

Building the Next Generation Enterprises

PISA

(Planning, Integration, Security and Administration)

An Intelligent Decision Support Environment for IT Managers and Planners

CASE STUDY: IT Infrastructure Planning through PISA-PlanIT

January 22, 2008

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

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IMPORTANT NOTE TO THE READERS

This document assumes that the reader has browsed through the 'PISA Overview Document'.

1. CASE STUDY OVERVIEW

XYZShop, a real life retail-manufacturing company that wishes to stay anonymous¹, was formed in 1985 by a small group of engineers in Chicago to build, repair, and sell electronic devices. The initial business of the company was televisions, radios and calculators. With time, the company included VCRs and PCs into its product lines. In the 1990s, the company entered into business partnerships with numerous suppliers around the globe and acquired a startup company that builds desktops, laptops, network devices (e.g., routers, access points), and personal digital assistants. XYZShop also formed partnerships with numerous other computer hardware/software vendors and acquired several retail electronic stores that sell and service network products, increasingly in the wireless area. These stores also sell, market and service the XYZShop products. In the 2000s, the company has started thinking about providing technology solutions, consulting, and training services for mobile and wireless areas. The company management believes in controlled growth, i.e., systematically explore new markets and diversify by using new products and services after careful strategic analysis and evaluation of core competencies.

The company headquarters are in Chicago with branch offices in the US, Europe and Asia. The company has currently about 900 employees and operates many regional offices: Southern (HQ: Atlanta), Western (HQ: San Francisco), Eastern (HQ: New York), Midwestern (HQ: Detroit), North Western (HQ: Seattle), European (HQ: Paris), and Asian (HQ: Tokyo). Each region supports between 5 to 10 local offices (some of these offices are stores, the others are marketing, training, consulting and support centers). The company wants to outsource some business functions, plans to buy and rent most of its applications, but also wants to build and re-use some.

This document shows the overall procedure, with numerous screen-shots, the company used to develop an overall IT infrastructure plan by using PISA. Specifically, the document illustrates how:

- Enterprise Modeler helped in developing a high level model of this organization
- Application Advisor aided in automation of business processes through application software
- Platform Advisor recommended computing hardware and software needed to support the applications
- Network Advisor suggested a wireless/wired network configuration that interconnects the applications, users, and computing platforms
- Security Advisor analyzed system vulnerabilities and recommended security solutions

2. BUILDING 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.

¹ This case study in fact is based on a combination of two real-life companies. The office locations and products have been modified slightly for the purpose of simplicity and anonymity.

Figure 1 shows the first step in building an enterprise model. User defines a business scenario by choosing a scenario name, size of company, type of industry segment (pull down menu shown), etc. XYZShop used this screen to define a business scenario of the company.

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	STEP 1: Company Please enter scenario of your organization. The in since the recommendations and decisions made by	Profile Basic Data ? formation entered here will be extremely important y the 'Advisors' will be based on this data.	
	(SMBs) Name of Scenario Size of Business (number of employees)	manufl Small (staff 11 - 100)	
	Type of industry Segment Number of Sites	Manufacturing Select an industry segment Consulting Services Education	
	Site Locations	E-MarketPlace Financial Services (Banking) Healthcare Provider Insurance Legal Manufacturing Deal Estate	al
	Mobile Computing and Wireless Reliance ?	Retail and Wholesale Software Telecommunications	
🖉 Done	On-demand Services 😕	⊙None ○Few ○Many	ue v

Figure 1: Developing a Business Scenario

Once a user has made basic selections, an appropriate enterprise business pattern (EBP) is selected. Figure 2 shows the EBP that was shown for XYZShop. This EPP is fetched from the Pattern Repository. The repository has a graphic image plus an XML representation of this EBP.



Figure 2: Reviewing the Enterprise Business Pattern (EBP)

PISA produces a list of business functions (BFs) for the type of industry chosen based on the EPP shown previously. Figure 3 shows the list of BFs for XYZShop. Notice that the user can outsource some BFs, delete some by selecting 'None' and add some (yellow button at the bottom of screen).

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Figure 3: Displaying and Assigning Business Functions

PISA produces a summary of the enterprise options chosen by the user at the end of Enterprise Modeler. Figure 4 shows the summary of the enterprise model developed by XYZShop. This model shows the .BFs that have been outsourced and the ones that are assigned to the sites with staff assignments. We have not shown all steps of the Enterprise Modeler. The following enterprise model is stored in the Project Models repository.

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Profile Name: manuf1											
Enterprise Model											
Enterprise Model											
Per your input, the summary of the enterprise model is as follows:											
Sites: 2 Local Number of Employees: 56 Reliance on Web: Basic Websites Mobility Requirements: No use of mobile computing On Demand Services: None Summary of Business Functions and Personnel Distribution across the Organization											
Locations	Rusinges Eurotions	Personnel									
Eocations	Business Functions	Manager	Knowledge Worker	Operator							
Outsourced	Human Resource Management		Not Applicable								
Outsourced	Sales		Not Applicable								
	Corporate Management	1	2	1							
site1	Customer Support and CRM	1	5	1							
	Finance and Accounting	1	5	1							
	Logistics	1	4	1							
	Marketing	1	5	1		_					
site2	Production	1	5	1							
	Supply Chain Management	1	2	5							
	Warehousing and Distribution	1	2	7							

Figure 4: Summary of Enterprise Model

3. Automation Strategies (Application Advisor)

The Application Advisor suggests an application plan to automate the BPs based on the enterprise model developed by previously. This advisor 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.

Figure 5 shows how the various BFs (business functions) and BPs (business processes) within the BF for XYZShop will be automated (buy, rent, outsource, etc). This step was used to create different IS planning scenarios within a given business scenario. For example, a company may decide to automate all BFs/BPs, outsource all, or a mixture. Very small organizations (e.g., SOHOs) may not even need to go to the BP level. This screen leads to other screens (not shown) that allowed XYZShop to make more detailed decisions.

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	STEP 2(b): Select Automation Strategy (Detailed Issues)										
	Please select suitable solution strategy for each Business Process. There are six options including: <u>Manual (no automation needed)</u> , <u>Buy Pkgs (Buy Commercial Packages)</u> , <u>Rent from ASP,Inhouse Development</u> , <u>Outsource Development</u> and <u>Re-Engineer</u> existing application software. 'Buy Commercial Packages' will be the default option. If you cannot choose an option, click on 'Get Recommendation'. Please select desired automation strategy for each Business Process										
	Business Function Business Process Solution Automation										
	Corporate Management	All	ERP	Manual 🗸	Get Recommendation						
	Customer Support and CRM	All	ERP	Rent from an ASP	Get Recommendation						
	Finance and Accounting	All	ERP	Rent from an ASP	Get Recommendation		Ξ				
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	Supply Chain Management	All	ERP	Buy Pkgs	Get Recommendation						
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Figure 6 displays how XYZShop explored and selected application packages and ERP Solutions.

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	Select	Finance and Accounting	All	ERP	Rent from an ASP						
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Figure 6: Selection of application packages

Figure 7 shows the recommended application packages produced by PISA based on the intelligence gathered so far. The user can receive the explanations (justifications) of the recommendations and also can explore or modify the recommendations the alternative actions. XYZShop used this screen extensively to capture its present method of operation (PMO).



Figure 7: Modifying the Recommendations

Figure 8 shows the summary of Application Plan produced by the Application Advisor for XYZShop. Note that the application packages have been chosen from the COTS database.

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Figure 8: Summary of Application Recommendations

4. 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.

Figure 9 shows the recommendations generated by the Platform Advisor for the various Workgroups at the different sites XYZShop. The **View/Change Recommendation** button allows a user to view and modify the recommendations. XYZShop modified the requirements and recommendations to add, for example, wireless users.



Figure 9: Determining Computing Platform Services

After XYZShop received all recommendations, the platform recommendation summary was displayed as shown in Figure 10. It shows the servers, the desktops, and mobile/wireless computing platforms suggested by the Platform Advisor. The following screenshot shows a small portion of the recommendations produced by PISA.

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		Business Function: Corpo	rate Manager	nent	
Title	qty	Configuration		Software (Applications + Middleware)	
Manager	1	Type: wired Hardware: Dell Dimension 4400 OS: Microsoft Windows 2000		 MS Office XP MS Outlook Express MS Internet Explorer 6.0 	
Knowledge Worker		orker 2 Type: wired Hardware: Dell Dimension 4400 OS: Microsoft Windows 2000		 MS Office XP MS Outlook Express MS Internet Explorer 6.0 	
Operator	1 Type: wired Hardware: Dell Dimension 4400 OS: Microsoft Windows 2000			 MS Office XP MS Outlook Express MS Internet Explorer 6.0 	

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Figure 10: Recommendations of Platform Services

🥝 Internet

5. 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. The Network Advisor is an "intelligent" system that recommends a network solution by inferring a great deal of information based on the past interviews with the other advisors. Thus a user does not have to sit for hours providing all the information. It gathers additional information from a quick interview and uses the information it has gathered to recommend a solution.

The following figure shows the estimated workload model for different workers in different workgroups of XYZShop. You can modify the estimated workload (XYZShop did modify a few workload estimates).

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			site1/FA					Knowledge W	orker		200	kbps	20	kbps
			site1/FA					Operator			200	kbps	20	kbps
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Figure 11: Workload Estimation

The Network Advisor shows recommendations based on user input. The following figure shows a table with the following entries based on the XYZShop information:

- # shows the network number
- Campus shows the name of the site (e.g., HQ, site 1, site 2, etc.).
- BPs shows the business processes (BPs) to be served by the network.
- Users shows the total number of users (Wired + Wireless) on the network. For example, (38 +7) shows that 38 wired plus 7 wireless users will be on this network.
- Bandwidth shows the total bandwidth, in Kbps, needed by the network to support the number of users on the network. This helps you to choose a fast enough network.

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	Prev Adv	isor Step1	Network Advise Step2	Step3	Next Advisor						
STEP 2: Display Network Model											
	The Netv	work Advisor has come	up with a recommendation based on the : wing table	nput you have provided. You ca	n see the details						
	anangeu	oy Campus in the louid	wing table.								
	The table	shows networks for di	ifferent workgroups at different campuses	(sites)							
	#	Campus	Workgroups	Users (Wired+Wireless=) Total	Bandwidth						
	1	site1	 Invoicing 	(38+7=)45	9000 kbps						
	2	site2		(23+3=)26	5200 kbps						
	3	site3	 Payroll 	(30+4=)34	6800 kbps						
				Show Diagra	am Proceed						

Figure 12: Displaying a Network Model

The user can click on the **Show Diagram** button for views of the network (shown below). Users can see different aspects of their network by clicking on different icons.



Figure 13: Displaying a Network Model (Graphic)

A user can also use this Advisor to determine the commercial products to support the network design. The Network Advisor suggested the commercially available network products, shown below, based on XYZShop requirements.

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	Pre Ad	evious visor Step1 <u>STEP 3: Dis</u>	Network Advisor Step2 playing selected Commercial Produ	Step3 reaction → Next Advisor	
	The Ne see the	etwork Advisor has Selected the follow details in the following table.	ing commercially available network pro	ducts per your requirements. You can	
	#	COTS Selected	Features	Usage	
	1	Linksys Cable/DSL Modem	N/A	Path: site l	
	2	Wireless-B Access Point	Type: Wireless Access Point Topology: 802.11b Bandwidth: 11Mbps Vendor: Linksys	Path: site l/ FA Devices Attached: 2 Load: 0.8Mbps	
	3	EtherFast® 10/100 16-port Auto- Sensing Hub	Type: Hub Ports: 16 Bandwidth: 10Mbps Vendor: Linksys	Path: site l/ FA Devices Attached: 8 Load: 3.2Mbps	
	4	5-Port 10/100 Switch	Type: Group level switch Ports: 5 Bandwidth: 100Mbps Vendor: Linksys	Path: site]/ FA Devices Attached: 3	
	5	Wireless-B Access Point	Type: Wireless Access Point Topology: 802.11b Bandwidth: 11Mbps Vendor: Linksys	Path: site]/ HcG Devices Attached: 5 Load: 2Mbps	
	6	EtherFast® 10/100 24-port Auto- Sensing Hub	Type: Hub Ports: 24 Bandwidth: 10Mbps Vendor: Linksys	Path: site]/ HcG Devices Attached: 24 Load: 9.6Mbps	
			Twne: High		*

Figure 14: Displaying Communication Products

The following figure shows the summary of network plan produced by the Network Advisor for XYZShop.



Figure 15: Network Summary

6. 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.

The Security Advisor analyzes the security features of the models developed so far and suggests a security plan that can be used to secure networks, databases, applications, platforms, and other objects. This Advisor starts with setting the security requirements for the different "objects" (resources to be protected) in the network. The following figure shows the objects to be protected in the XYZShop system (this list is produced automatically). The user can change the defaults by setting security requirements to be high, medium or low.

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											-		
	Advisor Step1 Step2 Step3 Step4 Advisor												
Step1: Secure individual objects ?													
	Here you set the security requirements for different "objects" (devices, computers, databases, software packages) in the network.												
	Following are the vulnerable device/object types. Please specify your security requirements and click the "Continue" button to proceed.												
		#	Objec	t Type	Security Level								
		1	Cable/DSL N	<i>f</i> lodem	⊙ Low	⊖Medium	⊖ High	○None					
		2	Access Point		OLow	\bigcirc Medium	⊙ High	○None					
		3	Hub		○Low	💿 Medium	⊖ High	○None					
		4	Switch		\bigcirc Low	\bigcirc Medium	\bigcirc High	⊙ None					
		5	Router		○Low	💿 Medium	⊖ High	⊖None					
		6	Wireless Hos	t	○Low	\bigcirc Medium	📀 High	○None					
		7	Wired Host		OLow	💿 Medium	⊖ High	○None					
		8	Application S	erver	\bigcirc Low	⊙ Medium	\bigcirc High	○None					
								Cont	tinue				

Figure 16: securing Individual Objects

This Advisor next suggests solutions for the main objects in the system based on the security requirements chosen previously. For example, it shows what should be done to protect databases, applications, network devices, and other vulnerable objects.

The solutions show the type of encryption (e.g., symmetric key, asymmetric key, PKI, digital certificates), authentication (e.g., ID, PW, secure ID cards), authorization (e.g., authorization control lists), and other techniques. Figure 17 shows this information for XYZShop. Note that if you chose higher security requirements, more solutions are suggested (naturally!).

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	Object t	type				Weakness			Sol	utions		
Cak	ole/DSL Mode	m	•	Device	is not p	placed in a se	cure Location	▶ Protect	ct the netwo	rk devic	e by plac	cing in a
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Figure 17: Displaying Security Vulnerabilities and Solutions

Attack trees are a convenient way to explore potential attacks and thoroughly examine the impact of weaknesses in the system. An attack tree is simply a tree that is similar to a logical decision tree that pinpoints what could be attacked, where the attack could happen, when the attack could take place and what could be the results. Attack trees can illustrate how a single weakness, such as sending passwords on clear links, can result in multiple threats to your system.

The Security Advisor automatically runs attacks on the objects in your network. The following figure partially shows the result of running the attacks on the XYZShop network developed so far. Safe and unsafe show which attacks a network is safe or unsafe from.

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<i>→</i>		
	Threats for:Hub	
	Threats	Status
	Un-Authorized Person Connects to the Hub to Access Network	Safe
	Intruders possibly modify device settings	Safe
	Steal or Damage Hub	Safe
	Tap into device to attemp eavesdroping	Safe
	Denial of Service	Safe
		Analyze Attacks
	Threats for:Switch	
	Threats	Status
	Threats Un-Authorized Person Connects to the Switch to Access Network	Status Unsafe
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings	Status Unsafe Unsafe
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch	Status Unsafe Unsafe Unsafe
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch Tap into device to attemp eavesdroping	Status Unsafe Unsafe Unsafe Unsafe Unsafe
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch Tap into device to attemp eavesdroping Denial of Service	Status Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch Tap into device to attemp eavesdroping Denial of Service	Status Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe Analyze Attacks
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch Tap into device to attemp eavesdroping Denial of Service	Status Unsafe Unsafe Unsafe Unsafe Unsafe Analyze Attacks
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch Tap into device to attemp eavesdroping Denial of Service Threats for: <i>Router</i>	Status Unsafe Unsafe Unsafe Unsafe Unsafe Analyze Attacks
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch Tap into device to attemp eavesdroping Denial of Service Threats for: Router Threats	Status Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe Analyze Attacks Status
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch Tap into device to attemp eavesdroping Denial of Service Threats for: Router Intrust Un-Authorized Person Connects to the Router to Access Network	Status Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe Status Status
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch Tap into device to attemp eavesdroping Denial of Service Threats for: Router Un-Authorized Person Connects to the Router to Access Network Intruders possibly modify device settings	Status Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe Status Status Safe Safe Safe
	Threats Un-Authorized Person Connects to the Switch to Access Network Intruders possibly modify device settings Steal or Damage Switch Tap into device to attemp eavesdroping Denial of Service Threats for: Router Un-Authorized Person Connects to the Router to Access Network Intruders possibly modify device settings Steal or Damage Router	Status Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe Unsafe Safe Safe Safe Safe

Figure 18: Attack Tree Analysis

The following figure shows the network diagram for XYZShop with security features added. The security features are displayed by moving the mouse over certain icons.



Figure 19: Security Display

The Security Advisor also displays an audit and control checklist customized for the scenario at hand. Part of this checklist for XYZShop is shown below.

Audit and Control Checklist

Color coding

The segments in Customized Checklist are color coded to represent the following:

- If the segment is "Black", no change needed to this segment
- If the segment is "*Blue*", you can reduce this segment or even remove it according to your requirement
- If the segment is "*Red*", you may need to expand this segment according to your requirements

6.1. Organizational Controls and Security Administration

These controls are intended for the entire firm and address the organizational structures, policies and procedures.

6.1.1. Documentation of the Information Systems Strategic Plan

- Management has developed and implemented long and short term plans that identify and fulfill the organizations strategies _____
- Information systems security is adequately addressed in the organizations long- and short-term plans
- The management of the information systems security was established and applied using a structured approach ______

6.1.2. Information Security Policies and Procedures

- Information security policies exist ______
- These policies are adequate to address Privacy, Integrity, Authorization, Authentication, and Availability (PIA4) in the following areas (circle the ones that are NOT adequately covered by the policies):
 - Web pages
 - Firewalls
 - Employee Surveillance
 - o Electronic Banking
 - 0

Figure 20: Display of a Security Audit List

A summary report, shown below, is produced at the end of the Security Advisor.



Figure 21: Summary of Security Solutions

7. PRODUCING A CONSOLIDATED IT PLAN

PISA PlanIT produces a **Consolidated Report** that reflects the IT Plan developed by different advisors.

The report is shown at two levels: a high level summary (snapshot of this summary report is given below). A detailed summary report is also generated (shown on the next page). The following figure shows the summary report for XYZShop.

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Corporate Management	×	-	-	-	-	
Customer Support and CRM	×	-	-	-	-	
Finance and Accounting	×	-	-	-	-	
Human Resource Management	×	-	-	-	-	
Logistics	×	-	-	-	-	
Marketing	×	-	-	-	-	
Production	×	-	-	-	-	
Supply Chain Management	×	-	-	-	-	
Sales	X	-	-	-	-	
Warehousing and Distribution	×	-	-	-	-	
e-Advertising	×	-	-	-	-	
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Total Networks Devices	1	10				
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Master Gantt C	<u>Chart</u>		View Details	ž –		
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Figure 22: Summary of IT Infrastructure Plan

A snapshot of the detailed report for XYZShop is shown below for illustrative purposes (the report can be quite long). This report was used by XYZShop for several purposes such as the following:

- Treat the IT plan generated by PISA as a sketch and extend/modify this plan to take into account the situations not handled by PISA
- Buy products to support the organization
- Issue bids and RFPs/RFQs (requests for quotations, requests fro prices)
- Develop a more detailed plan based on this plan.

Final Note: It took XYZShop managers about 30 minutes to produce a completely documented IT infrastructure plan, including the overall summary plan shown in this document.



Figure 23: Displaying a Consolidated IT Plan