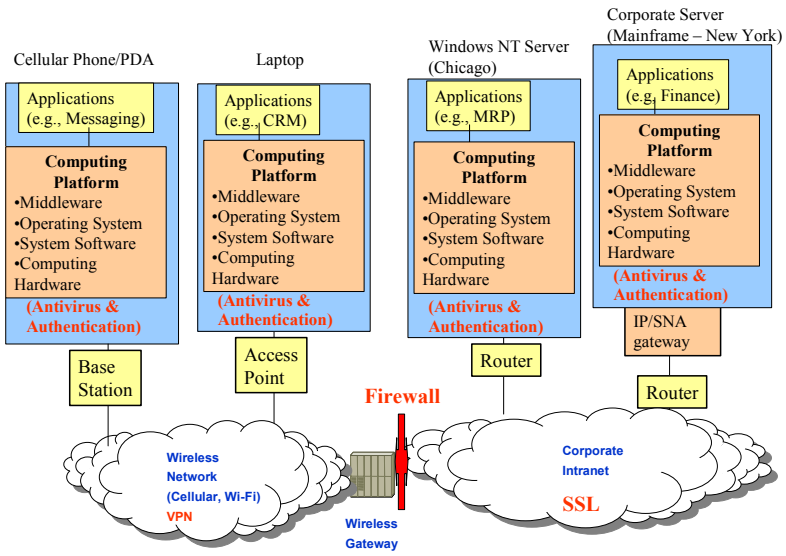

Figure 8: Sample Security Plan

Figure 8 shows a sample security plan for the XShop as generated by the Security Advisor. Note that Figure 8 is an extension and refinement of the network plan shown in Figure 7. The plan suggests firewalls and other security technologies (antivirus software, authentication packages, VPN[2], and SSL[3]) that can be used to secure the networks, the computing platforms, and the applications.

12. Project Planner

Project planning is an important part of most IT undertakings. The Project Planner automatically infers and suggests a work breakdown structure (WBS) for the project. This information is inferred from the detailed information captured in the PISA advisers. For example, if a user plans to buy a software package, then the WBS would entail the following 'obvious' activities: a) purchase the package, b) install the package, and c) configure the package. The WBS for simple as well as more intricate activities is produced automatically in an XML format that can be ported into the MS Project format for more detailed reports.

13. COTS Advisor

An important issue in IT planning is to determine the appropriate commercial off the shelf (COTS) packages that will support the plan. The COTS Advisor collaborates with all other advisors to provide commercially available solutions. This Advisor collects the instances of the various objects (e.g., software packages, routers, access points, computers,) and populates the Techbase – a database of COTS solutions. The contents of the Techbase are used to update ("enrich") the object model by the various advisors. The COTS Advisor is designed to extract information from various sites (based on input parameters), synthesize and categorize it based on an extensive ontology, and store the results in the Techbase for use by other advisors.

14. Diagram Generator

PISA captures a great deal of information through the user interviews. This information, stored in XML documents, needs to be translated to visual presentations. The Diagram Interpreter renders this information to diagrams by using Flash and Java Applets. The goal is to render the object model into a visual representation for the end user so that they can understand and modify the results if needed. This also includes a visual editor that can be used to edit the configurations shown to the user. The Diagram Interpreter is somewhat similar to Graphviz (www.research.att.com/sw/tools/graphviz/) in concept but it maintains semantic information to support different views needed by the various advisors. For example, it displays a high level business view, an application view, a network view, and a security view of the object model (OM).

15. Intelligent Document Generation

IT planning projects require a great deal of documentation. The document generator is responsible for collecting information from the OM and producing well formatted documents in XML when needed. At the end of the interview, for example, the document generator reads the information gathered during the interview and produces a comprehensive report. The report summarizes the important information captured during the interview (company profile, recommendations of applications, networks, platforms, security, etc.) in a format that can be used for RFP/RFQ (request for price/request for quotation).

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[2] VPN (Virtual Private Network) encrypts the traffic before it is transmitted over the network.

[3] SSL (Secure Socket Layer) is a commonly used software package for secure Web operations such as on-line purchasing.

SECTION D: Architectures and Integration Through AIM

Note: This section is a bit more technical. Please proceed with caution.

16. Overview

PlanIT produces an enterprise-wide IT plan that shows the main elements of the IT infrastructure. However, it does not answer the important question: how will all these elements fit together to form a working solution? This is where AIM fits in. A user would typically develop an enterprise-wide plan by using PlanIT and then use AIM to investigate in more detail how different aspects of this plan can be integrated into an overall architecture. AIM helps its users to develop an integration plan based on Service Oriented Architecture (SOA) principles. See the side bar "What is a Service Oriented Architecture (SOA)?" for a quick tutorial on SOA.

Development of an integration plan is a complicated task with many challenges. Instead of a 'big bang' approach where all enterprise systems are converted to SOA in an afternoon, AIM supports a gradual approach where the enterprise achieves an integrated architecture one business (application) area at a time. The AIM methodology, shown below, guides the user through the iterative process of choosing a business problem and then developing and evaluating integrated architectures for the chosen problem

The AIM advisors (Business Problem Explorer, Intelligent Requirements Generator, Integrated Architecture Advisors, and Integrated Solution Advisor) support different stages of this methodology and generate extensive documentation (an integration requirements document, an integrated architecture document, and an evaluation report) that can be used to understand, explain and communicate the major decisions. The starting point for AIM is the overall IT plan generated by PlanIT.

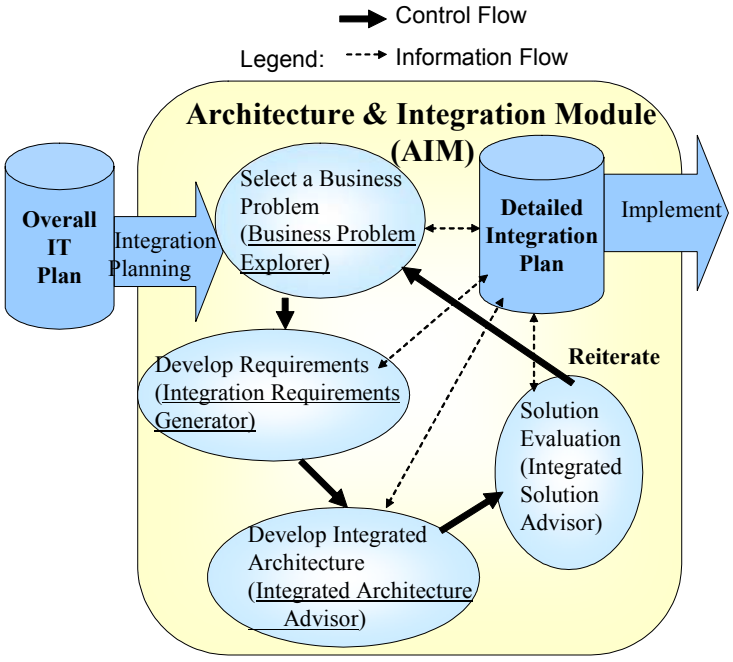

Figure 9: Conceptual View of AIM

What is a Service Oriented Architecture (SOA)?

Main ideas of service oriented architectures:

- Users (consumers) are primarily interested in services that they can receive from service providers.
- A service is a unit of work delivered by a service provider to achieve desired end results for a service consumer.
- Services are provided by *reusable* components, i.e., these components can be combined into applications. Thus a component that verifies, for example, customer account can be reused in different applications that need to verify a customer.
- The components must have clearly defined interfaces that the provided services can be published over the Web and discovered, selected and invoked by a wide range of clients.
- Although SOA can be implemented by using different technologies, Web Services are the key enablers of SOA because they support the description, publication, discovery, selection, and invocation of services over standard Web protocols.
- SOA relies on a sophisticated infrastructure, called an Enterprise Service Bus (ESB), that provides the communications, routing, security, directory and administration services for the service providers and the service consumers in an enterprise. SOA Patterns are typically used to specify various ESB configurations. Figure 1 shows a sample ESB configuration. .

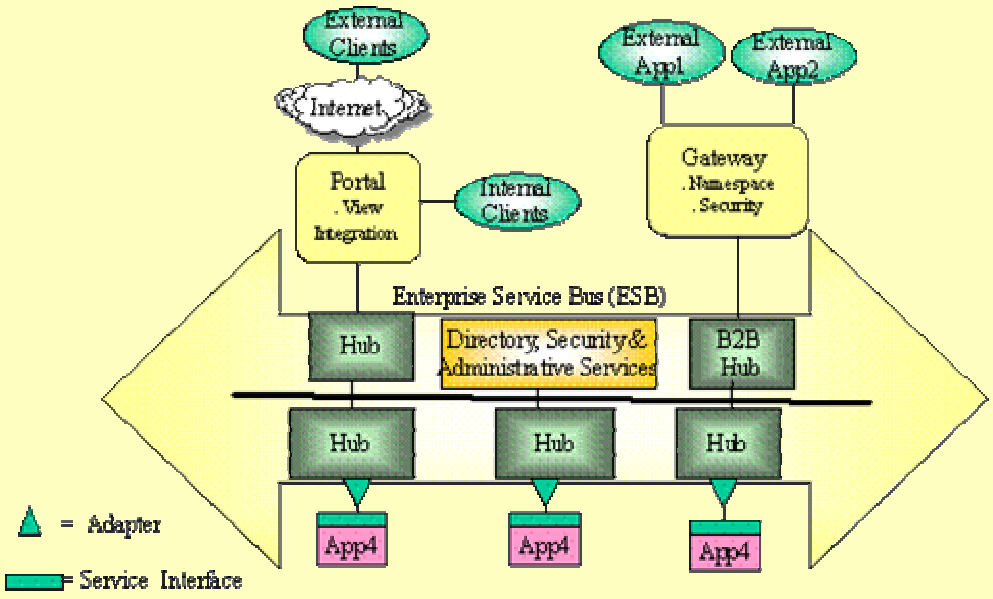

Figure 1: Enterprise Service Bus (ESB) – Conceptual View

SOA Patterns and ESBs

An SOA architecture pattern or just an SOA pattern defines the infrastructure services needed by the applications in SOA. These infrastructure services are typically defined in terms of an Enterprise Service Bus (ESB) that provides the main mechanism for integrating the internal applications. An SOA ESB provides a collection of technologies (middleware such as Web Services, adapters/gateways for protocol conversion, data transformers, transaction managers, and

work/process flow systems) that allow diverse applications to talk to each other. At their best, ESB platforms hide all the complexity needed to enable interactions between applications that were developed at different times by using different middleware technologies. Thus ESB platform is not a new technology – rather, it is a combination of "well-known" technologies that can integrate multiple applications. All applications (business components) provide services that are invoked through well defined interfaces. The following figure shows a conceptual view of an ESB.

While there is no industry-standard definition, an ESB is expected to posses the following common set of characteristics:

- **Communication through a Broker**. An ESB uses a software intermediary (a hub) between the sender and the receiver, providing a brokered communication between them.
- **Intelligent Routing through Directory Services**. ESBs typically use a directory service to resolve addresses at run time and may also route messages based on predefined rules (e.g., find a closest service provider). A Hub provides communications services between various service providers and consumers An ESB may consist of one or more hubs.
- **Endpoint metadata**. ESBs typically keep metadata about service interfaces and message schemas. This information is used to translate messages. .
- **Message transformation**. ESBs typically provide off-the-shelf adapters that are used for message and protocol translations.
- **Basic Web services support**. Most ESBs support basic Web Services standards including SOAP, WSDL, and XML. UDDI support for directory services is also becoming popular. stery service as well as foundational standards such as TCP/IP and XML.

Some ESB vendors offer additional features including security, administration, software development, validation, logging, and auditing capabilities.

In short, ESB platforms are sophisticated mediators that provide an "application bus" for rapid and flexible integration of a very wide range of applications that may span technology vintages (past, present and future) as well as organizational boundaries (inter and intra organizational boundaries). ESB platforms are an outgrowth of earlier mediators such as application gateways and object wrappers and are intended to insulate the business from changes in the applications and business needs and help with combining systems from acquired companies ESB platforms may use different types of middleware technologies (e.g., CORBA, Message Queuing, etc). However Web Services are the most recent technologies of ESBs. ESBs may also exist as EAI (enterprise application integration) platforms or message brokers.

ESB software is commercially available from vendors such as IBM (Websphere ESB), Microsoft (Biztalk Server 2006) and others (e.g., Sonic Software, Systinet, Tibco, Fiorano, IONA).

Sources of additional information:

- IBM SOA Website: www.ibm.com/soa
- Sun SOA Website: www.sun.com/soa
- IEEE Computer Society Technical Committee on Services Computing - www.servicescomputing.org. This is a very good website on SOA information..
- SOA Portal at http://www.service-architecture.com/
- IBM System Journal, Service-Oriented Architecture special issue, Volume 44, Number 4, 2005. This is a really good issue. It has many good articles.
- Book: "Service-Oriented Architecture (SOA) Compass: Business Value, Planning, and Enterprise Roadmap", By Norbert Bieberstein et al, IBM Press, Oct 2005.
- Barry, D., "Web Services and Service-Oriented Architectures: The Savvy Manager's Guide", Morgan Kaufmann, 2003.

17. WHO SHOULD USE AIM AND WHY?

AIM is intended for IT managers, IT planners, and IT architects to work through the following business scenarios:

- Determine how a given application (called ***Target Application***) can interwork with its surrounding applications by using SOA. The target application may be a new application, an existing application that is being extended-migrated, or a critical app that needs to (re)evaluated.
- Estimate the cost of transitioning to SOA and how can this cost be justified in business terms.
- Develop and evaluate an SOA plan in terms of cost, performance and security.
- Transition an application or a group of apps to SOA through replacement or gradual migration strategies.
- Outsource an application through rental, remote hosting, or other outsourcing scenarios and evaluating the tradeoffs.
- Develop a data warehouse for business intelligence and understand how it fits into the overall enterprise architecture.
- Do gap analysis between your current method of operation (PMO) and future method of operation (FMO) based on SOA. In other words, given a future business scenario, what type of SOA services, configurations and platform should be used in terms of outsourcing, renting, remote delivery of services, and extended enterprises scenarios.

18. EXAMPLE REVISITED

To illustrate the main issues addressed by AIM, let us consider the following situation for XShop. To improve sales, the company needs a very flexible online purchasing (OP) application that is based on SOA. The company needs help in addressing the following issues: what other applications interface with OP, how will they be impacted if OP is transitioned to SOA, what happens if OP is outsourced and hosted elsewhere, how will OP be accessed from a wide range of user devices, what will be the most appropriate integration strategy (access in-place, data warehousing, or migration) to mesh OP with other XShop applications, what type of integration technologies will be most suitable, and what will be cost of transitioning OP to SOA?. Additional issues include: are there commercial-off-the-shelf products that can be used for OP, what type of middleware technologies are needed to support different architectures, which ESB (enterprise service bus) platform should be used, what are the performance and security tradeoffs when different components of this application participate in B2B trade, and what type of cost/benefit analysis need to be considered while evaluating these alternatives. These are non-trivial questions that require a great deal of time and effort to answer in a purely manual approach. In the following sections, we will illustrate how AIM can possibly help.

19. BUSINESS PROBLEM EXPLORER (BPE) AND THE KNOWLEDGEBASE

Developing an understanding of the problem and establishing a business case is a typical first step in any integration effort. The BPE plays an important role in selecting the critical applications that will participate in the integration project and will be used as a basis for impact analysis. For each critical application, an "Application Group" (a group of applications that interact with the critical app) is defined. After you have selected the application(s), the next advisors in AIM are invoked to develop and evaluate an integrated architecture based on SOA.

The Business Problem Explorer supports application selection by allowing the users to browse through the AIM knowledgebase. For example, the user selects OP by using the knowledgebase. The knowledgebase consists of 3 parts: pattern[4] repository, object models, and COTS database. The Pattern Repository (PR) plays a central role in AIM because we heavily use patterns to quickly develop solutions. Our Pattern Repository at present contains patterns for popular applications in ebusiness and m(mobile) business (e.g., eprocurement, supply chain management, customer relationship management, enterprise portals, etc). These patterns are refined through an interview with the user. We have found that this approach significantly reduces the number of questions to be asked from the user and quickly generates solution sketches that can be refined and customized by the user. Object Models (OMs) represent the information created about different objects (e.g., application components) for a user session. A common *OM* is at the core of collaboration between different advisors because it is refined and expanded as the advisors work on solving a particular problem. To provide maximum flexibility, *OM* and all of its subsets, are implemented as XML documents. COTS database is another vital component of the knowledgebase because it helps translate a high level architecture sketch to an implementation view. Considerable effort has been expended on automatically updating the COTS database by extracting information from the Internet by using intelligent agents.

20. INTEGRATION REQUIREMENTS GENERATOR (IRG)

Development of requirements is an important but extremely time consuming process. This advisor heavily relies on the pattern repository (PR) to quickly develop a requirements document. The heart of IRG is an interview that develops a requirements pattern based on a very few questions. The interview starts with an enterprise application pattern, shown in Figure 10, that allows the user to understand external interfaces of the application and conduct sensitivity analysis. For example, the online purchasing application (OP) of XShop can be analyzed to determine which systems interface with OP. Figure 10 is based on a well known enterprise application pattern that combines the fundamental as well as industry specific aspects of enterprise applications. We have mapped this pattern to XML to automate answering of questions such as the following: a) if a particular application is replaced with another application, what other applications will be impacted, b) which application, if replaced, will have the most impact in terms of integration, c) which application, if replaced, will have the least impact in terms of integration. We have created enterprise application patterns for several industry segments that include manufacturing, healthcare, telecom, and others.

Starting with an analysis of Figure 10, additional information is gathered through the interview that considers factors such as user access, back-end apps, B2B apps, transaction value, volume, number of partners, mobility, personalization, etc. Figure 11 shows the interview. The outputs of this interview are used to populate the requirements document. In short, to develop a requirements document for integration of online purchasing application, the user will basically fill out an interview form shown in Figure 11. As a result of this interview, this advisor selects appropriate patterns from the PR and customizes them based on the results of the interview.

[4] A pattern, simply stated, is a sketch that can be refined and specialized for different situations.

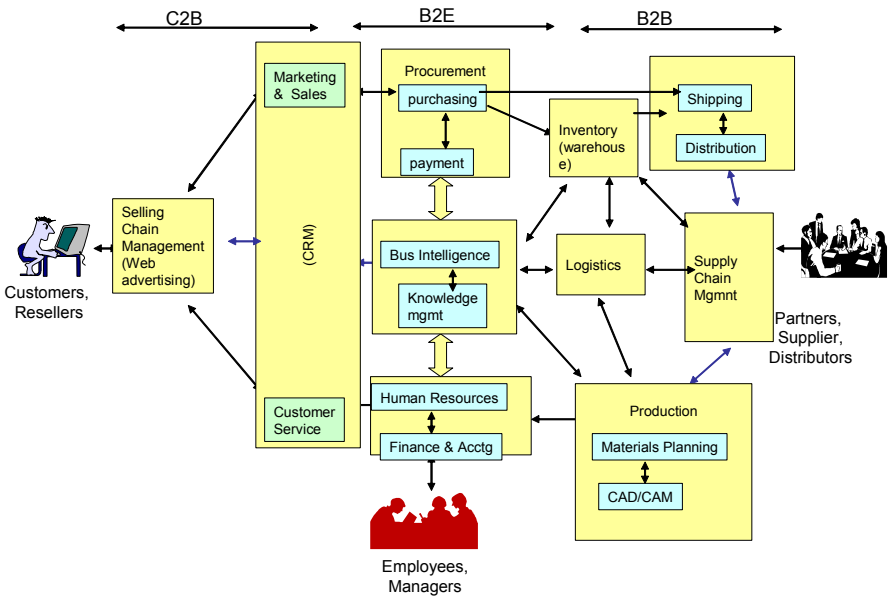

Figure 10: Enterprise Application Model

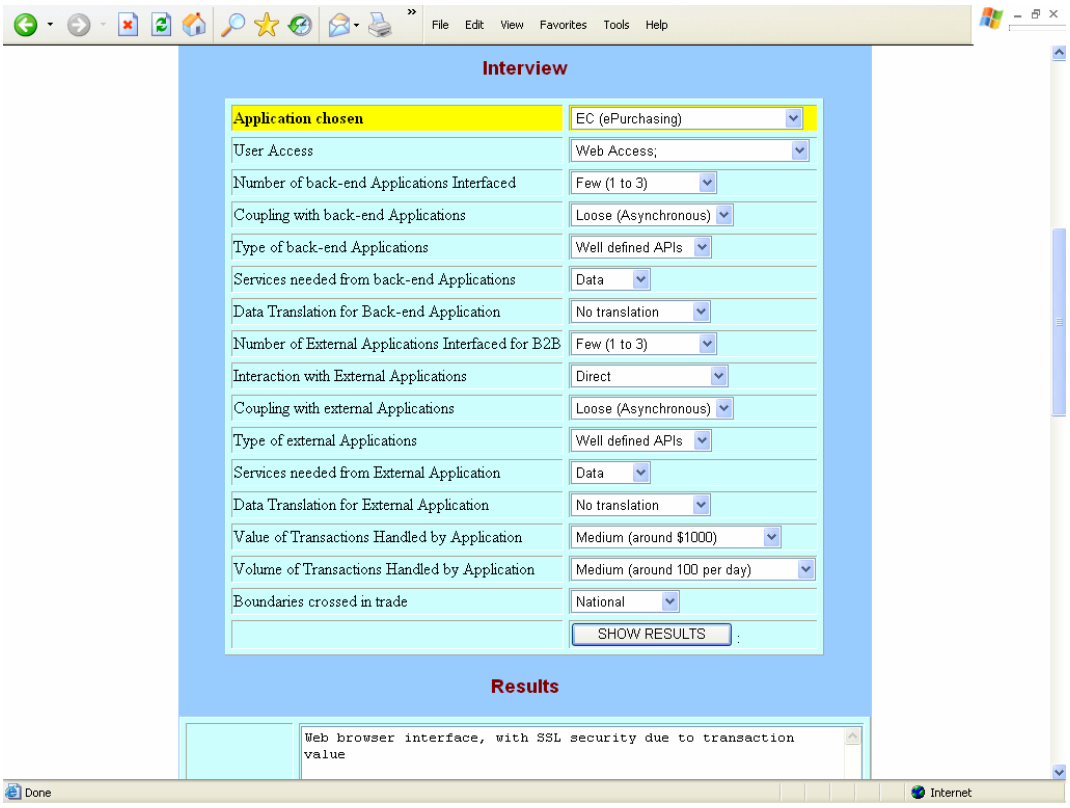

Figure 11: Sample Interview

21. INTEGRATED ARCHITECTURE ADVISOR (IAA)

This advisor develops an integrated architecture based on SOA from the requirements created by the previous advisor. The main objective of this advisor is to capture the complexity of the problem and translate this complexity into the needed SOA features. We start with the pattern shown in Figure 12 as most suitable for SOA.

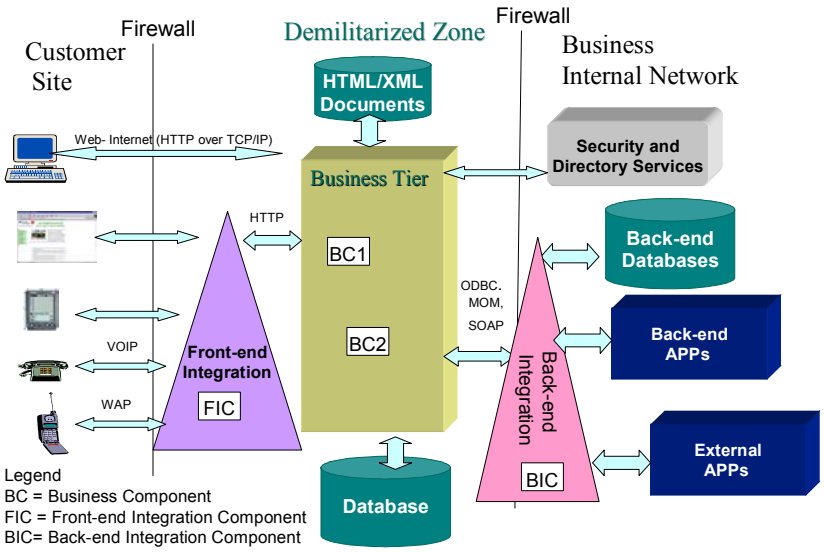

Figure 12: SOA-based Architecture Pattern

This pattern assumes that the application consists of N large grained components that are arranged in several tiers: front-end integration, business logic, backend integration, back-end apps, and external (B2B) apps. This architecture is developed through an interview that customizes the following integration components:

- BCs (Business Components) that imbed the business logic of the application and provide business services. The default is one BC per application (you can modify it, if you wish)
- FICs (Front-end Integration Components), also known as user integration components, that allow different types of user devices (e.g., mobile, handheld) to invoke the BCs.
- BICs (Back-end Integration Components) that BCs use to interact with different back-end and external applications.

Determination of these integration components depends on several other factors such as hosting options and integration strategies used for internal and external (B2B) applications. To illustrate these options and their impact on integration, let us go back to the online purchasing (OP) application of XShop. If Xshop decides to rent an online purchasing system from an ASP (e.g., use Amazon.com's purchasing system), then the back-end integration is the responsibility of the ASP. However, if the order processing app is rented from an ASP but inventory and shipping reside at XShop site, then remote integration between ASP and XShop is needed. This advisor highlights the idea that for different hosting choices (e.g., rent, build) you need to develop a different architectural solution.

Let us consider the situation when OP is hosted at XShop site. In this case, a local integration architecture is needed where all back-end systems (purchased, rented, developed) may reside at XShop site. This advisor helps the user develop an integration strategy with in-house systems – the strategy may be one or a mixture of the following:

- Access-In-Place - Consolidate the enterprise resources by using adapters and mediators such as wrappers, gateways and EAI (Enterprise Application Integration) platforms.
- Data Warehouse - build a "shadow" system to house the frequently accessed data
- Migration - re-architect and transition the resources gradually

The choice depends on the number of applications, the type of resources needed, data currency requirements, business value of applications (e.g., mission critical versus needed for outdated/unimportant functions), flexibility and growth requirements, technical status of application (e.g., highly decomposable versus monolithic), data query (ad hoc) requirements, data currency requirements, and number of host applications accessed by clients for needed data. Figure 13 shows a sample interview. This advisor uses the results of this interview to establish the technical aspects of the Front-end Integration Components (FICs) and BICs.

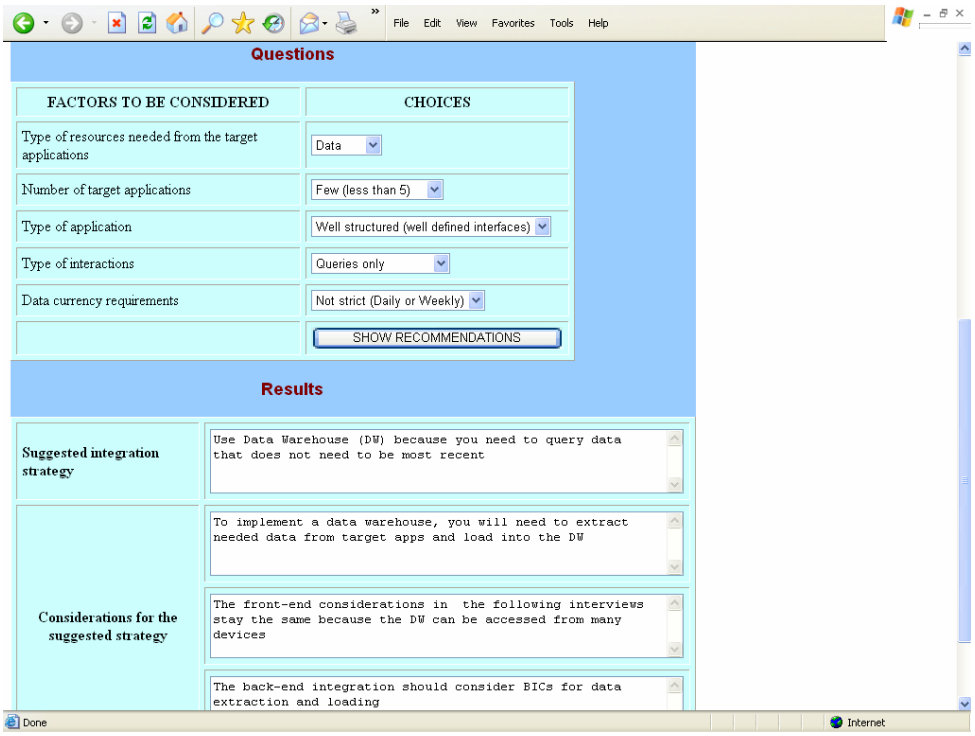

Figure 13: Sample Interview about Integration strategy

This advisor also suggests a B2B Integration strategy. Integration of new applications with external applications (applications of suppliers and business partners) for B2B trade is an important issue. However, business applications do not directly interact with the internal private applications of the trading partners. Instead a "Public Processes" is created by each supplier that handles all requests and passes these requests to its internal applications. The interviews of this advisor help to determine how your apps will interact with the public processes of each supplier This interview allows you to a) decide about a strategy (direct versus indirect, integration versus data warehouse), and b) for each strategy (direct or indirect) choose appropriate technologies.

At the conclusion, the IAA produces an architecture document that captures the recommendations by this advisor through the interviews. The architecture document consists of the following (this information is represented in XML): a) an enterprise service bus (ESB) configuration diagram that shows the architecture, b) description of the front-end, back-end, and external integration technologies in terms of the adapters and integration component, and c) business service descriptions and specification of business components.

22. Integrated Solution Advisor (ISA)

This advisor translates the SOA features determined previously into solutions and estimates the related costs, performance and security metrics. Beyond architectures, it is vital to see how architectures can be translated into solutions that can be actually deployed. ISA meets this need by suggesting a set of integrated solutions based on what-if analysis. It produces a table that lists

plausible solutions with appropriate commercial-off-the-shelf (COTS) packages based on performance/security/cost evaluations. This advisor is a very powerful tool that allows the analysts to go beyond the high level models created by the previous advisors and facilitates investigation of various implementation scenarios with some insights about performance, security, and cost considerations. For example, it helps the user to select the COTS (commercial-off-the-shelf) application packages that can be bought and suggests an application service provider (e.g., Corio) for rental and outsourcing. ISA collaborates and consults with several PlanIT advisors (Network Advisor, Security Advisor, COTS Advisor, and Project Planner) to develop and evaluate solutions and simulates a "team problem solving" environment.

The main results of these analysis are the estimated cost/effort, security, and performance for different potential solutions S1, S2,,,Sn. These results are used to evaluate and choose the most suitable solution. The analyst can look at these results and go back to previous advisors to generate other solutions if the results so far are not acceptable. At the conclusion of ISA, a summary report is produced highlights the main results plus a project plan for the selected solution. Figure 14 shows a partial view of this report.

Figure 14: Summary of Candidate Solution Evaluation (Partial Display)

Integration Cost Evaluation for Order Processing Application

Estimated Integration Costs

Cost of ESB Platform, routing, B2B trade, registry, security, and administration) (USD)	10000 *
Effort in installation, implementation, and training (person days)	10
Cost for additional integration software	5000
Average expenses per person-day	$500
Total estimated cost in USD	20000

Security Recommendations

Resource Type	Threat and Vulnerabilities	Suggested Security Measures
Enterprise Service Bus(ESB)	Many attacks can be launched on the ESB platform (e.g., denial of service attack, corrupt the output produced by the ESB so that it produces erroneous outputs).	Protect ESB hubs with IDs/PWs so that others cannot tamper with it
SOA Gateway	An intruder can launch a denial of service attack on the SOA gateway, eavesdrop or corrupt the output produced by the gateway	Protect the SOA gateway with IDs/PWs so that others cannot tamper with it
Service Provider(SP)	• Widely distributed SPs accessible from multiple players expose many issues and require multiple signons. • An intruder can launch a denial of service attack on the Service Provider or can corrupt the output produced by the SP. • Because of different partners, NR (non-repudiation) is harder.	• Protect the SPs with IDs/PWs so that intruders cannot invoke them • Use SAML (Security Assertion Markup Language) assertions about authorization and authentication

Performance Analysis for Order Processing Application

Important Parameters and assumptions

SECTION E: Technical Architecture and Concluding Remarks

23. Technical Architecture of PISA

PISA platform is based on the Microsoft .NET Framework. The system resides on an IIS server and is accessible from commonly available Web browsers. Figure 15 shows the technical architecture of PISA with its two major modules: PlanIT and AIM. All advisors are ASP.NET modules that run on the IIS server and are written in C#. We are currently investigating some rule based engines for future developments. All advisors are invoked from a controller that signs a user in, assigns a unique ID to the user, and manages user sessions. This allows each user to develop and store his/her own output (planning model) that is enriched as the user invokes different advisors. As stated previously, the planning model (PM) is a set of XML documents that represents the results of the interviews as the user interacts with different advisors. After being invoked, each advisor conducts its own interview, consults the object model to review the decisions made so far, makes inferences as much as possible, makes further decisions based on the user interview, extracts needed patterns from the patterns repository, and further enriches the object model. The object model is used as a basis for collaboration between the advisors.

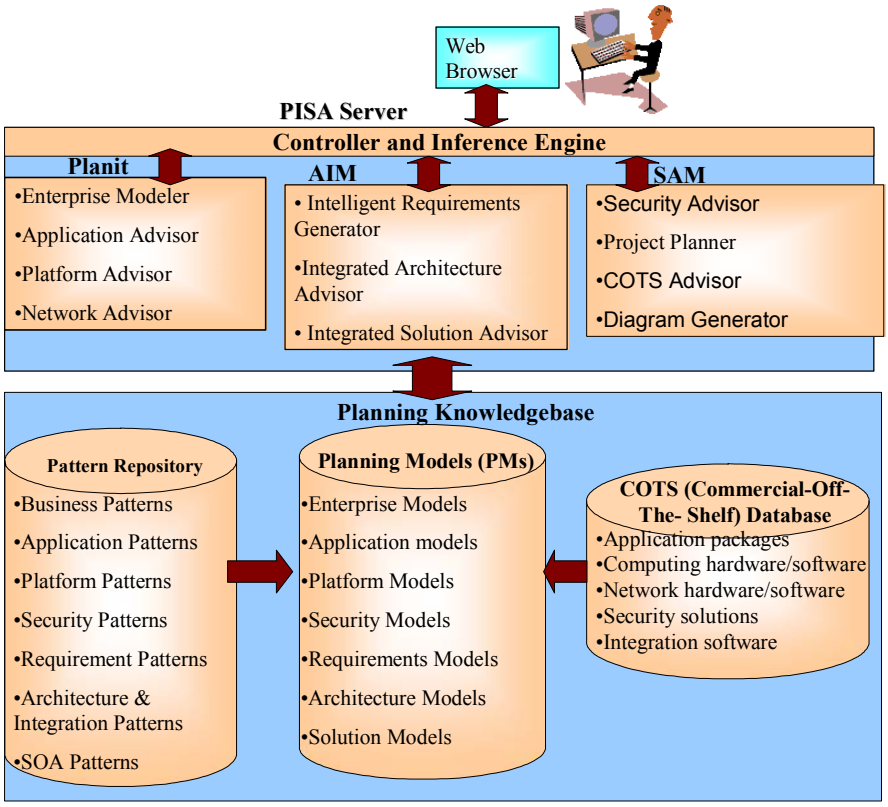

Figure 15: Technical Architecture of PISA

24. Concluding Comments and Next Steps

PISA is an extensive computer aided consulting environment that uses business patterns, best practices, inferences, and collaboration to recommend IT solutions for contemporary businesses.

The "family" of PISA advisors help a user walk through an extensive array of IT planning, architecture and integration choices. At the conclusion of the session, the system produces an extensive report that gives a summary of all the results produced during a session with PISA:

- **The Enterprise Model** that shows your company information (company type, company size, number of sites, what business processes are performed on what sites, what are the workgroups and where do they reside).
- **The Application Plan** that shows what business processes will be automated, what strategies (rent, buy, outsource, re-use) are used to automate the business processes, and any COTS (commercial-off-the-shelf) packages selected.
- **The Computing Platform** plan that shows the computing hardware and software needed to support the application plan.
- **The Network Plan** that shows the wireless as well as wired network to support your staff (called Intranet), your customers and your business partners and suppliers.
- **The Security Plan** needed to protect your corporate assets (databases, programs, computers, network links, network devices).
- **Requirements document for integration** that shows the requirements of selected applications for integration.
- **Integrated architecture document** that shows the architectures that are most suitable for integration.
- **Project plan** that shows the work breakdown structure based on the interview and then produces a Gant chart.

The next steps are:

- Develop an RFQ (Request for Quotation) to solicit proposals from consulting companies and service providers who will implement the plan
- Select and hire a consultant to refine and implement the plan

The report produced by PISA is already in an RFQ format and can be used by the consultants to quickly understand what you are planning to do. When commercially available in the Fall of 2005, we will provide consultation support to help the industrial users implement and deploy the recommended plans.

We are planning to keep expanding this system in the future. The current prototype has been used in controlled industrial and academic settings with very positive results. Future research and development directions include a wide range of activities to add new advisors and also improve the existing ones.

