Implementing Information Technology to Effectively Utilize Enterprise Information Resources

Yousif Mustafa and Clara Maingi

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Implementing Information Technology to Effectively Utilize Enterprise Information Resources

Yousif Mustafa and Clara Maingi
Central Missouri State University, USA

EXECUTIVE SUMMARY

This is a typical case of implementing information technology in order to assist an enterprise to effectively utilize its production information resources. The enterprise, a world-class leader in Pharmaceutical industry, currently keeps a large number of technical research reports on shared network media. These reports contain scientific specifications extremely essential to the enterprise's final products. In order to utilize these reports, a researcher has to navigate and literarly read through each report to identify whether it is relevant to what he/she is currently working on. Often times, researchers find it more feasible to create their own reports rather than wasting time and energy on the searching process. Our solution to the problem is to create an information system which will keep track of these reports, provide a concise synopsis of each report, enable the researchers to search using keywords, and give a direct link to locate that report via a friendly Web-based user-interface.

BACKGROUND

The subject company is a world leader in life sciences focused primarily on two core business areas: pharmaceuticals and agriculture. Its dedication to improving life has been through the discovery and development of innovative products in the areas of prescription drugs, vaccines, therapeutic proteins, crop production and protection, animal health and nutrition. The company is also involved in the research, development, production, marketing and sales of organic and inorganic intermediate chemicals, specialty fibers, polymers, pharmaceuticals and agricultural chemicals. The company employs over 95,000 professional employees in more than 120 countries around the globe. Financial data are shown in Appendix A of this case.

SETTING THE STAGE

The company uses SAP Enterprise Integrated Software. SAP integrates and automates business processes starting with the procurement of raw materials, human resources, manufacturing and ending with the sale of the finished products. In order to manage the organization, the Decision Support

Department frequently requires its employees, report developers, to generate various reports to respond to numerous types of queries. These reports are the major source of information for the organization to make decisions at any level of management. However, these report developers are not permitted to directly access the SAP database because of the following reasons:

1. Direct access of the SAP database would greatly slow down the SAP system performance.
2. The generic format and contents of the reports generated by SAP do not have specific use for most users.
3. Reconfiguring SAP to generate specific reports is very expensive since it is huge and written in ABAP (which is a German programming language), which makes it even more expensive to hire a programmer who knows ABAP.
4. Reconfiguring SAP would make it more difficult for the organization to easily upgrade to newer versions of SAP.

Therefore, the organization decided to set up a process in which data from the SAP tables are automatically copied to DB2 tables. The DB2 tables are immediately updated whenever the SAP data is changed. The SAP database is stored on Oracle tables on UNIX servers while the DB2 database are kept into IBM-DB2 servers. The company also decided to utilize a user-friendly report generator called Impromptu as their primary choice to access the DB2 database tables.

These reports cannot be generated by running a simple query on the DB2 tables because these reports often include computations which convert different sets of data into more complex information, such as calculating cycle-time for a product from the moment the raw materials are acquired in the warehouse to the moment the finished products are completed. This part of report generation takes the longest time because the formulas created must be tested for their accuracy. Due to the nature of the company, we are not at liberty to show samples of their actual reports. However, we have attached some general purpose sample reports that can be derived from the Impromptu report generator (see Appendix B).

Impromptu report developers individually generate their reports and store them on a shared network location. Currently, there are more than 5000 reports and close to 60-70 are created daily. However, storing these reports on a shared network location is of little or no use to the Impromptu report developers. Each time a report is needed, developers often start making an Impromptu report from scratch even though a closely similar report may have already been available on the network. Searching through the 5,000 plus reports is both time consuming and frustrating. A developer has to retrieve each report and read through it to determine whether or not it is relevant to his/her current needs. Almost all developers prefer to start from scratch rather than try to search the network. A single Impromptu report could be very costly since each may take anywhere from 15 minutes to 12 months to generate, depending on the complexity of the report. The cost of generating a report can be broken down into:

- Searching the database tables for the required fields.
- Analyzing and deciding on the logical combination of these fields, then generating the correct mathematical and statistical functions required for the report.
- Testing the accuracy of the formulas on the report.
- Fully documenting the report.

Each Impromptu report is saved in two formats, .pdf and .imr format. The .pdf format is a snapshot of the report that can only be viewed using Acrobat Reader. The .imr format, on the other hand, represents the executable version of the report which can be "run". The .pdf format is necessary as an Impromptu report developer can quickly glance to decide if it is the report that he/she needs. This is important because "running" an Impromptu report is a CPU time-consuming operation.

CASE DESCRIPTION

The first step in our problem-solving approach is to explicitly and clearly identify users' requirements. We used the personal interviews technique (described in Dennis and Wixom, 2000;

Hoffer, George, and Valacich, 1999; Osborne and Nakamura, 2000; Whitten, Bentley, and Dittman, 2001), with the system users to identify the two following requirements:

1. Providing developers with the capability of documenting and saving their reports in a searchable manner.
2. Enabling the developers to search quickly and easily, via a user-interface, for a target report using different search items (which will be discussed in greater detail later).

Our solution to the problem is to develop an information system that would provide a rapid and easy tool to document, store, and search reports. Our system will keep a repository of searchable data of each report developed (in addition to the existing ones), including a link to the storage media where the report was saved. The system would enable developers to quickly search for any report using date report created, developer name, developing department, or a combination of key words.

In order for us to describe the processes of the new system, which we named the ImpromptuReport Dictionary, along with the data flowing between them, we used the DFD Gane and Sarson notations (described in Dennis and Wixom, 2000; Hoffer, George, and Valacich, 1999; Jordan and Machesky, 1990; Osborne and Nakamura, 2000; Whitten, Bentley, and Dittman, 2001). ADFD (Data Flow Diagram) is a graphical modeling tool used to depict the processes that a system will perform along with the data that flows in and out of each process. Figure 1 shows the context diagram of the system, which is the highest level of abstraction. Usually, the context DFD shows one process representing the whole system, the data which flows in and out that process, the origin of data (source), and the final destination of the data (sink).

Figure 2 shows level-0 DFD, which is a decomposition of the context DFD, where the system performs two major processes: updating the ImpromptuReport, and searching ImpromptuReport Directory Database. The diagram also identifies three data stores:

1. D1, our proposed searchable repository.
2. D2 and D3 are the locations on the network where the Impromptu reports (both the pdf and imr versions respectively) reside after they are submitted.

D3 is the location on the Impromptu report developers' personal computer on which they saved the Impromptu report so that they can modify it at later time if the developer chooses to.

Figures 3 and 4 depict further DFD decomposition in order to identify more processes.

Next, we modeled the data which the system needs to function properly using the ERD Chen's notations (explained in Dennis and Wixom, 2000; Hoffer, George, and Valacich, 1999; Jordan and Machesky, 1990; Whitten, Bentley, and Dittman, 2001). The ERD (Entity Relationship Diagram) is a graphical modeling tool used to depict the data entities, their attributes, and relationships.

Both the DFD and the ERD are excellent graphical tools for modeling purposes; they are also beneficial communication tools to validate that the software development team has accurate under-

Figure 1: The Context DFD

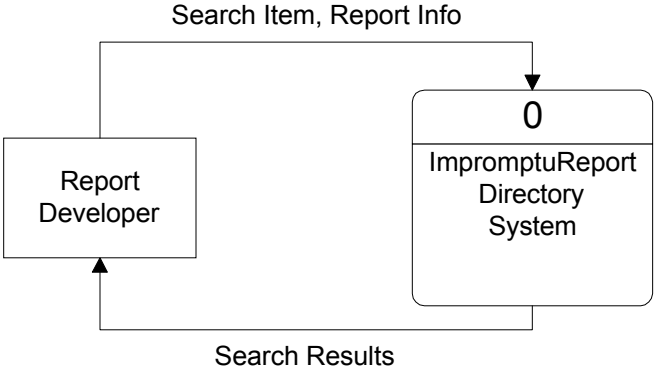


Figure 2: Level-0 DFD

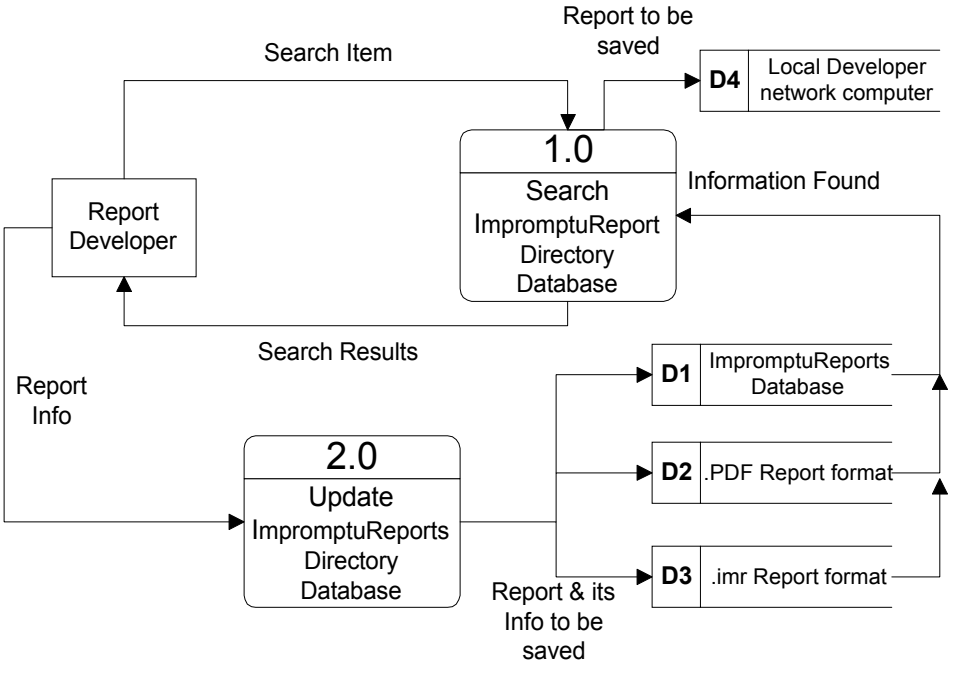
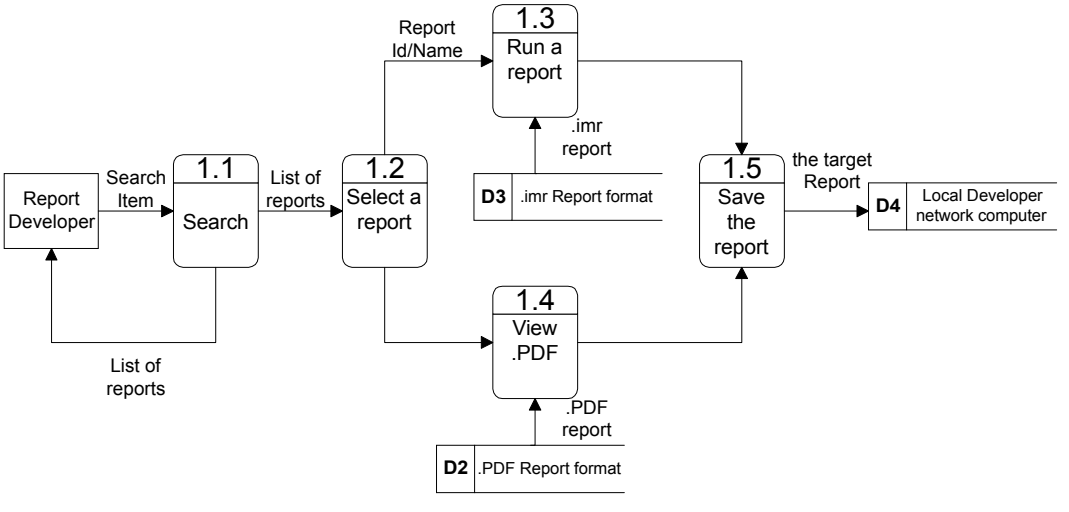


Figure 3: Level-1 DFD for Process 1.0



standing of the system and users' requirements. Eventually each process on the DFD will be translated to a program, and almost every ERD may become a database table.

Figure 5, shows that the system contains three entities, which are relevant to the functions of our system, with only their partial attributes shown due to space limitations. However, to increase the efficiency and maintainability of our system, we made the decision to merge these three entities into one database table. This resulted in minimizing response time since querying one table is often quicker than navigating three.

We named the resulting table, ImpromptuReport, which has the following set of attributes:

- *Report Id:* a unique numeric identification number which will automatically be generated whenever a report is archived. This is the primary key of the *Impromptu Report* table.
- *Developer Id:* A string representing the developer's unique Id within the enterprise.
- *Business Function:* The department which the Report was made for (e.g. Inventory, Human Resources).

Figure 4: Level-1 DFD for Process 2.0

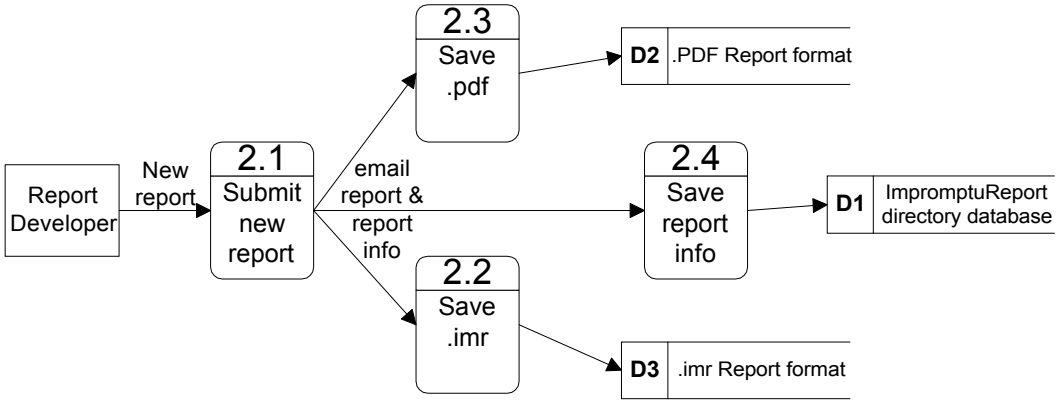
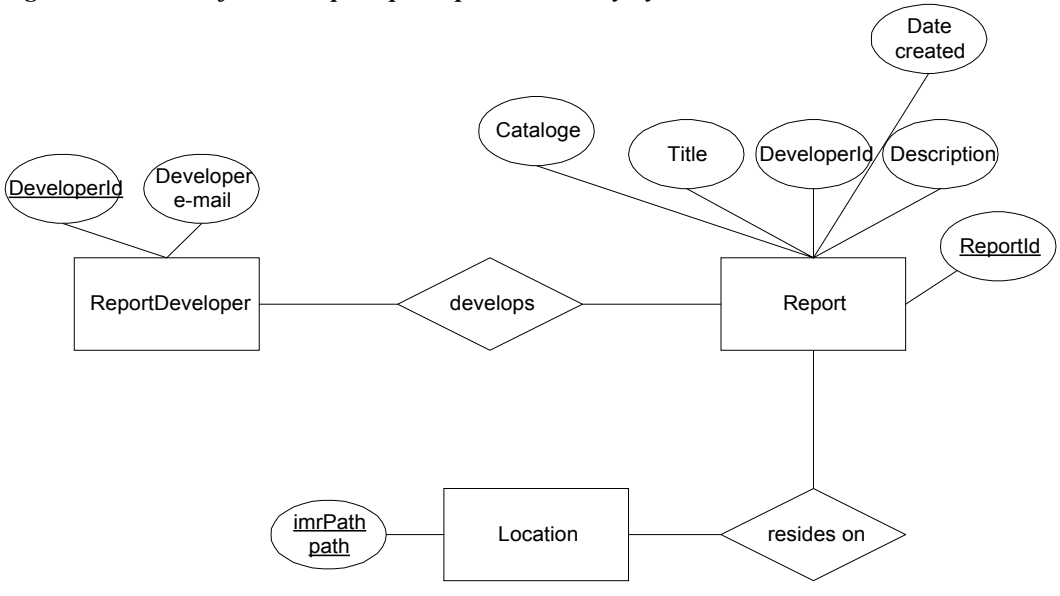


Figure 5: The ERD for the ImpromptuReport Dictionary System



- *Catalog:* A string used to identify the various databases where certain reports are saved. Each business area within the company has its own database identified by a unique Id.
- *Report Title:* A string representing the title of the report as given by the developer.
- *Description:* A sting describing the functions and contents of the report.
- *imrPath:* A hyperlink to the .pdf version of the Impromptu report on the network.
- *pdfPath:* A hyperlink to the .imr version of the Impromptu report on the network.
- *HotFiles:* A list of the data files from the Oracle database needed in the Impromptu report. This data is not available from the SAP database.
- *Date Created:* The date when a report was created by the Report Developer.
- *Date Revised:* The date when the report Developer revised a report.

In order to avoid any anomalous behavior (O'Neil, 1994)of this table, we had to make sure that the table is normalized in the third normal form (3NF) using the following tests (Ramakrishnan, 1997; Ricardo, 1990):

1. Since there are no multi-valued (repeating) fields, then the table is in the 1NF.
2. The table is in the 2NF if it is the 1NF and all the nonkey attributes are fully functionally dependent on the key. In other words, if the key is a single attribute, which is true in our table, then the table is in the 2NF automatically.
3. The table is in the 3NF if it is in the 2NF and no nonkey attribute is transitively dependent on the key. By examining our table, it is clear to us that the value of every nonkey attribute is only determined by the primary key of the table and not any other attribute.

Any further testing of a table which is in the 3NF is often unnecessary since many real-world databases in 3NF are also in BCNF (O'Neil, 1994).

A typical ImpromptuReport table would look like the one shown in Table 1.

Shown on the following pages are our Web-based graphical user-interfaces that users will use to provoke the various system functions. We followed the design guidelines explained in Dennis and Wixom (2000); Hoffer, George, and Valacich (1999); Jordan and Machesky (1990); Navarro and Tabinda (1998); Whitten, Bentley, and Dittman (2001).

Figure 6, below, shows the system Dialogue Diagram (as described in Dennis and Wixom, 2000; and Hoffer, George, and Valacich, 1999), where the system can be provoked via the company Web page. Developers will then be given the choice to search or submit a report for saving as shown in Screen 1. Upon selecting the search option, developers can use a number of search keys as shown in Screen 2. Once the system finds a match, the developer can then highlight the specific report and version to display.

Upon selecting the "submit a new report" option, Screen 4 will be displayed and all the information will be submitted to the system administrator. The system administrator, in turn, will use the same information given to save the report information to the Impromptureport database.

The final step in our case was to implement and operate our system. The following systematic steps were followed in order to materialize our design into a fully functional system which meets users' requirements stated in the beginning of the case.

1. *Creating the Database:*

This includes creating the ImpromptuReports table using Oracle database, creating the form necessary to enter data into this database, and populating the table with data. All authenticated users (Impromptu report developers) will have read-only access to this database while a system administrator will have read-write access.

2. *Creating the Web interface and the search mechanism:*

A Web-based interface was created to be used to navigate through this system. Creating this web interface includes creating an ASP form and developing all the codes which will be required to connect the Web interface to the database and enable the user to search the Oracle database by submitting a search on the HTML forms. Some valuable tips and procedures to execute this step were founded in Champeon and Fox (1999), Friedrichsen (2000) and Hentzen (1999).

Table 1: An example of an ImpromptuTable

Attribute Name	Sample Value
Report Id	00990
Developer Id	Nm7435
Business Function	Inventory
Catalog	R3 Battg
Report Title	Manufacturing Goods Receipts
Description	Summarizes goods receipts from process orders for a product, product group, material type, month, year, and plant. Purpose is to provide data on manufacturing performance
imrPath	**\Reports\Planning**
pdfPath	**R3 Battrchkg.Pdf**
HotFiles	**Dbrport.MIS**
Date Created	04/05/00
Date Revised	0/06/01

3. *Training and documenting:*

All users will be trained to search for any report as well as submit their own reports for saving. A full-scale documentation of all aspects of the system, including operation and troubleshooting, was conducted as part of our project.

Current Challenges/Problems Facing the Organization

We believe that the company will face three types of challenges as a result of implementing our system:

1. *Cultural:* the system will enforce the concept of team work in which report developers have to adapt to reuse and build on top of other players' work. The system will also enforce the culture of personal accountability where each developer has the responsibility of fully and properly documenting his/her reports so that it can be utilized by other developers. Additionally, report developers will have to follow a standard procedure and format when developing and/or saving their reports.
2. *Operational:* The company must develop an operational procedure and allocate the required resources in order to maintain the system on a regular basis. Maintaining the database and the other files and providing developers with Ids are two examples on ongoing operational procedure.
3. *Technological:* Report developers have to face the challenge of learning and utilizing the advances of information technology in order to improve their performance. The company, on the other hand, will need to search fo the most efficient report development tool. SAP is about to release a new version that has more report development features, therefore the company will have to evaluate SAP development tool versus Impromptu.

Figure 6: The Dialogue Diagram for the ImpromptuReport Dictionary System

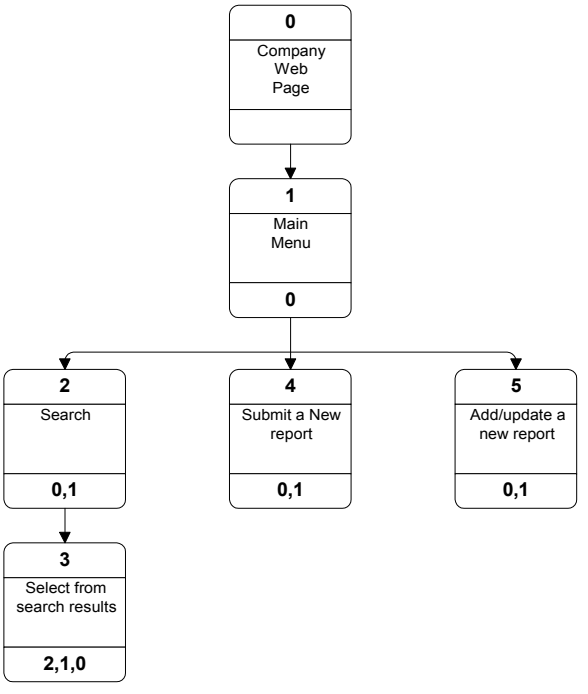


Diagram 1: Narrative View, Screen 1

Narrative Overview

Form: Screen 1
Purpose: Initial Web-page Main Menu of the ImpromptuReport Dictionary System
Users: All Impromptu Report Developers

Sample Design

Please Make a Selection:

- Search for a Report
- Submit a Report

Exit

Continue

Diagram 2: Narrative Overview, Screen 2

Narrative Overview

Form: Screen 2
Purpose: To search the Impromptu Report Dictionary System
Users: All Impromptu Report Developers

Sample Design

Please enter one or more search fields:

Report ID

Report Name

Report Author

Description / Purpose

Catalogs

Hot files

Report Business Function

Exit | Clear Fields | Search

Diagram 3: Narrative Overview, Screen 3

Narrative Overview

Form: Screen 3
Purpose: To display results obtained from searching the database
Users: Impromptu Report Developers

Sample Design

Click on the .pdf link to view the Impromptu pdf file in Acrobat Reader

Report ID	Report Title	Developer Id	Description	Date Created	Catalog	HotFiles	Business Function	pdf.Path	.imr Path

*If there are no matching reports this will be displayed by a text message.

Exit | Back

Diagram 4: Narrative Overview, Screen 4

Narrative Overview

Form: Screen 4
Purpose: To submit a new Report to the ImpromptuReport Dictionary System
Users: All Impromptu Report Developers

Sample Design

Please provide the following information:

Report Title	
Developer Name	
DeveloperId	
Description	
Catalog	
Business Function	
HotFiles	
Date Created	
Date Revise (when applicable)	

Exit | Attach .imr | Submit

Diagram 5: Narrative Overview, Screen 5

Narrative Overview

Form: Screen 5
Purpose: To add/update a new Report to the ImpromptuReport Database
Users: System Administrator ONLY

Sample Design

Report ID	
Report Title	
Developer Name	
DeveloperId	
Description	
Catalog	
Business Function	
HotFiles	
Report Business Function	
Date Created	
Date Revised (when applicable)	

Exit

Save

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BIOGRAPHICAL SKETCHES

Yousif Mustafa received a Ph. D. in Industrial and Manufacturing Engineering in 1998 and a M.S. in Industrial and Manufacturing Engineering in 1993 from Wayne State University, Detroit, MI. Dr. Mustafa is currently an assistant professor at the Computer Information Systems Department of Central Missouri State University, Warrensburg, Missouri.

Clara Maingi is a senior with a double major in CIS and Accounting at the College of Business of Central Missouri State University, Warrensburg, Missouri. Currently, Clara is doing her internship as an application developer at the Information Systems Department of Aventis Pharmaceuticals, Kansas City, Missouri.

APPENDIX A

Financial Summary
For the six months ended on 06/2000, net sales rose 9% to EUR11.09 billion. Net income applicable to Common before U.S. GAAP rose 57% to EUR337M when compared to 1999 results. Results reflect increased life sciences sales.
Recent Earnings Announcement
For the 3 months ended 09/30/2000, revenues were 5,429; after tax earnings were 126. (Preliminary; reported in millions of Euro.)

Statistics at a Glance – NYSE:AVE As of 5-Dec-2000

Price and Volume

52-Week Low
on 8-Mar-2000
$45.50

Recent Price
$79.25

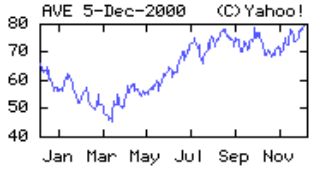
52-Week High
on 30-Nov-2000
$79.938

Beta
0.46

Daily Volume (3-month avg)
126.0K

Daily Volume (10-day avg)
166.0K

Stock Performance



big chart [1d | 5d | 3mo | 1yr | 2yr | 5yr

Per-Share Data

Book Value (mrq*)
$11.60

Earnings
N/A

Earnings (mrq)
$0.14

Sales
N/A

Cash (mrq*)
$0.15

Valuation Ratios

Price/Book (mrq*)
6.83

Price/Earnings
N/A

Price/Sales
N/A

Income Statements

Management Effectiveness

Return on Assets
N/A

Return on Equity (ttm)
1.23%

Financial Strength

Current Ratio (mrq*)
1.06

Debt/Equity (mrq*)
1.39

Total Cash (mrq)
$120.9M

Short Interest

As of 8-Nov-2000

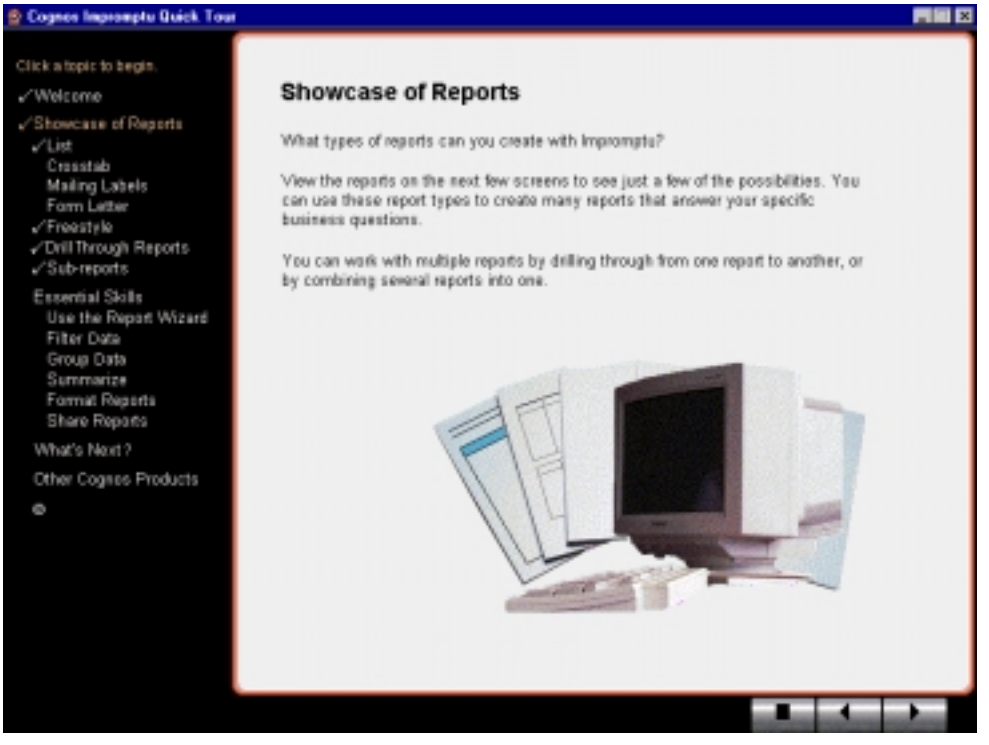
Shares Short
658.0K

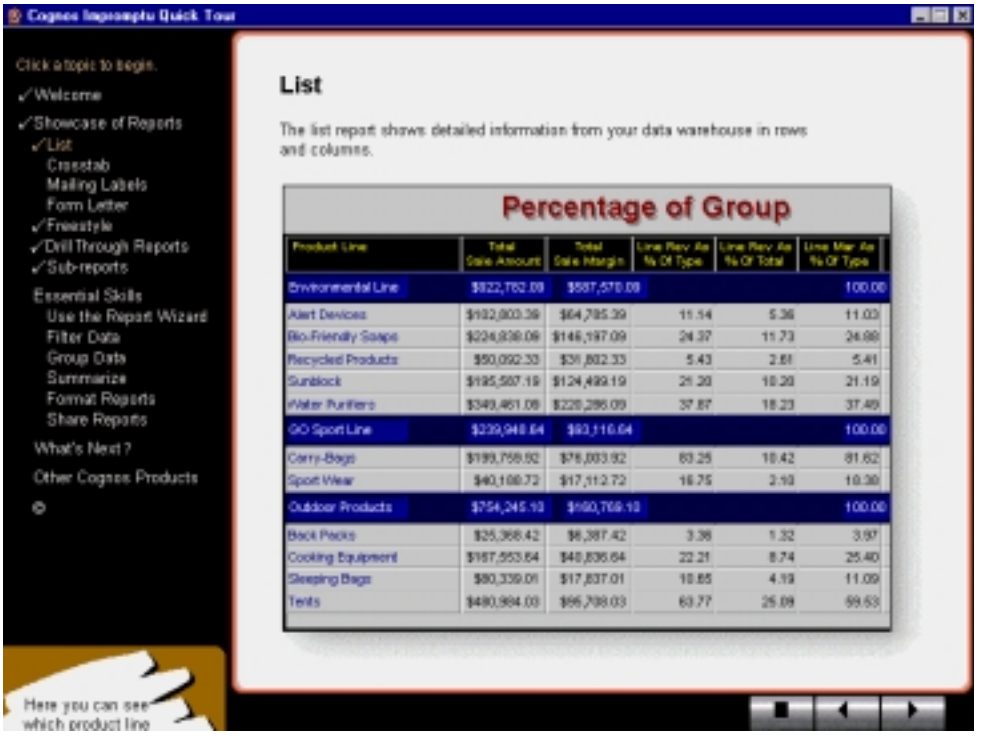
Percent of Float
0.1%

APPENDIX A (CONTINUED)

52-Week Change +23.7%	**Income Statements** Sales *N/A*	Shares Short (Prior Month) 490.0K
52-Week Change relative to S&P500 +26.6%	EBITDA (ttm*) -$153.1M Income available to common (ttm) $110.9M	Short Ratio 5.93 Daily Volume 111.0K
Share-Related Items Market Capitalization $61.8B	**Profitability** Profit Margin *N/A*	**ADR Information** Shares/ADR 1
Shares Outstanding 779.8M Float 662.8M	Operating Margin (ttm) -1.3%	
Dividends & Splits Annual Dividend none	**Fiscal Year** Fiscal Year Ends Dec 31	
Last Split none	Most recent quarter (fully updated) 30-June-2000	
	Most recent quarter (flash earnings)	

APPENDIX B


Cognos Impromptu Quick Tour
Click a topic to begin.
✓Welcome
✓Showcase of Reports
✓List
Crosstab
Mailing Labels
Form Letter
✓Freestyle
✓Drill Through Reports
✓Sub-reports
Essential Skills
Use the Report Wizard
Filter Data
Group Data
Summarize
Format Reports
Share Reports
What's Next?
Other Cognos Products
Showcase of Reports
What types of reports can you create with Impromptu?
View the reports on the next few screens to see just a few of the possibilities. You can use these report types to create many reports that answer your specific business questions.
You can work with multiple reports by drilling through from one report to another, or by combining several reports into one.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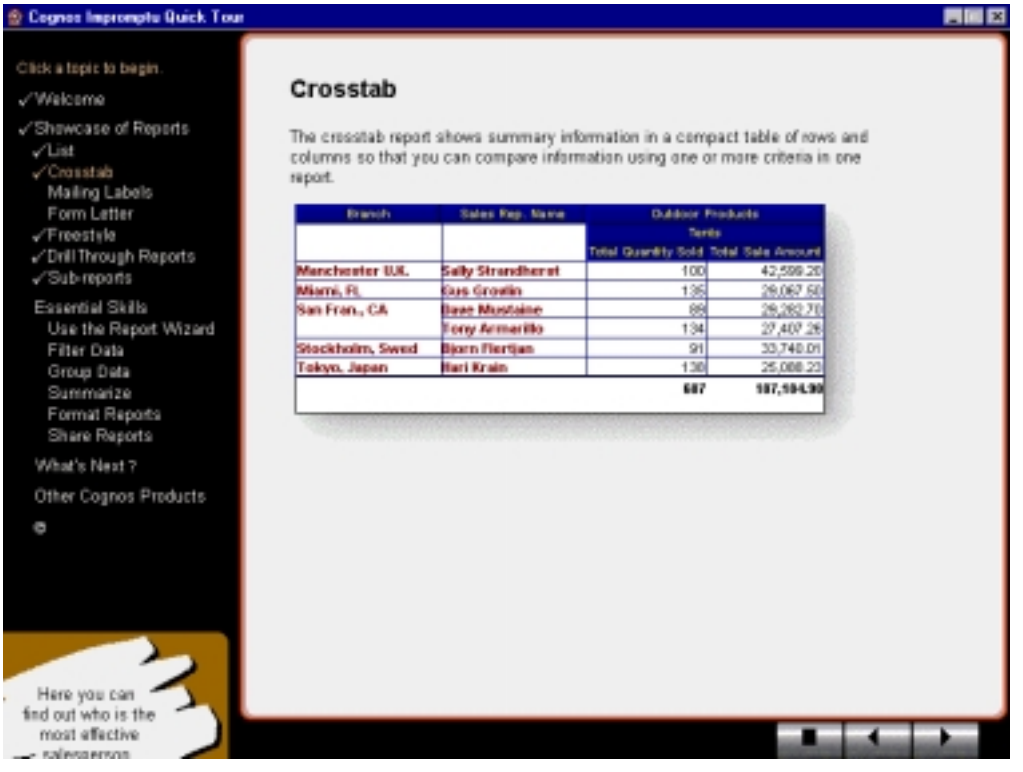
Essential Skills
Use the Report Wizard
Filter Data
Group Data
Summarize
Format Reports
Share Reports
What's Next?
Other Cognos Products
List
The list report shows detailed information from your data warehouse in rows and columns.
Percentage of Group
Here you can see which product line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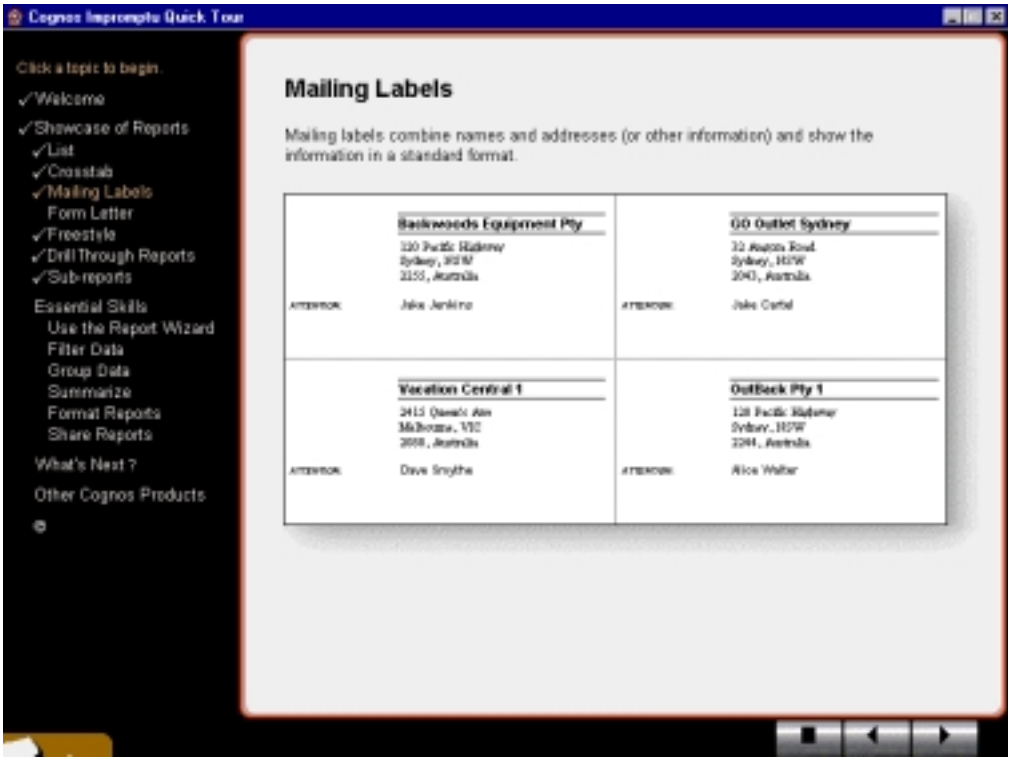
✓List
✓Crosstab
Mailing Labels
Form Letter
✓Freestyle
✓Drill Through Reports
✓Sub-reports
Essential Skills
Use the Report Wizard
Filter Data
Group Data
Summarize
Format Reports
Share Reports
What's Next ?
Other Cognos Products
Here you can find out who is the most effective
Crosstab
The crosstab report shows summary information in a compact table of rows and columns so that you can compare information using one or more criteria in one report.
Branch
Sales Rep. Name
Outdoor Products
Tents
Total Quantity Sold
Total Sale Amount
Manchester U.K.
Sally Strandherst
100
42,599.20
Miami, FL
Gus Grostin
135
28,067.50
San Fran., CA
Dave Montaine
66
26,282.70
Tony Armarillo
134
27,407.26
Stockholm, Swed
Bjorn Flertjan
91
33,740.01
Tokyo, Japan
Hari Krain
136
25,088.23
687
187,184.90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✓Welcome
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✓Crosstab
✓Mailing Labels
Form Letter
✓Freestyle
✓Drill Through Reports
✓Sub-reports
Essential Skills
Use the Report Wizard
Filter Data
Group Data
Summarize
Format Reports
Share Reports
What's Next ?
Other Cognos Products
Mailing Labels
Mailing labels combine names and addresses (or other information) and show the information in a standard format.
Backwoods Equipment Pty
120 Pacific Highway
Sydney, NSW
2155, Australia
ATTENTION: John Jenkins
GO Outlet Sydney
32 Avalon Road
Sydney, NSW
2040, Australia
ATTENTION: John Corbel
Vacation Central 1
ATTENTION: Dave Smythe
OutBack Pty 1
ATTENTION: Alice Walter


Cognos Impromptu Quick Tour
Click a topic to begin.
✓Welcome
✓Showcase of Reports
✓List
✓Crosstab
✓Mailing Labels
✓Form Letter
✓Freestyle
✓Drill Through Reports
✓Sub-reports
Essential Skills
Use the Report Wizard
Filter Data
Group Data
Summarize
Format Reports
Share Reports
What's Next ?
Other Cognos Products
Freestyle
The freestyle report is a combination of elements from other popular reports, such as charts, pictures, and list reports.
THE GREAT OUTDOORS
Product Annual Sales Performance
Order Details
Order Number
Order Date
Sale Amount
Sale Margin
Here two list reports, a picture, and a chart are used to assess the annual performance of each product.
Last 4 Years
Customer Information
Number
Client
1009 GO Outlet Kista AB
1011 GO Outlet Singapore
1026 GO Outlet London
1035 Ultra Sports 1
1055 OutBack Pty 1
1056 OutBack Pty 2


Cognos Impromptu Quick Tour
Click a topic to begin.
✓Welcome
✓Showcase of Reports
✓List
✓Crosstab
✓Mailing Labels
✓Form Letter
✓Freestyle
✓Drill Through Reports
✓Sub-reports
Essential Skills
Use the Report Wizard
Filter Data
Group Data
Summarize
Format Reports
Share Reports
What's Next ?
Other Cognos Products
Drill Through Reports
With drill through, you can link two or more reports together so you can find more transaction-level details in other reports. By specifying a value from the first Impromptu report, you can find related information that isn't contained in your original report.
THE GREAT OUTDOORS
Total Customer Sales in Australia
Customer Name: Backwoods Equipment Pty
Product No.
Product
Sale Amount
Sale Profit
Sale Margin %
40103 StarDome 448.74 38.74 8.63
40303 GO Large Waist Pack 575.00 175.00 30.43
50203 GO Water Bottle 220.16 92.16 41.86
60200 EnviroSak 110.88 78.88 71.13
60201 Enviro-Kit 187.72 111.72 59.51
1996 Sales:
Year End: $59,530.67
Last 6 months: $41,971.63
Last 3 months: $2,475.80
1997 Sales:
Year End: $88,855.95
Last 6 months: $67,107.57
Last 3 months: $33,160.58
ordered by this customer.
Double-click StarDome to drill


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Sub-reports
When you need information from several business queries in one report, you can combine the reports in one with sub-reports. With sub-reports, multiple reports appear on a single page. You don't need to open several reports to get the information you need.
Global Sales Performance
Country: Australia
Total Sales: $148,386.62
Sales Rep. Name No. of Orders Total Sales
Melbourne, Aus 95 148,386.62
Kaley Gregson 35 61,816.36
Malcom Young 38 47,564.07
Torey Wandtke 22 39,006.19
Product Type: Environmental Line
Total Sales: $83,786.29
Product Total Sales Total Profit
Alert Devices 6,263.79 3,408.79
Microwave Detective 2,268.11 1,484.11
Pocket Radon Alerter 386.10 243.10
Pocket U.V. Alerter 3,609.58 1,701.58
you can explore
les in Australia
and total
ironmental Line
sales without