DEPLOYING BUSINESS INTELLIGENCE IN A DISTRIBUTED DATA WAREHOUSE USING ORACLE DISCOVERER AND REPORTS

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Abstract

Through developing expertise with Oracle Discoverer and integrating it with Oracle Reports, the Ministry of Environment, Lands & Parks has leveraged available resources and their investment in the data warehouse infrastructure to deliver timely, appropriate, and previously inaccessible decision support information to the right user. Choosing a business intelligence tool for the user has dramatic cost and functionality implications. Getting the right tool onto the right desktop unleashes the information in the data warehouse.

Introduction

Business Intelligence (BI) is the application of assumptions and experience to create insight and understanding of a business area through a set of concepts, methods and processes that improve business decisions by integrating multiple data sets. Information is produced through the acquisition, handling and analysis of data that is then communicated to others in the organization to improve strategic and tactical decisions. BI is used to describe information system applications that do performance measurement, interpret past data, and identify trends.

The Ministry of Environment, Lands and Parks (MELP) is responsible for the management, protection and enhancement of British Columbia's environment. This includes the protection, conservation and management of provincial fish, wildlife, water, land and air resources; the management and allocation of Crown land; and the protection and management of provincial parks, recreation areas and ecological reserves. The land mass is about 94 million hectares (about three times the size of the state of California) and government offices are spread throughout. Because of its mandate, MELP's information systems manage data that is quite different from the usual business information that would be found in a telecommunications company or fabrication plant. Some examples of the data collections are:

- Environmental data about endangered species and soil, air, and water quality.
- Land usage data about logging, grazing, trapping, and water extraction.
- Park data about attendance, safety & security, and management status.
- Enforcement data about permits and violations of such legislation as the *Firearm Act*, *Fish Inspection Act*, *Fisheries Act*, *Water Act*, *Environmental Assessment Act* or the *Wildlife Act*.

The following goals are given to achieve this mandate.

- Natural Diversity - Protection, conservation and restoration of a full range of biological and physical diversity native to British Columbia.
- Healthy and Safe Land, Water and Air - Clean, healthy and safe land, water and air for all living things.
- Sustainable Social, Economic and Recreational Benefits - Provision of social, economic and outdoor recreational opportunities within the constraints of maintaining a naturally diverse and healthy environment.

These goals can conflict with one other in a complex manner.

- Can forest timber be harvested while still maintaining wildlife habitat?

- Can land be used recreationally without disturbing endangered species?

Data analysis is critical as MELP strives to achieve these goals. This analysis requires subject specialists to create knowledge from the data, as well as people capable of working with data structures and business intelligence tools. Figure 1. shows the business model from a landscape perspective.

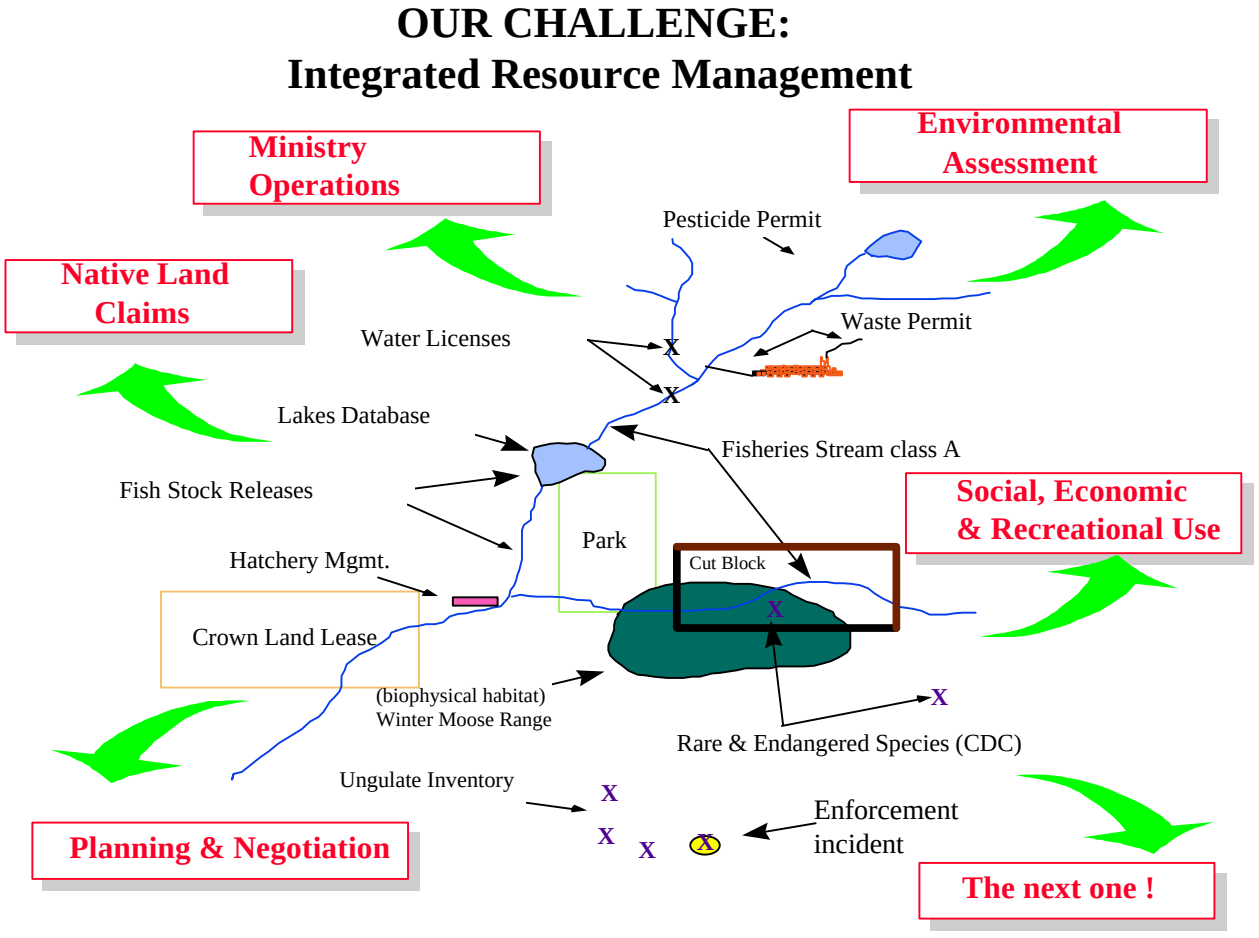


Figure 1 MELP Business Model (adapted from Cooney 1999)

At MELP, BI involves the integration of base information (both attribute and spatial) with event driven or project information to detect significant events and clarify difficult issues. Specific examples include:

- Monitoring environmental trends such as short term and long term precipitation and conduct flood forcasting.
- Presenting accurate scenarios at the negotiating table where land use decisions are being made.
- Granting a permit to dump waste effluent with consideration of all downstream uses such as domestic water use and unique wildlife habitat.
- Integrating Park and Protected area information from data originating from attendance, safety and security incidents, facilities inventory and costs, and management issues assessment to better use the limited resources available.

The requirement is for a system, data architecture and tools deployment that can evolve and adapt quickly as situations change. Only then is it conceivable to make intelligent business decisions in light of the reality of incomplete data of varying accuracy and often contradictory information. Success relies upon placing the right exploration and analysis tools on the desktops of the right users so that the overwhelming wealth of data that has accumulated can be used to provide relevant insights, identify trends and discover opportunities.

Approach

The early vision for Information Systems delivery was stated as, “Ensure access to information from every desktop computer in the Ministry.” In so doing, “...give Regional staff the data and tools required to produce the information necessary to assist decision making...”

The approach at MELP to BI implementation is somewhat uniquely driven by the intensive reliance on spatial data as part of the business. Consequently the design and structure of the entire BI architecture has been closely aligned with the deployment of Geographical Information System (GIS) tools. The GIS implementation is noted to be successful because of:

- enforcement of data management and technology standards;
- a clear understanding of the key business requirements;
- keeping the vision dynamic and non-technical;
- management of expectations;
- using ministry staff in a team environment to brainstorm, prototype and implement the vision;
- creating an environment to encourage experts to be innovative. (Cooney 1999)

Over the past five years a data warehouse has been developed that combines both attribute and spatial information. This data is pushed to nine geographical dependent datamarts across the province. In each regional or sub-regional site IT workers specializing in attribute and spatial data are available to assist front-line workers in using the data. The regional datamart locations are shown in Figure 2.

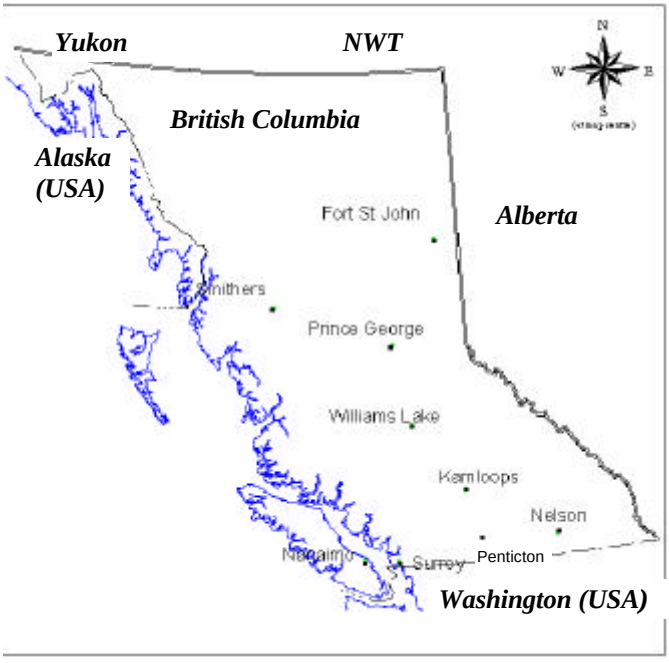


Figure 2 Regional Datamart Locations

The collateral benefit of GIS as the front runner technology used against our data warehouse has been an example set that can be utilized in the implementation of the attribute BI infrastructure. The effort and expense of the work that has gone on in establishing, educating, promoting, and managing the spatial data infrastructure can be leveraged into the attribute BI tools deployment. The success factors noted above have become proven strategies for the introduction of other BI tools.

The BI tools that will be discussed here are Discoverer 3.1 and Oracle Reports 3.0 in conjunction with various Web presentation strategies. However, it should be noted that there are other tools that satisfy various business needs including the statistics package SAS, MS Access, Excel, and for spatial work the GIS tool ArcView from ESRI customized as the *Geographical and Oracle Access Tool*, GOAT (see Howard 1999 and http://www.env.gov.bc.ca/gis/goat5/).

Understanding the Client

Applying a BI approach requires the understanding of the end user requirements. Frequently much effort is spent on the technical architecture for data management and delivery. If the end result of the BI initiative is to promote disparate data into an integrated knowledge framework then it is the user's interaction with the data and the process of making informed decisions that is crucial. Understanding the user can be done by classifying the range of BI users according to various criteria such:

- Data usage - the position on the continuum between report producer and report consumer;
- Technological sophistication - complexity of functionality appropriate to the user (e.g. static web presentation, parameterized report, full drill pivot data exploration) ;
- Task - the particular BI task that must perform (advanced analysis, analysis, ad hoc query, dynamic reporting, and epoch reporting);
- Role - user's function in the organization (e.g. analyst, subject area specialist, front-line decision maker, manager)

Applying eight basic characteristics, Dresner (1997) produced a model that identifies three major classes of BI users (Figure 3.) The impetus is to refine the tool choice to the right user so as to avoid the mistake of implementing the "lowest-common-denominator" solution which can result in missing important opportunities to empower users with deeper business insights.

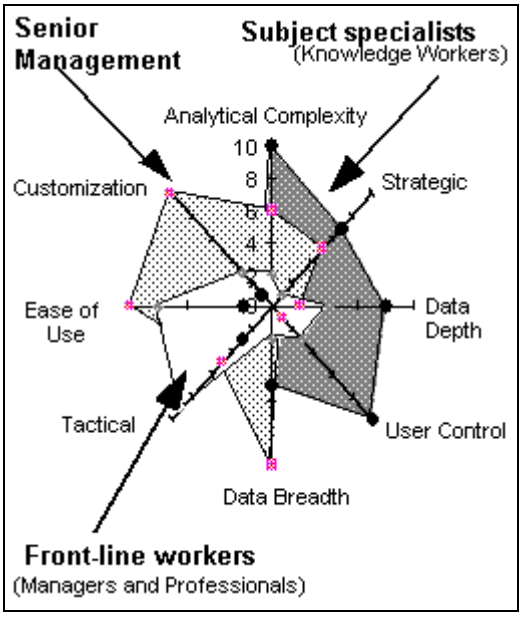


Figure 3 BI Use Classification (adapted from Dresner , 1997)

The eight characteristics used in the model are:

- analytical complexity
- strategic decision making
- data depth
- user control
- data breadth
- tactical decision making
- ease of use
- customization

The three distinct classes of BI users based on the above general characteristics have been labeled:

- front-line workers (managers & professionals)
- subject specialists (knowledge workers)
- senior management

Front-Line Workers (Managers & Professionals)

These are the line managers and professionals who make up about three quarters of the client base. There focus in on specific program or "enterprise mission" and their data domains can be relatively focused because of the tactical nature of the work. Analysis is usually done using query and reporting tools and spreadsheet models. Technical sophistication may be limited but many graduate to be more demanding knowledge workers over time.

Subject Specialists (Knowledge Workers)

The most technically proficient and analytical workers who support both executives and front-line workers dealing with complex data sets. The emphasis is on in-depth understanding and the ability to predict trends and use models to create scenarios. They demand the most flexibility in the tools used and put the heaviest demand on the data infrastructure. They deliver the bulk of the core BI products that become starting points for the other two classes of user.

Senior Management (Executives)

They require information across a broad scope but not to any great depth. There interest is in anomalies and trends mixing both tactical and strategic decision making. Demands may be for high analytical capability yet the user sophistication may be limited therefore generating the requirement of custom applications. Ease of use is very important.

Tools Right Sizing

In endeavouring to deliver useful business intelligence two factors are paramount. Firstly, the user must be classified as to type as described in the previous section. This process provides an understanding of the user needs and variety prior to implementing any BI initiative. Secondly, the information should be provided through the correct tool that accommodates the needs of the user type. Ideally the suite of tools deployed can be kept to a minimum through the use of a given tool by more than one class of user. Cost can become a factor if an overpowered (and more expensive) tool is provided to a class of user that only uses 10% of the functionality. Indeed the solution works but it is possible that a cheaper tool could do the same job while recognizing the risk of adding yet another piece of technology to manage. When selecting more than one tool as the BI solution there is great benefit to integration between tools that will facilitate the handing off of analysis products between various user types.

At BC MELP we have standardized on the Oracle Application Server (OAS) for PL/SQL and an Oracle tools suite that includes Oracle Discoverer 3.1 and Reports 3.0. Both Discoverer and Reports come with different implementation architectures such as client/server, application server, and web application which will be discussed later.

In figure 4 are represented the BI tasks that our user group demands with a rough correlation to scope of function provided by the tool set. Complete coverage of the tasks by the tools are shown with overlaps in the area of dynamic and epoch reporting. For the purposes of this paper the area of Advanced Analysis has not been addressed. (Currently some high end analysis and predictive modeling is carried out in the statistics package SAS. There are plans to evaluate the Oracle Express product which integrates into the tool set.)

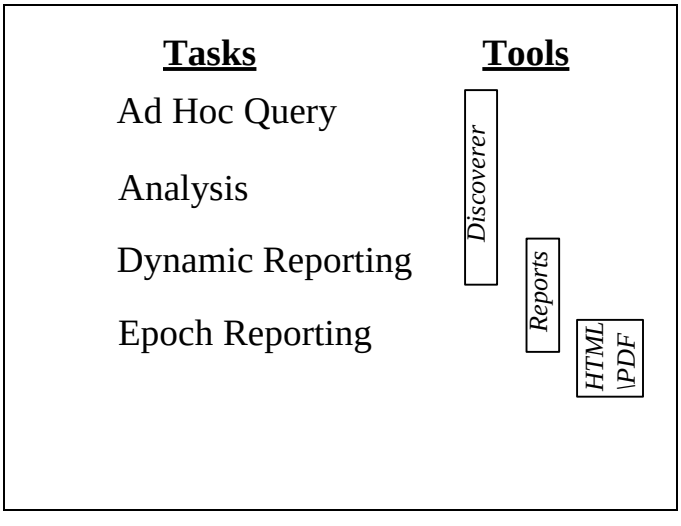


Figure 4 BI User Tasks and Oracle Tools

Discoverer 3.1 covers the tasks of ad hoc query and analysis and can also be used for dynamic reporting. Reports 3.0 is used specifically for dynamic reporting but through caching of Reports and the production of HTML and PDF output can be used for epoch reporting. Epoch reporting is also covered by HTML pages and PDF products edited from other sources.

Revisiting the three user categories (Front-Line Workers, Subject Specialists, Senior Management) an exercise to map each onto a specific tool will fail. Once size does not fit all and a given user has needs at various times that span the functionality of a particular BI tool. A rough depiction of the correlation of user categories to BI tasks and BI tools can be seen in figure 5.

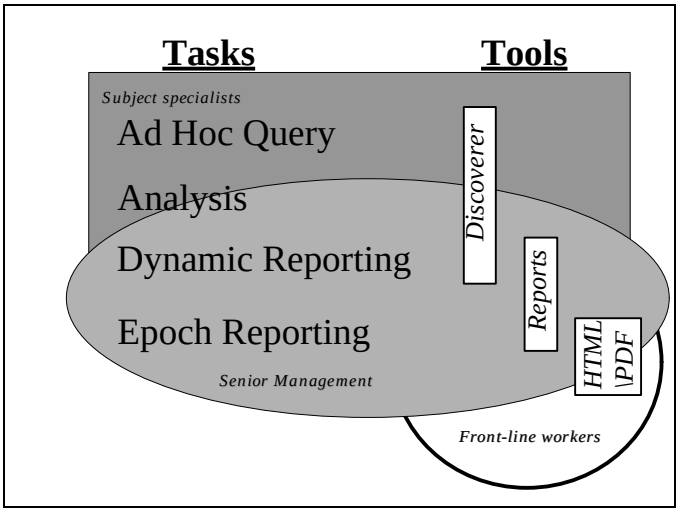


Figure 5 Mapping of BI Tasks and Tools with User Classification

The *subject specialist* can utilizes the full range of functionality in the Discoverer tool to satisfy their requirements for ad hoc query, analysis and dynamic reporting. Their is no real usage of the Web interfaces from their perspective as a data consumer. Not depicted is their role as an information producer and distributor who may indeed produce report output for consumption by others in HTML or PDF format. Their typical analysis product would be Discoverer workbooks and Oracle Reports for primary usage by the other two classes of users.

The *senior management* can utilize the full range of functionality in the Reports tool that satisfies their requirements for dynamic and epoch reporting. In addition some users my get their epoch reporting from the static HTML/PDF products. Some analysis work is required that could make use of the higher functionality in the Discoverer tool.

The *front-line workers* are served best by a combination of static HTML/PDF products and Oracle Reports products. Some analysis work may be desirable that is found in the Discoverer tool.

In all cases these users may graduate to using tools of greater sophistication as data manipulation and knowledge creation becomes a more ingrained part of their work. It is expected that the need to ask more complex questions will outstrip the functionality of the current tool they are using.

It is interesting to note that Discoverer could be a suitable single tool answer for all user classes. Its much praised ease-of-use combined with its analytical power makes it a desirable tool to put on everybody's desktop. Having hundreds of people involved in BI functions at MELP we have implemented a tools right sizing strategy that provides the best data available in the best tools available in a fiscally prudent manner. The key to the success of this strategy will be the integrated nature of the Oracle BI tools suite and the full featured "thin client" technology.

Training

The biggest impediment to any BI implementation is the amount of effort that must be put into Data Administration. To use Discoverer a data manager or data administrator must define the Business Area in the end user layer that describes all the relevant database objects, their summarization tables, hierarchical roll-up, and express terms in the end user language. In order to push forward with our BI initiative a two day Discoverer training and workshop was developed in house. The first day introduces the BI architecture at MELP and then users are trained on the Discoverer tool. This training uses the Video Store demonstration database provided with the product with some extensions and additional details in areas where students typically have problems. By the end of the first day the users have completed exercises on building Business Areas and creating workbooks.

The second day of the course is a workshop. The students go "live" against data sets they are familiar with in the data warehouse. They create Business Areas and workbooks against real data meaningful to their business. Often this process uncovers problems with the current data model in the warehouse and generates prescriptive action. To date about 40 people have taken the two day training.

Further training is needed in the area of generating Oracle Reports from the ad hoc query exported from Discoverer.

Architecture

The current (March 1999) technology infrastructure for the Data Warehouse and BI tools is shown in table 1.

	Current Version	Current Installs	Notes
Server	HPUX 11	1 Master Data Warehouse 9 Datamarts in regions TOTAL = 10	42 HP Unix servers in total of which 10 are dedicated to the data Warehouse/Mart.
Database	Oracle 7.3.2	1 Master Data Warehouse 9 Datamarts in regions TOTAL= 10	about 75 instances total of which 10 are dedicated to Warehouse/Mart. Migration to Oracle 8.15 scheduled for all Warehouse instances.
Storage	DEC StorageWorks 450 Compaq 3000	1 Master Data Warehouse 11 at regional Datamarts 1,500 Gigabytes storage	RAID 5 configuration. Storage includes Oracle, GIS, and imagery for both Data Warehousing and operations in regions.
Network	Novell 4.11 NT 4.0 Server Wide Area Network TCP/IP	20 Novell sites/1900+ users 3 NT sites/300+ usrers	100 mbps standard LAN. Some shared 19.2k and 56k access by district offices into Regional sites.
Client PC	Win 3.11, NT 4.0, MAC	2200+ desktops	All desktops to be NT 4.0 for Y2k.
Web Server	OAS 2.1 & 3.0 Apache 1.3.6	1 Master Data Warehouse 9 Datamarts in regions TOTAL=10	OAS 4.06 is scheduled to be installed to run PL/SQL
Application Server	NT Terminal Server 4.0 (NTTS)	8 in regions 6 in headquarters	In headquarters 2 production NTTS and 3 are used for test, Y2k, development and migration

Reports 3.0	Developer 2.1	15 Developer named licenses; unlimited runtime on NTTS	Developer Server is being installed on the Master Data Warehouse with 8 concurrent user license.
Discoverer 3.1	3.1.26 client	15 Administrator Editions 15 named users 25 concurrent users	2 concurrent user licenses on each regional NTTS. 7 concurrent user licenses on NTTS at headquarters. Evaluating Discoverer Viewer. No version for HPUX yet.

Table 1. MELP technology infrastructure for BI

Application Server: NT Terminal Server & Citrix Metaframe

Cost effective implementation by MELP relies on the use of Microsoft NT Terminal Server (NTTS) running Citrix Metaframe. Microsoft Terminal Server and Citrix Metaframe is a multi-user Windows application server software that allows 25 concurrent users to log on and run applications in separate, protected and secure virtual sessions on a multiprocessor compaq server. The Citrix ICA protocol separates an application's logic from its graphical user interface. The user interface runs on Citrix Metaframe universal, thin-client software, while the application logic executes on Microsoft Terminal Server. This thin client solution allows the BI applications to run on a very powerful Compaq server. There are fourteen NTTS currently installed at MELP that range in configuration from dual Pentium Pro with 394Mb RAM up to a four way Pentium 450 Xeon with 1.3Gbytes of RAM. The applications running include concurrent Discoverer sessions, Report 3.0 runtimes, and the GIS application ARCView GOAT described earlier.

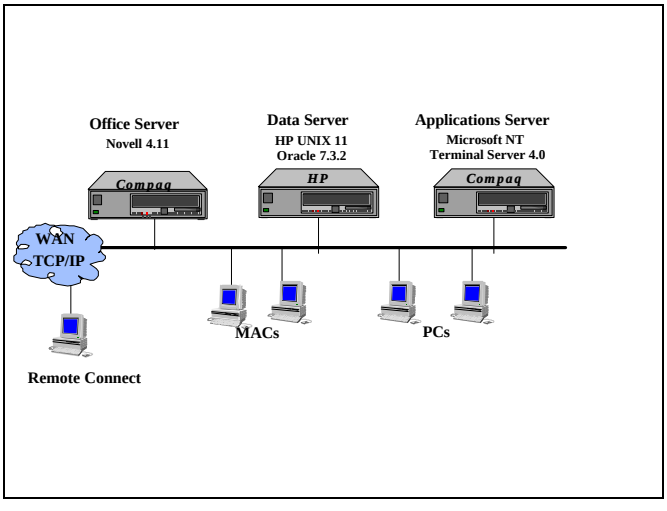


Figure 6 Regional systems configuration

The typical regional configuration is shown in figure 6. To run BI applications a user first initiates a Citrix Metaframe session which creates a virtual NT machine for them running on the NTTS. The user can be local to the LAN, remote across the WAN or using the available dial-up infrastructure run by the provincial government called SPANDIAL. The Citrix ICA protocol just traps mouse and keyboard input from the user and provides screen images, while all application processing is conducted on the NTTS. The only user installation required is the Citrix Metaframe thin client software. BI

tools installation, upgrade, and tuning all happen in a single place on the NTTS. All database queries happen rapidly over the LAN where the data server sits beside the application server.

Reports runtime is also available directly from the Office Server on the LAN as well NTTS. Accessing reports this way results in the client side processing happening at the user's PC. For some users this provides adequate performance, otherwise they can initiate an NTTS session to execute their reports.

Developer Server

The master data warehouse in the provincial capital is being enhanced with the Developer Server facility to run Reports 3.0. Oracle Reports and the Developer Server together introduce a multi-tier architecture for executing and distributing reports to a large and widely distributed user community. With this, reports may be executed remotely on the more capable HP UNIX server platform where resources are greater, and at the same time significantly reduce the load on the client machine.

The Developer Server is a multi-process engine able to generate report output dynamically based on requests received from clients. These requests may be issued from end user PCs, from an interface with the web server. The Server handles client requests by entering all report submissions into a job queue, as one of the server's runtime engines becomes available, the next job in the queue is dispatched to that engine and executed. It will deliver the results in HTML or Adobe Acrobat Format (PDF).

Implementing the Developer Server will provide an easy interface whereby any user can execute a Report. In addition the server provides job scheduling and report caching functionality that permits reports to run at off peak time and caches reports so that multiple users can get the same report without having to rerun it. Combining job scheduling and reports caching allows a strategy of executing standard reports following overnight Data Warehouse refresh so that they are immediately available to the users at beginning of the work day.

Discoverer Viewer for the Web 3.1W

Discoverer Viewer lets users access workbooks created with the Windows release of Discoverer and then drill down to analyze query results. It shares the same End User Layer as the Windows release of Discoverer, allowing immediate deployment of ad hoc reports to to the Web. It requires no Oracle software to be installed on the client. Client Java applets, which are dynamically loaded from a centralized server, allow the Discoverer viewer to be accessed via a simple web browser. MELP is currently evaluating this product as a candidate tool for its BI architecture. It requires Oracle Application Server not currently available for HPUX. Also the Ministry standard Web Browser will have to be upgraded to be compatible with the Java environment.

Discoverer Viewer 3.1 is a first release and has far less functionality than the Windows client version 3.1.26. For instance, table pivoting is not yet supported. At half the price of the windows versions (about US$500) it may make sense for some users requiring a web based BI implementation. Future releases promise enhanced functionality approaching that of the current windows version. The application server approach has all the inherent benefits as outlined for the NTTS above.

BI Tools Integration

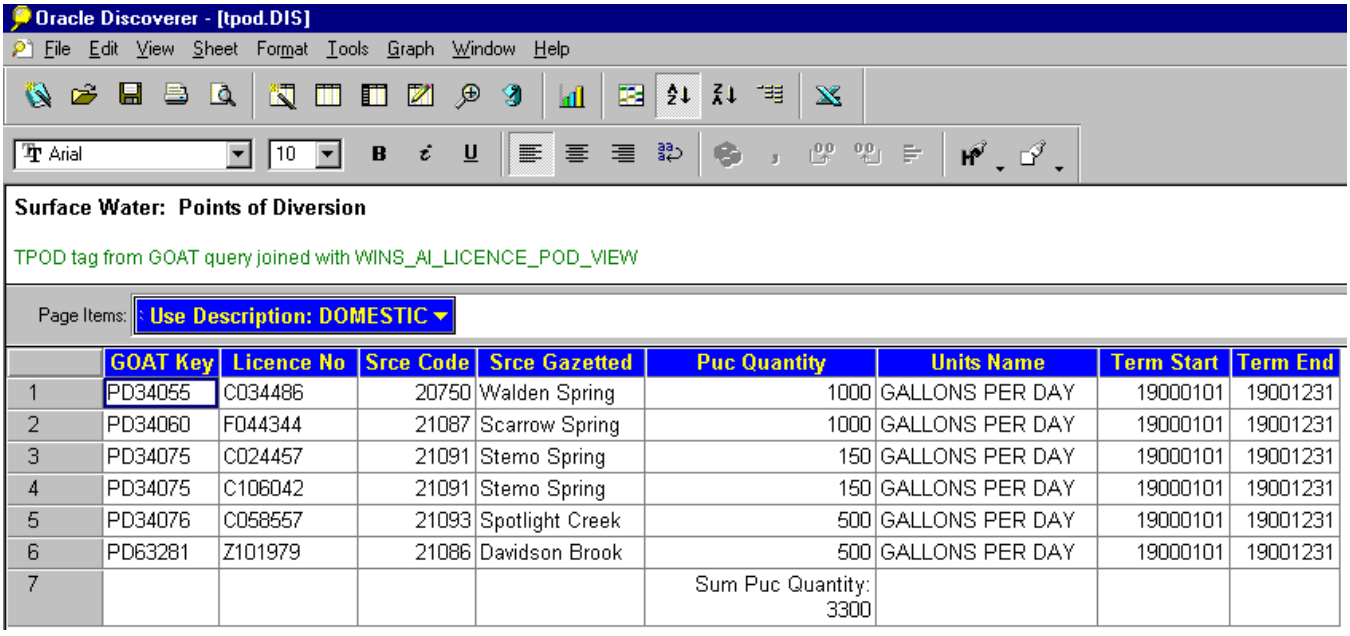
Tools integration is important to our overall BI strategy. Table 2 shows the interrelationship of the currently deployed tools: Discoverer, Reports, and Web presentation. Each is described as to the currency of the data it is querying, the data sources it uses, and the integration with the other reporting tools.

	Data Currency	Data Source	Tools Integration
Discoverer 3.1	1. Immediate, against last warehouse refresh. OR 2. Scheduled to off peak cpu time.	Relational warehouses and datamarts	Can export to Reports, Excel, PDF (Adobe Acrobat) and HTML format.
Reports 3.0	1. Immediate, against last warehouse refresh or production system. OR 2. Scheduled to off peak cpu time.	Relational warehouses and datamarts and data in transactional systems.	Generate multiple frame based style reports from Discoverer. Generate PDF and HTML format.
Web (HTML/ PDF)	Epoch - snapshot at a significant point in time	Multiple sources with free form editing.	Utilize Discoverer or Reports generated HTML or PDF files.

Table 2. Data Properties compared for Discoverer, Reports & Web.

Discoverer 3.1 & HTML Web Presentation

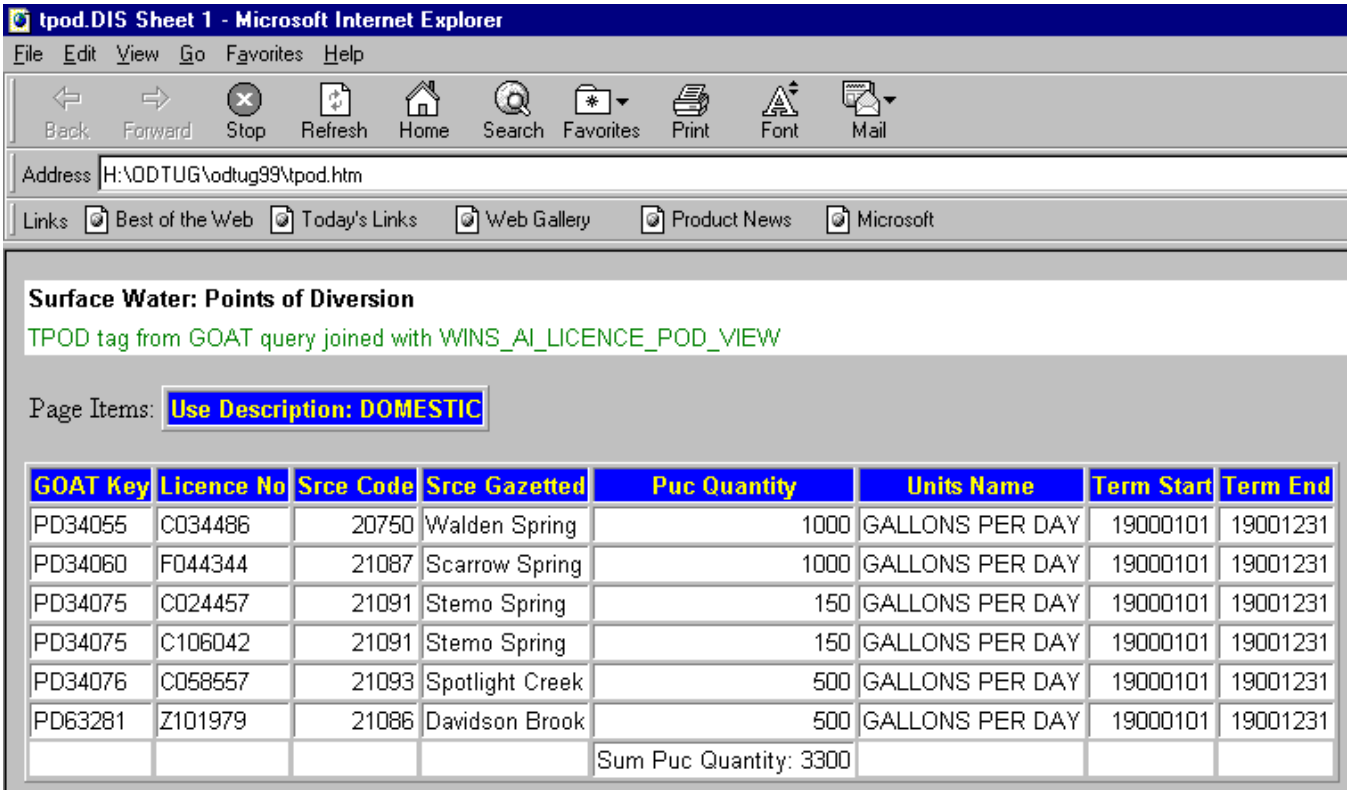
Discoverer 3.1 can export directly to HTML format. The HTML output can be edited into epoch based reporting for internet and intranet use. Any workbook can be generated as an HTML table with excellent look and feel. Figure 7 shows a sample workbook screen shot of a simple analysis on surface water points of diversion.



	GOAT Key	Licence No	Srce Code	Srce Gazetted	Puc Quantity	Units Name	Term Start	Term End
1	PD34055	C034486	20750	Walden Spring	1000	GALLONS PER DAY	19000101	19001231
2	PD34060	F044344	21087	Scarrow Spring	1000	GALLONS PER DAY	19000101	19001231
3	PD34075	C024457	21091	Stemo Spring	150	GALLONS PER DAY	19000101	19001231
4	PD34075	C106042	21091	Stemo Spring	150	GALLONS PER DAY	19000101	19001231
5	PD34076	C058557	21093	Spotlight Creek	500	GALLONS PER DAY	19000101	19001231
6	PD63281	Z101979	21086	Davidson Brook	500	GALLONS PER DAY	19000101	19001231
7					Sum Puc Quantity: 3300			

Figure 7 Sample screen shot from Discoverer 3.1

Using the Discoverer **FILE|Export..** and selecting **Hyper-Text Markup Language (*.htm)** format results in an excellent static representation of the analysis as shown in Figure 8.



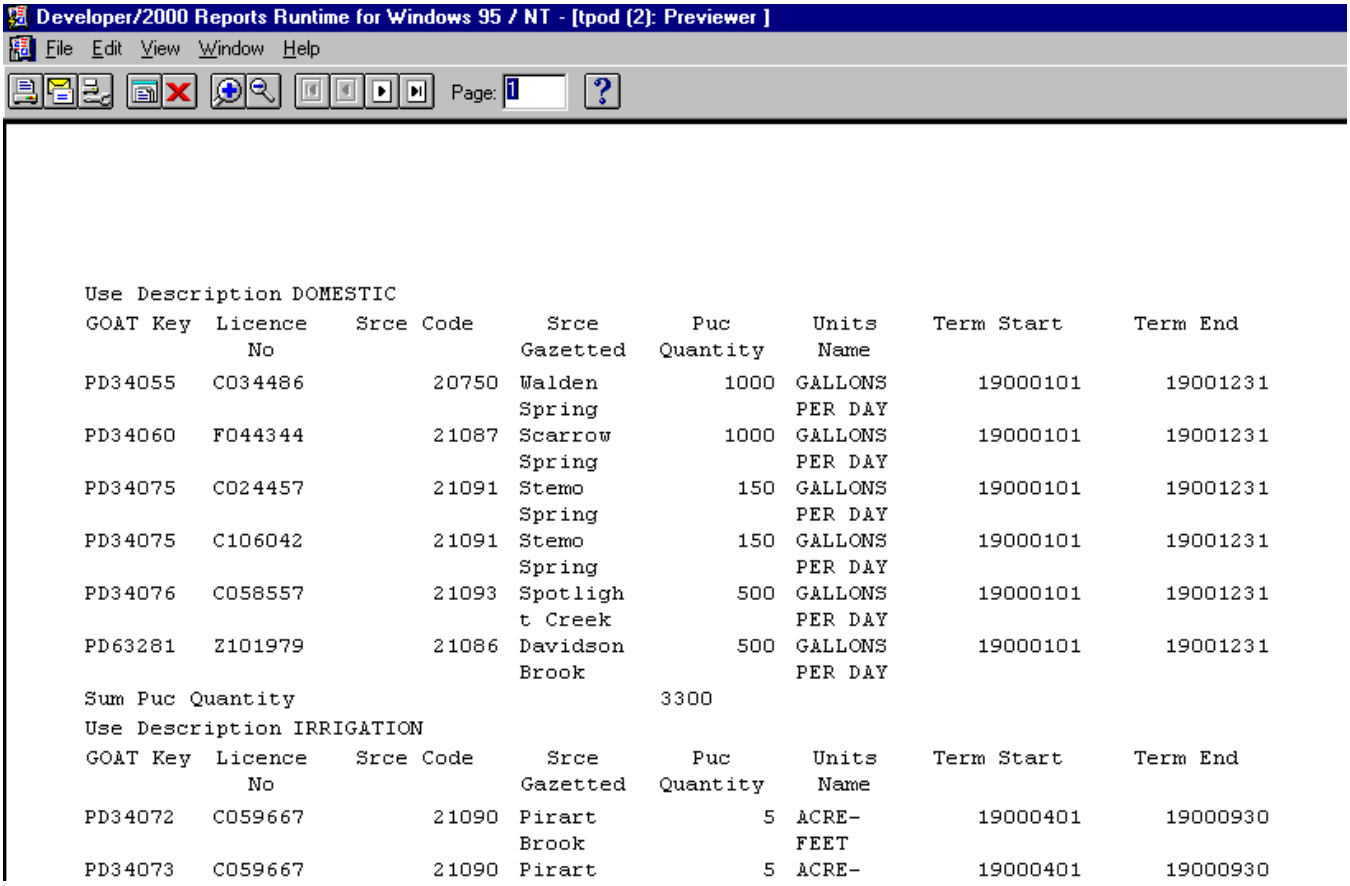
GOAT Key	Licence No	Srce Code	Srce Gazetted	Puc Quantity	Units Name	Term Start	Term End
PD34055	C034486	20750	Walden Spring	1000	GALLONS PER DAY	19000101	19001231
PD34060	F044344	21087	Scarrow Spring	1000	GALLONS PER DAY	19000101	19001231
PD34075	C024457	21091	Stemo Spring	150	GALLONS PER DAY	19000101	19001231
PD34075	C106042	21091	Stemo Spring	150	GALLONS PER DAY	19000101	19001231
PD34076	C058557	21093	Spotlight Creek	500	GALLONS PER DAY	19000101	19001231
PD63281	Z101979	21086	Davidson Brook	500	GALLONS PER DAY	19000101	19001231
				Sum Puc Quantity: 3300			

Figure 8 Sample screen shot from Web browser

Discoverer 3.1 & Reports 3.0 Presentation

Discoverer 3.1 can export directly to Oracle Reports Definition (RDF) format. The report can be edited in Report Builder and made available via the Reports runtime on the NTTS or office server. With the installation of the Developer Server on the data warehouse UNIX system any Web browser will be able to execute the reports.

Discoverer tables and crosstabs can be exported as an Oracle Report if the Oracle Reports application is installed on the same PC. Using the Discoverer **FILE|Export..** and selecting **Oracle Reports Definition file (*.rdf)** format results in a dialogue that produces an embryonic Oracle Report as shown in Figure 9.



Use Description DOMESTIC

GOAT Key	Licence No	Srce Code	Srce Gazetted	Puc Quantity	Units Name	Term Start	Term End
PD34055	C034486	20750	Walden Spring	1000	GALLONS PER DAY	19000101	19001231
PD34060	F044344	21087	Scarrow Spring	1000	GALLONS PER DAY	19000101	19001231
PD34075	C024457	21091	Stemo Spring	150	GALLONS PER DAY	19000101	19001231
PD34075	C106042	21091	Stemo Spring	150	GALLONS PER DAY	19000101	19001231
PD34076	C058557	21093	Spotligh t Creek	500	GALLONS PER DAY	19000101	19001231
PD63281	Z101979	21086	Davidson Brook	500	GALLONS PER DAY	19000101	19001231
Sum Puc Quantity				3300			

Use Description IRRIGATION

GOAT Key	Licence No	Srce Code	Srce Gazetted	Puc Quantity	Units Name	Term Start	Term End
PD34072	C059667	21090	Pirart Brook	5	ACRE-FEET	19000401	19000930
PD34073	C059667	21090	Pirart	5	ACRE-	19000401	19000930

Figure 9 Sample screen shot from Reports 3.0 runtime

This report was generated “unformatted”. Standard layouts can be created which might include standard headers, footers, disclaimers, colour schemes and corporate logos. The report was run directly in Reports Runtime without going through Reports Builder. What we see is complete, with respect to data, but the formatting requires some work to deal with such readability issues as wrapping of text in fields. In addition the report does not respect the Page Item selection and report on just “DOMESTIC” Use Description, but continues on to list all the Use Descriptions grouped by type.

Reports 3.0 and PDF Web Presentation

Ten minutes of work in Reports Builder creates a Report that will generate directly to Adobe Acrobat **.PDF** format for distribution as seen in Figure 10. (This edited report could also be executed with the Reports runtime above for presentation as in the previous example Figure 9.)

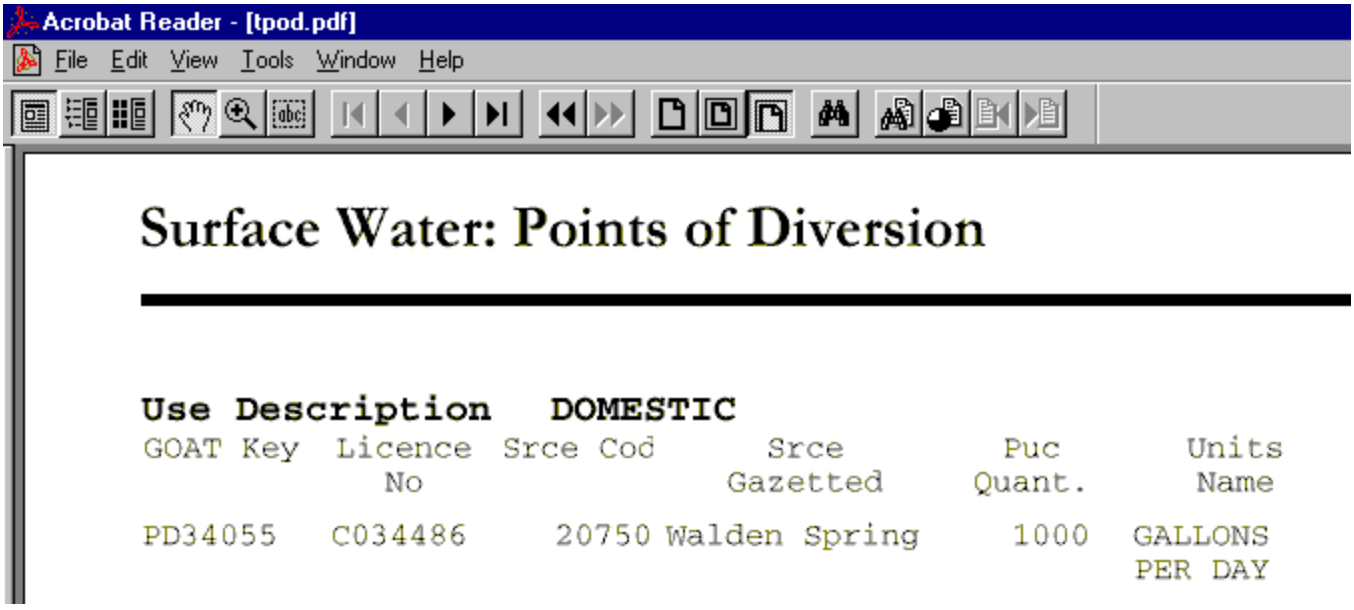


Figure 10 Sample screen shot from Adobe Acrobat

This format for presentation can be used to create epoch reports (generated on data at one point in time for repeated reference) as shown in this example. In addition PDF reports can be generated on the fly with the Developer Server and delivered to the user's web browser. The excellent production quality of the Adobe Acrobat presentation and the pervasive use on the internet make it an attractive choice for BI reports.

Integration of Discoverer, Reports & Web Presentation

When generating an Oracle Report 3.0 from a Discoverer ad hoc query there is still much work needed to define a useful, readable output. What comes from Discoverer is a place to start which includes some basic formatting and, most importantly, the SQL query. This will have incorporated all the performance enhancements available from Discoverer such as summary redirection. It still remains for someone to edit the layout for readability. This can be done by staff other than the Subject Specialist who created the analysis. The formatting can be completed by either IT staff or other users with publication responsibilities.

The Parameters created in a Discoverer workbook do not convert to Reports as a Parameterized Report. These have to be redefined in Report Builder.

Also when exporting to Oracle Reports the SQL is passed through with aliases that were required for Discoverer. The readme.wri file that comes with the Discoverer 3.1 installation gives the following example and suggestion:

```
Select region as e109, year as e102
from video31.dept_reg_year
```

The column names "region" and "year" are passed through as the column headings in Oracle Reports. In the Reports Designer layout area, the columns will be referred to with their alias name "e109", "e102". If you wish to modify these to the actual column name you may do so be reviewing the SQL passed through to Reports and making the translation.

Generating PDF output directly from Discoverer is not practically possible. The feature **FILE|Export.. Adobe Portable Format file (*.pdf)** is not a directly a Discoverer process but instead generates a Reports RDF that is then read in the background by Reports which generates the PDF file. It does work but the output cannot be relied upon to be very readable. It is advisable to generate to the Report Builder, edit the report layout, and then publish the report as PDF.

Summary

At the Ministry of Environment, Lands, and Parks, business intelligence involves the integration of base information (both attribute and spatial) with event driven or project information to detect significant events and clarify difficult issues. It is possible to classify users and provide the appropriate tools to their BI task requirements in a productive and cost effective manner.

To achieve success in BI implementation follow the proven strategies of:

- enforcement of data management and technology standards;
- a clear understanding of the key business requirements;
- keeping the vision dynamic and non-technical;
- management of expectations;
- include staff in a team environment to brainstorm, prototype and implement the vision;
- creating an environment to encourage experts to be innovative.

An integrated BI tool suite allows the distribution of the knowledge products to consumers in the most useful format for their ongoing analytical needs. The internet/intranet technologies will be a part of this solution. Embracing the thin client, multi-tier architecture provides performance, cost, and ongoing maintenance benefits. The implementation presented here has shown the use of the Microsoft NT Terminal Server with Citrix Metaframe to provide this capability. As the tools and products mature for the Web such products as the Discoverer Viewer 3.1W will be a viable option.

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