WebCheck – An Oil Analysis Based Maintenance Extranet System

Abstract

The use of the Internet for extranet applications is in its infancy and the synergistic effects of these systems are only beginning to be understood. This paper details many of the benefits of WebCheck, an oil analysis based maintenance extranet system. WebCheck is a mature system operating in several countries with hundreds of on-line users. WebCheck allows for the exchange of equipment condition monitoring data provided by a centrally linked global commercial oil analysis laboratory. Centralization of the worldwide Laboratory Management Information Systems (LIMS) through the Internet allows for live and interactive flow of condition monitoring data between the laboratories, customers, original equipment manufacturers (OEMs), oil suppliers and consultants.

by Bill Quesnel, Hons. Bsc., Vice-President,
WearCheck Canada Inc.

Introduction

The business landscape is witnessing a transformation as we move into the Information Age. The Internet being the right medium has risen to fill the need of continually expanding global information systems. There is no industry that will remain unchanged as a result of the impact of the Internet on business. This paper focuses on the potential that exists within the oil analysis industry for a shared information system.

Historically the oil analysis industry has not kept pace with information technology. In part this is due to the lack of cooperation within the industry as a result of the normal level of competition that exists between companies. Further a general lack of integrated information systems, and more specifically industry standards for data exchange has hampered any collaborative efforts.

The Cycle of Evolution within an Industry

As an example we consider a single client using oil analysis. This client is only able to share in the knowledge and experience of the one oil analysis company that they have chosen. Having no knowledge of other oil analysis companies the client is not able to easily decide if the service they receive is the most effective. The experience of this client with oil analysis is not shared beyond the client themselves, and the oil analysis company.

Now consider that somehow, as an industry, we develop a platform that links both the systems and information and experience from all the oil analysis companies. We give the client access to this system and the tools to work with this information. Now the client is free to choose any

Figure 1 – *Evolution of an Industry through the collection and dissemination of data.*

oil analysis company, and is able to collaborate within a community of many oil analysis users.

This frees the client to reap the greatest effectiveness from oil analysis. In turn the client has a forum for discussion on oil analysis, and a method of communicating their experience to the oil analysis community at large. The client has now been empowered within the oil analysis industry.

Learning from these clients the oil analysis industry, including laboratories, OEMs, and fluid manufacturers, are able to adapt to meet the needs and preferences of the clients. In

response to client requirements organizations arise that contribute specialized data to the overall system. The system grows and refines itself based on the continual feedback from the community. The oil analysis industry, as a result, evolves at a greater pace than other more insular industries.

In order for the oil analysis industry to evolve at a greater rate it is essential to create both standards for maintenance-related data, as well as a platform within which this data can be collected and disseminated (*see figure 1*). This paper will address the current state of information systems in the oil analysis industry, and then outline an Internet-based system that is designed for the collaboration of oil analysis and maintenance-related data.

The Current State of Information Systems within the Oil Analysis Industry

In the oil analysis industry there are over 250 commercial laboratories, and 2000 private laboratories in North America alone. Each laboratory operates its own Laboratory Information Management System (LIMS). In addition most oil analysis companies offer a client-based oil analysis software package.

These client-based software packages offer varying levels of functionality. Functionality ranges from the ability to view oil analysis data and reports, to software packages that allow the client to fully manage their oil analysis program. Each software package uses a proprietary format for the exchange of data between the oil analysis LIMS and the client software. Of the entire customer base of any oil analysis company only a small percentage of clients actually use a client software package.

Of the small percentage of clients using an oil analysis software package the interaction between the client and laboratory is typically insular. In only rare instances is the client able to send some form of maintenance-related data back to the laboratory. More likely the client stores a vast amount of maintenance related information into a proprietary maintenance information system that is not shared with the laboratory.

Private Information Systems

Now once again consider our client. They possess a proprietary software package from their oil analysis company that contains their oil analysis data. Their maintenance data is stored in a separate system. There is no easy way to collaborate data from the two systems.

Furthermore data from either system is not being returned to the laboratory nor can the client collaborate their data with the oil analysis industry.

Now our client wishes to use a second laboratory or to move their business from one laboratory to another. The client is faced with at best a fragmentation of data, and in the worst case scenario a complete loss of their previous oil analysis data.

Frustrated, the client proceeds to purchase an oil analysis software package from a software provider. This software boasts a lengthy list of oil analysis companies capable of exporting data using the software's own proprietary format. The system is expensive and requires training, but now the customer can use several laboratories. Unfortunately the software is designed around viewing oil analysis data, and not around an oil analysis company, and so the system only accepts basic oil analysis data. Again there exists no way for the client to send data back to the oil analysis company.

So when we look at the current state of information systems in the oil analysis industry we see that the vast amount of data that exists is partitioned among many proprietary LIMS. Of this partitioned data only a small percentage is ever transferred to client systems. Of the client systems that exist each is proprietary in terms of the data being transferred to the client, the actual format of that data, and the functionality contained within the system. Of the total amount of maintenance data being entered into client systems only a minute fraction is ever sent back to the originating laboratory. Of all the oil analysis and maintenance-related data being collected worldwide none is available collectively to the oil analysis industry at large.

The Future of Information Systems in the Oil Analysis Industry

The solution is to move away from proprietary and insular information systems and move towards a common platform. The development of common information standards will allow for the collection of oil analysis and maintenance-related data. A shift from private to public information systems will allow for the dissemination of industry wide data. This data will be used not only to benefit oil analysis clients and oil analysis companies but to also benefit OEMs, fluid manufacturers, and maintenance consultants as well.

The ability to collaborate on a worldwide database of oil analysis and maintenance-related

information will allow the field of oil analysis to mature at a rapid pace. The result will be a marked increase in the consistency of service from oil analysis laboratories, which will increase the overall effectiveness of oil analysis. Increasing the effectiveness of oil analysis will allow the client to maximize productivity and realize a minimization of maintenance costs. A public information system will allow the oil analysis industry to attain this collective goal.

Public Information Systems

Now consider our client of the future. The client, after seeing an advertisement for WebCheck in a maintenance magazine, visits the Web site. The client sets-up a free account, and after receiving an e-mail detailing their new account information, the client proceeds to logon to WebCheck through their Web browser. WebCheck greets the new user, and directs them to a brief training video on setting up an oil analysis program. The user notes that he is able to purchase more detailed courses on many maintenance topics from the on-line training center.

After the brief introduction the client selects their industry from a setup list, and they are shown what types of equipment are routinely sampled in this application, what goals can be achieved through oil analysis and which tests are required to track these goals. The system recommends several laboratories that specialize in their

industry, and the user selects one close to their facility. The system then processes their order for oil analysis kits and sends it to the chosen laboratory.

The client then proceeds to the equipment management area and uses one of the pre-defined templates to set-up their sampling points and intervals. The system prints out a work-order report including a series of pre-printed labels, for attaching to the sample bottles, for the current round of samples to be taken. When the sample kits arrive the client passes the work-order and sample kits to the oiler, who takes the oil samples and submits them to the laboratory.

Within 48 hours an e-mail arrives informing the client that the samples have been completed and that one sample from a bearing system is severe. The client logs on to WebCheck and quickly pulls up the sample report. The ferrography indicates that a bearing failure is imminent and that immediate action is required. A message is attached to the sample and the client views it. The bearing manufacturer has viewed this situation and has a replacement bearing and a service technician available to perform the repairs. The client schedules the technician and accepts the terms of the work. The maintenance activity is automatically scheduled within WebCheck.

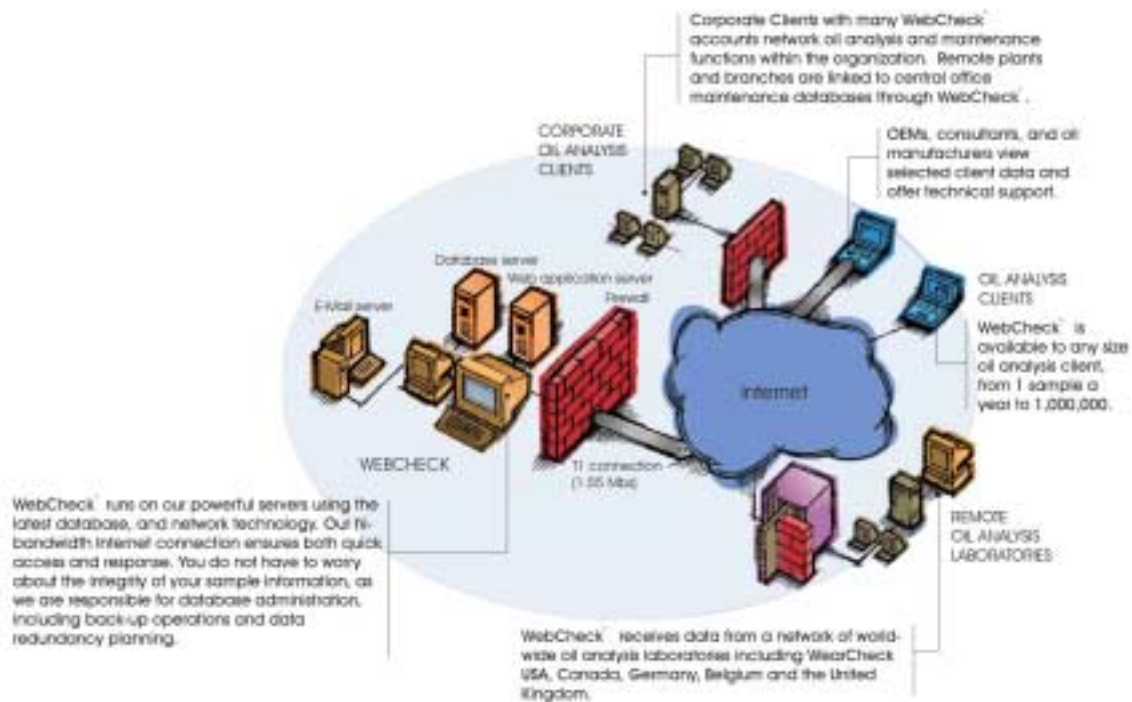On Wednesday the client logs in to WebCheck

Figure 2 – *A network schematic of WebCheck and WebCheck users.*

and follows up on the bearing system. The maintenance history dialog has recorded the repair, and displays a digital picture of the bearing that was removed showing a large wear scar. A resample has been scheduled for tomorrow so the client will log in on Friday to view the results of the oil analysis to ensure that the repairs were effective.

WebCheck the Future of Oil Analysis Information Systems

The beginning of such a platform already exists and this system, WebCheck, supports over 500 clients and collects data from 4 laboratories around the world (*see figure 2*). WebCheck is a Web-based application created for the collection and dissemination of oil analysis and maintenance-related data within the WearCheck International (WCI) group.

Quickly it became evident that if WebCheck could serve the needs of WCI then it could serve the needs of the oil analysis community at large. All that is required is industry acceptance and collaboration to make the WebCheck framework

a working standard. Currently WebCheck forms the basic foundation for an oil analysis based maintenance extranet system (*see figure 3*).

The Development of WebCheck

The business environment in which WebCheck was conceived played a key role in the development of this system as a common oil analysis platform. WearCheck International represents nine oil analysis companies from around the globe that operate autonomously aside from the sharing of business information, technology, and procedures. Prior to WebCheck the members operated information systems in total independence of one another.

As early as 1995 it became evident that as a group WCI could realize good economies of scale by developing common software systems. After witnessing a recurring cycle of LIMS development by each member, WCI was entertaining the idea of developing a common worldwide LIMS.

The first attempt at such an endeavor was undertaken in 1996. WearCheck Canada and
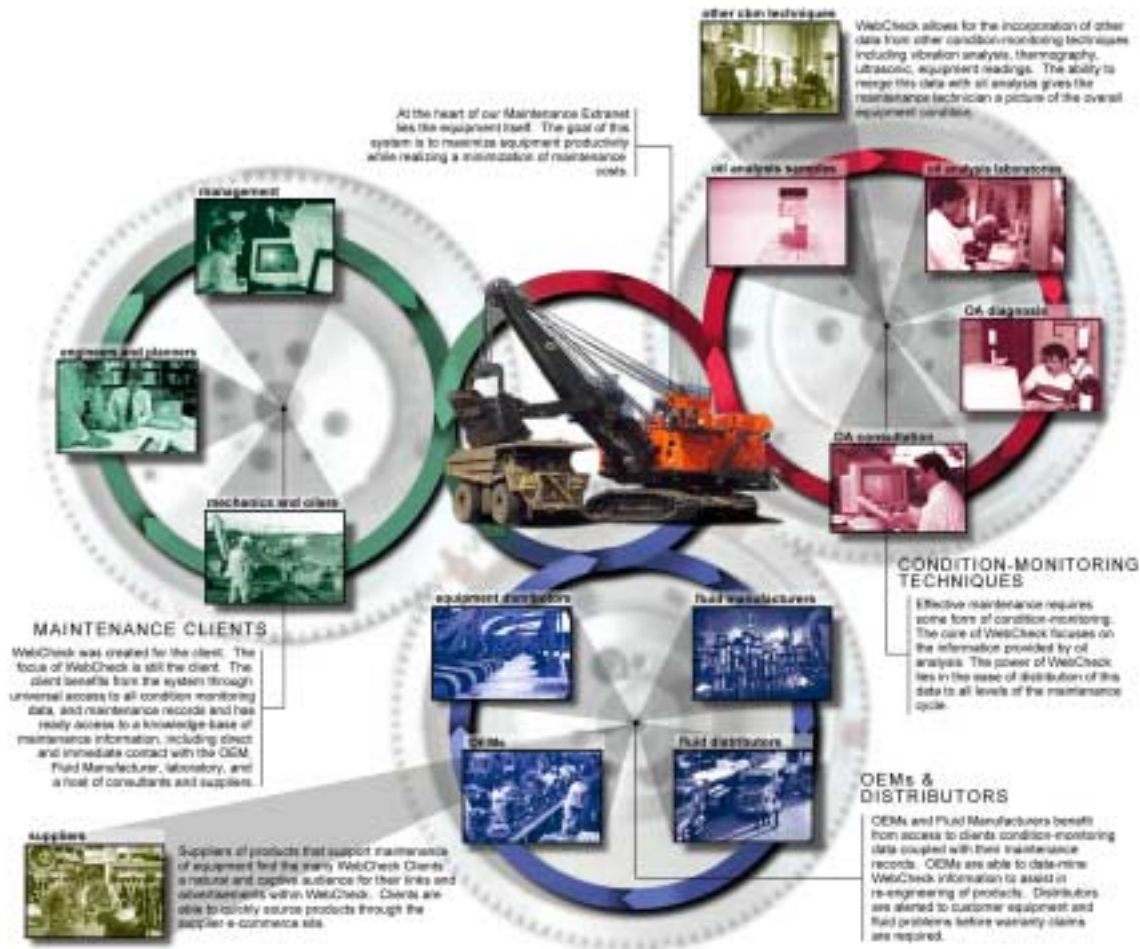

Figure 3 – *The scope of WebCheck - An oil analysis based maintenance extranet system.*

Australian Laboratory Services embarked on the development of a common LIMS. Soon after development began the system diverged into two separate LIMS. It became evident that using traditional software development technology that a universal LIMS could not be practically developed.

In 1997 a common data format was developed by WCI for the exchange of oil analysis data. Later when it became evident that Internet technology had advanced to the level where Web-based applications were a reality the development of a client based system was undertaken in 1998. The WCI data format developed the previous year formed the foundation of WebCheck and this allowed for the development and deployment of a working system within 3 months.

WebCheck is based upon a common database platform. Oil analysis data is supplied to WebCheck through a Web-based Laboratory Information Management System (LIMS). On the client side WebCheck allows clients to manage their oil analysis program and store maintenance-related data all using a Web browser.

The Benefits of WebCheck

From the inception of WebCheck over two and a half years ago, the system has witnessed many changes. The diverse client base and numerous WebCheck training courses have provided WCI with a great deal of feedback that has been channeled into new modules and functionality within WebCheck (*see Table 1*).

Following is a discussion of the benefits of WebCheck presented from the perspective of the oil analysis client, oil analysis laboratory, OEM and supplier.

Client Benefits

WebCheck was first developed as a system for clients to have "Quick access to oil analysis data". Through client feedback and continuos redevelopment WebCheck has become a tool for laboratories, and OEMs in addition to the client.

- **Quick Access to Oil Analysis Data**

    WebCheck possesses the basic functionality of any oil analysis client system, which is the

Table 1 – *WebCheck benefits.*

Client	OEM	Laboratory	Supplier
Currently Available			
• Quick Access to Oil Analysis Data • Networked User Base • Access to Support Information • Data Entry & Selection of Test Packages On-Line • Maintenance Tracking & Scheduling • Equipment Database Maintenance • Ability to Use a Network of Laboratories	• Registration of Equipment On-Line • Alerted to Customer Problems before Warranty Claims • Use of Industry Data for Re-engineering Purposes • Global Access to Data	• LIMS Management • Paperless Laboratory • Remote LIMS Management • Ability to Set-up Satellite Laboratories • Access to Customer Maintenance Information • Forum for Communication with Customers • Data Exchange for CBM-based Software	• Access to a Well-Targeted and Captive Audience • Remote Program Management by Maintenance Consultants
Currently Under Development			
• Setting, and Tracking of Goals • Direct Link to EOMs & Fluid Manufacturers • Ability to Source Products On-Line • On-Line Training	• Incorporate Lube Survey Systems		• Establish an E-Commerce Site

ability to view sample reports, test results, and recommendations as well as a number of trending graphs. In addition to this routine data WebCheck allows for the viewing of ferrography images, IR spectra, GC chromatograms, and other laboratory data.

Requiring only an Internet browser with no requirement for the downloading of laboratory data in any form translates to a very satisfying experience for the customer. The client views data on-line and in real-time with their oil analysis laboratory affording the best possible turn-around of oil samples data.

Further increasing the efficiency of the process, clients receive alerts by e-mail notifying them of recently completed analysis, including the level of severity of each sample.

- **Networked User Base**

  Once a small group of clients were up and running on WebCheck it became obvious that the system inherently networked all users. Tools were quickly developed to allow users to send messages to each other, as well as sample reports and data. Systems were developed to promote collaboration within the WebCheck community with further development planned.

  The system proved to be excellent for large organizations with multi-level managed oil analysis programs. Fleets with many branches across the country or continent could effectively manage their entire oil analysis program with ease. Companies with branch plants or multiple independently managed areas within a plant were able to take advantage of WebCheck as a networked system without the need to involve the organizations IT department.

  Clients began to use the services of outside consultants who for the first time could easily manage a clients oil analysis program remotely.

- **Access to Support Information**

  In many instances oil analysis clients are confronted with an oil analysis report and little support information on which to base further action.

  With WebCheck for the first time clients had access to wear limit tables, new oil baselines and typical limits, as well as hyperlinks to oil product specifications as well as OEM

specifications on the Web. With support information available at the click of a mouse the client is able to make better informed maintenance decisions.

- **Data Entry & Selection of Test Packages On-Line**

  The ability for the client to enter sample data on-line reduces the clients need for reduplication of samples and equipment data and eliminates data entry errors caused at the laboratory.

  Clients can select the appropriate test package and can modify the tests to be performed on a sample either before it is shipped, while the sample is in the laboratory, or after the sample analysis has been completed.

  Clients can request higher level test packages or additional tests on-line when routine testing detects abnormalities, ensuring the best cost-benefit ratio for their oil analysis program.

- **Maintenance Tracking & Scheduling**

  Clients have the ability to set-up sample scheduling intervals and to have the laboratory pre-print samples labels and deliver sample kits just in time for sample taking.

  Clients can generate future or historical sample schedules. WebCheck automatically tracks when a sample has been taken, missed, as well as future sample dates.

  Clients can enter and schedule maintenance actions and have tools to allow them to track both outstanding and overdue samples and maintenance actions.

- **Equipment Database Maintenance**

  Clients have control over the equipment in their oil analysis program. With direct access to equipment from all sites and locations clients can modify equipment information at any time. Clients have the ability to add new equipment to their database, in addition to updating and deleting existing equipment records.

  Additional tools including the ability to merge units allow clients to correct unit identification errors in order to maintain the integrity of their equipment databases.

- **Ability to Use a Network of Laboratories**

  A client can send samples to any laboratory that uses WebCheck and receive all results back through their WebCheck login.

  As far as the client is concerned which laboratory is used for testing is transparent to WebCheck. The client simply sees the samples data attached to the equipment regardless of which laboratory actually performed the analysis.

Some of the client benefits planned for future development of WebCheck include:

- **Setting and Tracking of Goals**

  Clients will be able to select goals for their oil analysis program. WebCheck will then ensure that they are conducting the necessary oil analysis tests to be able to track these goals.

  WebCheck will contain a detailed report for each goal showing the clients progress based on their oil analysis data as compared to industry wide data.

- **Direct link to OEM & Fluid Manufacturers**

  In the future WebCheck will present a forum for clients to contact OEMs and fluid manufacturers. Currently many OEMs and fluid manufacturers are using WebCheck. WebCheck will have representatives at many OEM and fluid manufacturers available to answer technical questions, and to respond to oil analysis results on their products.

- **Ability to Source Products On-Line**

  Studies on Internet procurement are illustrating approximately 30% savings for on-line sourcing of products as opposed to conventional sourcing.

  A natural potential exists for the linking of supplier e-commerce sites within WebCheck. Supplier links will allow WebCheck clients to source and purchase maintenance-related products on-line.

- **On-Line Training**

  Learning at a distance has become commonplace as a result of the Internet. Colleges, universities, and private institutions already offer degree courses, training courses, and post-secondary education on the Internet. WebCheck will offer on-line training to maintenance personnel in the form of downloadable training courses, on-line videos and slide presentations.

OEM Benefits

Many OEMs and fluid manufacturers have branded, or badged programs with oil analysis laboratories. OEMs use oil analysis for warranty validation. Fluid manufacturers use oil analysis to verify the effectiveness of their oils or to trouble shoot customer concerns with a product. WebCheck as a tool for OEMs monitoring their oil analysis program gives several distinct advantages over traditional oil analysis software.

- **Registration of Equipment On-Line**

  OEMs can log on to WebCheck and register new equipment sales. The registration page allows the OEM to indicate the warranty period and to generate a sampling schedule for the equipment points. The oil analysis laboratory is sent a purchase order indicating the client's address and the quantity of oil analysis sample kits required.

  The OEM has the ability to track sample schedules on warranted equipment, and can determine when clients are not sampling as per the warranty guidelines.

- **Alerted to Customer Problems Before Warranty Claims**

  For branded programs the OEM (or fluid manufacturer) can view clients sample data. Automatic tracking of problem units in the Trouble Log allows the OEM to quickly identify potential problem units.

  OEMs can view sample reports and maintenance histories and contact clients with maintenance recommendations before equipment fails. WebCheck assists in the avoidance of warranty claims saving the OEM money. As a result the client experiences less downtime increasing customer service.

- **Use of Industry Data for Re-engineering Processes**

  OEMs can view all historical sample data, as well as historical maintenance actions on equipment. Access to client sample and maintenance data coupled with the ability to generate statistical reports allows OEMs to use this data for re-engineering purposes.

- **Global Access to Data**

  Global OEMs and fluid manufacturers with clients around the world, have access to a pool of oil analysis and maintenance data from a varied source of clients and environments. WebCheck acts as a single source for this worldwide collection of oil analysis and maintenance-related data.

Some of the OEM benefits planned for future development of WebCheck include:

- **Incorporate Lube Survey Systems**

  Fluid manufacturers oftentimes are required to perform lube surveys for their clients. WebCheck will soon offer the ability to enter lube survey information on-line. The oil company, client and oil analysis laboratory will have access to the information reducing the need for a reduplication of this survey information.

Laboratory Benefits

WebCheck provides a Web-based oil analysis Laboratory Information Management System (LIMS) that is tightly integrated with the client portion of WebCheck.

- **LIMS Management**

  Oil analysis laboratories are high throughput service oriented companies. Achieving a high level of service is accomplished by incorporating a dependable, efficient, and multi-functional LIMS.

  WebCheck offers a full LIMS system including modules for:

  - Prelogging
  - Data Entry
  - Laboratory
  - Diagnosis
  - Distribution
  - Customer Service

  The LIMS can operate as either a centralized system within a corporate oil analysis company, as a stand-alone LIMS, or using an Application Service Provider (ASP) model so that a laboratory simply requires a robust Internet connection and Windows-based workstations to be operational.

- **Paperless Laboratory**

  The WebCheck Oil Analysis LIMS offers the oil analysis laboratory a true paperless solution.

  The laboratory system requires no sample tracking paperwork as the computer tracks sample status and testing requirements. Technician work schedules are assigned through laboratory workstations.

  In many cases clients no longer require hard-copy reports as they can access their sample data via WebCheck. Additionally clients have the option of receiving faxes, and e-mailed reports.

  Clients are able to perform sample data entry on-line so in many instances Sample Information Forms (SIFs) are not necessary reducing the amount of data entry to be performed.

- **Remote LIMS Management**

  All LIMS functions can be operated through the Internet from any location. A user can log on from a portable computer and check the status of the laboratory, assign work to technicians, and import data files.

  Customer service can be centralized as remote service staff have access to sample reports, customer information, and can dispatch reports by fax or e-mail.

  One distinct advantage is that analysts can diagnose samples from anywhere in the world. For large oil analysis companies this allows for the centralization of diagnosticians. For turnkey oil laboratories diagnosis can be sub-contracted out to other oil analysis companies.

- **Ability to Set-up Satellite Laboratories**

  With a LIMS already in place and operational it is easy to set up and administrate satellite laboratories. The satellite laboratory only requires an Internet connection and computer workstations to be linked to the centralized LIMS.

  Many LIMS functions can be managed remotely including customer service and diagnosis reducing the amount of dedicated staff required at the remote laboratory.

- **Access to Customer Maintenance Information**

  One of the better arguments for operating an "in-house" laboratory is that access to maintenance records and equipment details allows the analyst to make better recommendations based on the oil analysis data.

  WebCheck tracks all client maintenance information and gives the oil analysis analyst access to this information at the time of diagnosis.

- **Forum for Communication with Customers**

  WebCheck allows laboratories to post articles for clients on the WaterCooler

community Web site. In the near future, the completion of a centralized communications package within WebCheck will allow customers to e-mail laboratory contacts, and join in discussion groups on maintenance.

- **Data exchange for CBM-based software**

  Most clients will elect to use WebCheck, however for clients using other condition-based software the LIMS can export data to a variety of software formats including:

  - Dingo Maintenance
  - Entek (Odyssey)
  - DMSI (Lubriscan, Maintelligence)
  - CSI
  - CSV, and other ASCII formats

  Clients can receive their data by e-mail, from an FTP site, or via BBS.

Supplier Benefits

When you bring a large number of individuals to a Web site inevitably advertising and supplier influence will play a role. In the effort to keep WebCheck a free service to oil analysis clients it seems logical that most of the development costs be offset by advertising and e-commerce revenue.

WebCheck affords a natural environment for suppliers to advertise maintenance-related products and services. The clients actually benefit from the availability to maintenance services that they may previously have been unaware of.

- **Access to a Well Targeted and Captive Audience**

  Suppliers place advertisements within WebCheck that direct interested clients to a supplier profile page. Considering the average WebCheck login is 19 minutes (based on the previous 10,000 logins) this is a good deal of time for a supplier to deliver their message to an individual. A message delivered to the right person at the right time.

- **Establish an E-commerce Site**

  Development is under way to allow suppliers that do not possess an e-commerce site to establish and sell products through a WebCheck e-commerce site.

  The WebCheck e-commerce site will allow suppliers to maintain a database of products for sale on the site, and track product sales to clients via WebCheck.

- **Oil Analysis Program Management by Maintenance Consultants**

  The ability to assign an individual access to a company's oil analysis data has created a new form of entrepreneur.

  Maintenance consultants are individuals who co-manage an oil analysis program for a client. The consultant can log in to WebCheck, review reports, and samples data, make recommendations, make changes and updates to the clients equipment database, as well as many other oil analysis program related functions. WebCheck allows for consultants to manage oil analysis programs at a distance.

WebCheck allows clients, oil analysis laboratories, OEMs as well as other maintenance-related individuals to collaborate on oil analysis and maintenance-related data. As the number of laboratories and clients using WebCheck grows the benefits to users will increase accordingly.

Developing Data Standards

Maintaining supporting data for a system like WebCheck is a large task. WebCheck contains data on oils, including baselines and typicals, wear metal limits for equipment, as well as many other supporting databases.

There is a need to focus on the development of data standards for the maintenance industry. By developing common industry data standards we can simplify the process of collaborating data from many sources.

- Oil Manufacturers – Oil product information, baseline and typicals data, product incompatibilities, applications and specifications.
- OEMs – Equipment specifications, oil analysis guidelines, maintenance and operator manuals.
- Laboratories – Test, and samples data, client and equipment data, client feedback and maintenance records, wear metal and contaminant guidelines and limits.

XML promises to be a real enabler for both data exchange as well as simplifying the process of data exchange through technologies like DTDs, Schemas, and XSL.

Once an XML definition is created for a particular set of data, any source that is XML compliant can be polled using simple HTTP. The source will echo back an XML data stream in response to the request.
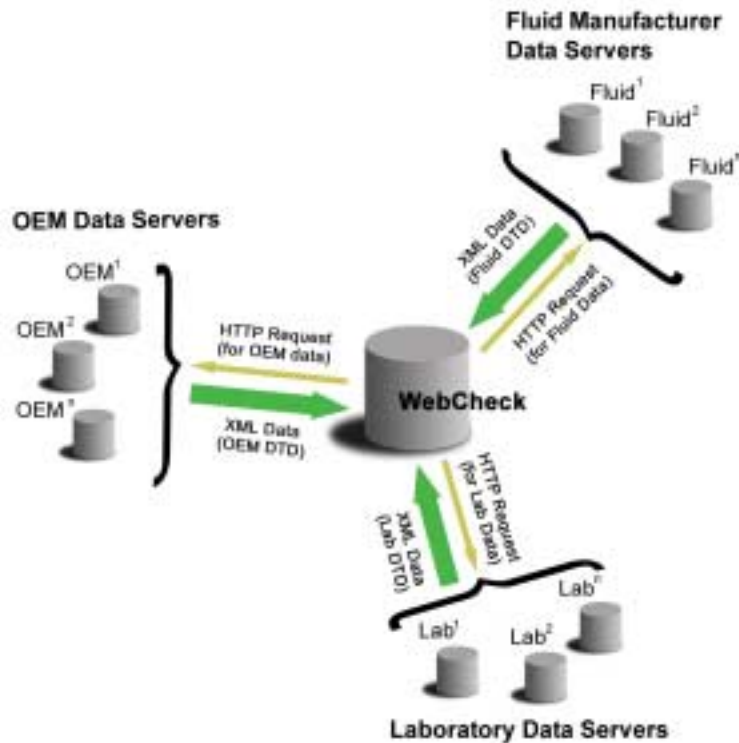
Figure 4 – *An XML Data Transfer Model illustrating WebCheck importing data from a series of XML-enabled Data Servers.*

A typical data exchange scenario using XML might involve WebCheck polling each oil company's data server for oil product specifications at a specified interval. In turn each oil company's data server would send back an XML document containing the latest product information. The WebCheck server would parse this XML document and the data would be updated in the database and made available to all WebCheck users (*see Figure 4*).

MIMOSA (www.mimosa.org) is one organization that is currently developing a common data framework for condition-monitoring data using XML. In the near future WebCheck will comply with a standard such as that being developed by MIMOSA. In this case becoming a WebCheck laboratory would be as simple as making your LIMS MIMOSA compliant. Exchanges of oil analysis related data would be accomplished between your LIMS and WebCheck using this protocol without the need for any further data exchange systems or formats.

Summary

Oil Analysis is ready to enter the Information Age. Data standards defining the format for condition monitoring data are being developed, and through advances in Internet technology it is now becoming possible to easily share and collaborate industry data.

What began as a project by WearCheck International to allow many unique laboratories to share one common software package for their oil analysis clients has moved the oil analysis industry closer to the realization of a common data platform.

It is now up to the clients that use oil analysis to demand common platforms that adhere to common data standards. A concerted movement among clients of oil analysis will ensure that such systems find a permanent home in the oil analysis industry.

With the data systems in place that make industry collaboration a common place occurrence oil analysis will evolve at a rapid pace. As these new systems of the Information Age increase the effectiveness of our oil analysis programs we will wonder how we ever did without them.