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Probably the most flexible process analytics system in the world...

A wild boast? We don't think so. During 2008 we have listened to the needs and wishes of our ever-increasing list of clients. Clients including world leaders in nuclear, petrochemicals, advanced materials, crop science, pharmaceuticals and many other industries. We have also undertaken more studies ourselves than ever before - and have learnt from the experiences. And we continue our relationship with Newcastle University and its unparalleled knowledge and innovation in our field. We are indeed proud of our flexibility.

Welcome to the last MS2 newsletter of 2008. In this issue we have no less than four new case studies. It is very gratifying to see MS2 being adopted as a key tool by so many companies, focusing on different aspects of manufacturing industry. We describe a variety of applications; in the nuclear industry at Sellafield, in the newly emerging biofuel industry at Immingham, in advanced chemical processing at Ciba in Bradford and at the National Industrial Biotechnology Facility on Teesside.

The big news, of course, is Project Hawk; our real time innovation which is now nearing completion.

The next version of MS2, V5.1, is also on the horizon and has a release date

confirmed as May 2009; we reveal for the first time some of the new and improved features which will be included. Put May 8 in your diaries; that is when we will host our annual User Group Meeting; 5.1 will be released then and we will also provide a free tutorial demonstrating the new features it will contain.

It has also become apparent that 5.1 and Hawk are highly complementary and symbiotic, so we'll describe how they will interact.

Some of Hawk's new functions, for instance direct interface with process control systems such as Emerson Process Management's DeltaV, are also very useful for obtaining data for historic analysis, and we describe these for the first time in detail.

We remain most grateful for the assistance and advice we continue to receive from the Centre for Process Analytics and Control Technology (CPACT) at Newcastle University. We will continue to work with both to ensure that we remain at the forefront of our industry.

In these uncertain economic times some of our clients are obviously facing more constraints than they would like and we are adopting a policy of assisting them as much as possible.

Finally all of us at AJM Consulting would like to wish you all a very happy Christmas and a prosperous 2009.

FINALIST

INNOVATOR/08

The Yorkshire and Humber Innovation Awards

This project receives funding assistance from the European Regional Development Fund.



Project Hawk Update



First Prototypes

The first prototypes of the real time MS2, codenamed Project Hawk, are operational. They need to be, because firm orders have already been received from Syngenta, ConocoPhillips, CPI and Johnson Matthey. As we approach the end of our substantial European Union funding, prototypes are becoming final versions and an innovative concept becomes reality. The initial prototypes are test beds for continuous processes. Batch is in the latter stages of development and will be operational shortly.

Interfaces to data historians from PI, Wonderware and Emerson Process Management's DeltaV distributed control system (DCS) are completed. Interfaces to other data sources will be completed when required; since we use industry standards such as OPC and SQL this will now be a simple task.

Actual Process Data

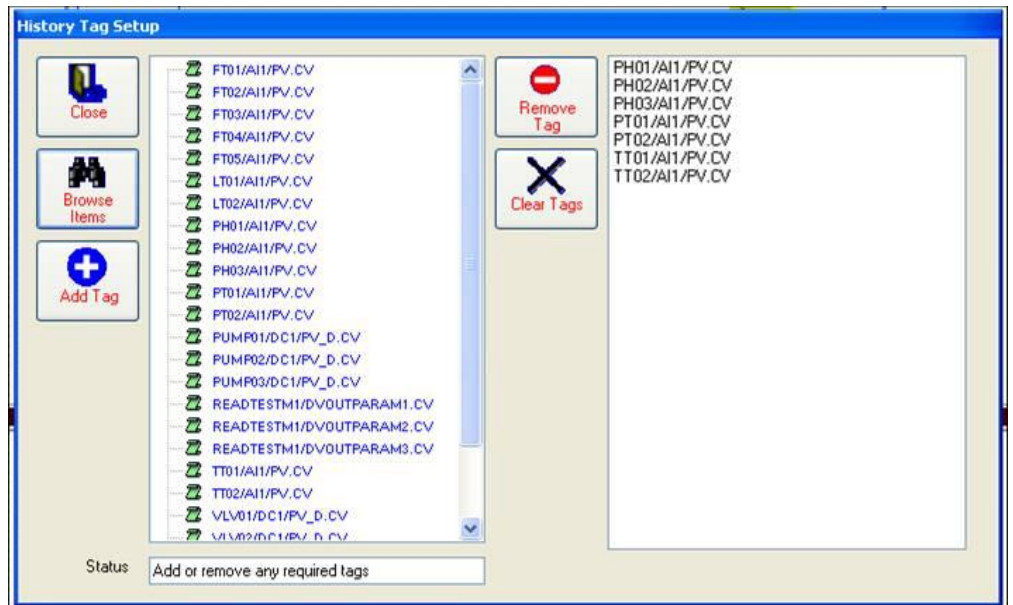
These demonstrators use actual process data supplied by clients, so we can be confident that, right from the start, Hawk can address the type of problems it was designed for.

Benefits throughout MS2

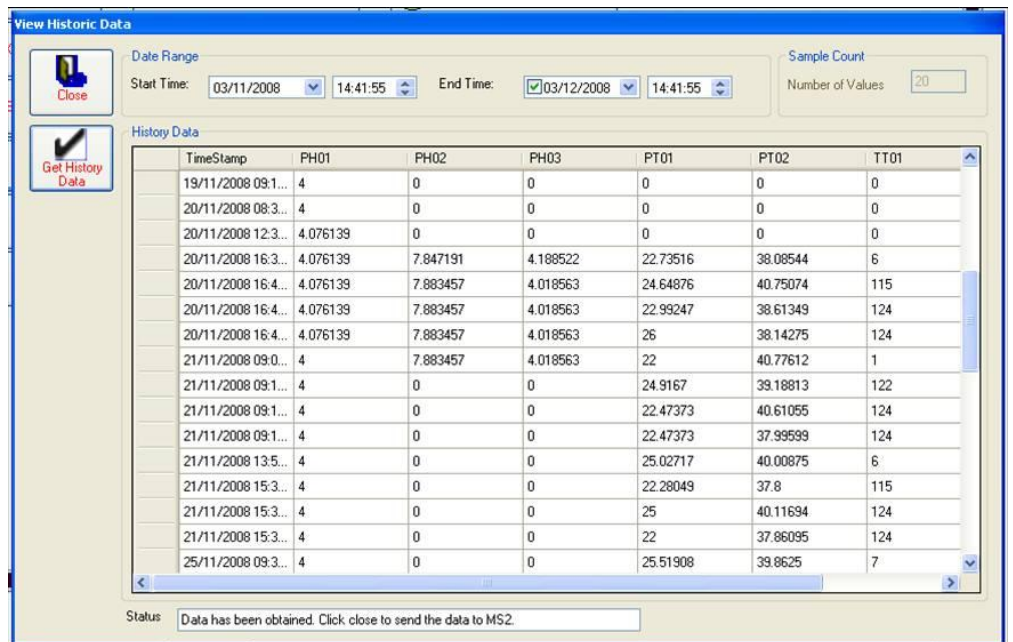
As "spin-offs" of Hawk technology, new functions will be available for MS2 applications. Firstly, extraction of data for historic analysis directly from plant historian or DCS systems, rather than having to create and import a transfer file. Secondly, historic data can be "replayed" in MS2, to enable detailed analysis of the onset of a fault condition. MS2, like a DVD recorder, can scan forwards or backwards at varying speeds, or step a single sample at a time, to observe the trajectories of both primary and derived variables.

Tag selection from source database

For all interfaces, it is possible to view, within MS2, a list of all the variable tags within the source system, and to select those required for import into MS2. This makes the process of setting up the interface simple and less error-prone. Where possible, for example in the DeltaV-specific tag selection screen within MS2 shown here, the



An example of MS2's DeltaV tag selection display



An example of MS2's DeltaV historic data interface display

hierarchical "tree" structure within the control system is used within MS2 to achieve a consistent look and feel.

Interface technology

The interface between MS2 and real time data sources uses OPC (Emerson Process Management's DeltaV), ActiveFactory's SQL Server front end (Wonderware) and the proprietary API modules provided by OSISoft (PI).

Operator Advice

The advanced process diagnostic functionality which is an integrated part of the Hawk design is in the latter stages of development and will be available shortly. Based on "expert system" heuristic technology, it employs pattern recognition techniques to identify the type of fault which is being detected and will provide the operator with advice which has been developed by process experts.

Version 5.1's new features

Since the launch of MS2 Version 5.0 at the User Group Meeting in May 2008, development of new features has continued. The new version, 5.1, will be released in Spring 2009, at the User Group meeting (see page 7). It takes MS2's process diagnostics capability to new levels, able to address more complex and varied problems. It is faster, more robust and easier to use. We've listened to the ever-growing user base and developed the many new features and enhancements which you have asked for.

Multiple problem analysis. Until now, only a single analysis set has been possible, which had the limitation that, where several fault conditions exist, analysis could be confused. V5.1 enables multiple analysis sets, each defined by tools such as Manhattan, parallel coordinates and Lasso. For analysis results, all are shown, so that a single score plot, for example, can show multiple fault clusters.

The Predictive technique of Projection to Latent Structures or Partial Least Squares (PLS), is now fully integrated. This is one of the most powerful linear regression techniques for handling noisy and highly correlated data.

Historic replay. Developed from the new Hawk real time diagnostic system, MS2's new historic replay functionality enables a data set to be played back in accelerated time, showing how a process problem builds up over time. The replay can be stopped, reversed, or skipped one sample at a time, enabling a clear visualisation of the way the problem under investigation develops.

Accumulated Score plots. Often, a principal component score plot will show only a partial separation of sample between the standard model and analysis data sets. An accumulated score plot shows far more clearly how the various sets are differentiated. The patterns generated by the analysis sets can be used as a fault signature.

Confidence Bounds. Also new to 5.1 is the incorporation of confidence bounds to score plots. These are multivariate control limits and, in MS2, are provided for the 95% and 99% levels.

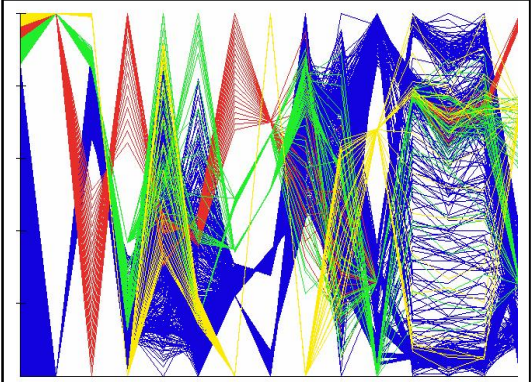
Speed. Some of the more complex calculations, such as multivariate analysis of batch trajectories, have been re-written entirely, using highly innovative algorithms which operate up to ten times faster than at present.

Multiple data import enables, for example, a standard model to be created and then used as the basis for comparison of numerous other data sets such as monthly performance comparison.

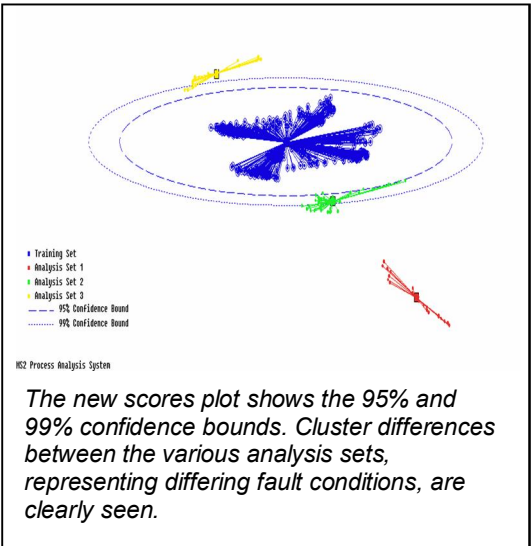
Additional screening rules are included, such as a logarithmic transform, and the ability to exclude specific batches based on selection of their trend profiles or other attributes.

New statistical functions are provided, such as skewness and kurtosis (measures of how a data set compares to a normal distribution curve) and many others.

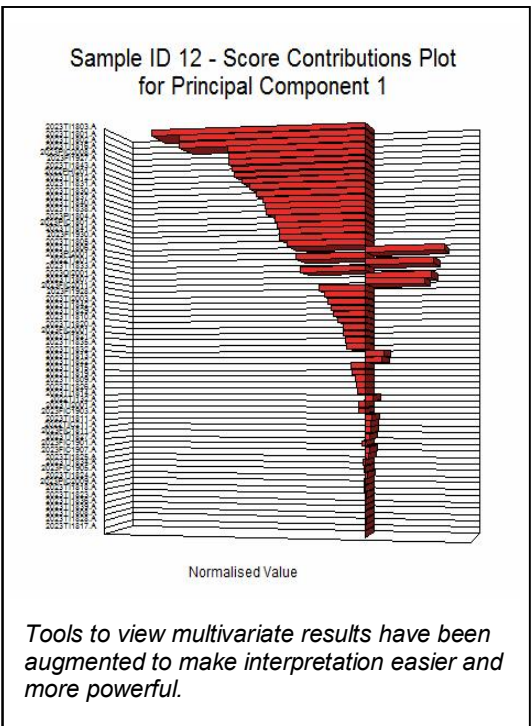
Additional trend graphs are now provided, showing multiple variables plotted in parallel, and with the option of showing the Manhattan change detection plot for each.



The new Parallel Coordinate Visualisation shows how the multiple analysis set variables (both uni- and multi-variate) exhibit different characteristics from the standard model.



The new scores plot shows the 95% and 99% confidence bounds. Cluster differences between the various analysis sets, representing differing fault conditions, are clearly seen.



Tools to view multivariate results have been augmented to make interpretation easier and more powerful.

CASE STUDY

Improving Quality at Sellafield using MS2 Process Analytics

Sellafield is one of the most complex and compact nuclear sites. Activities are centred around remediation, decommissioning and clean up of the historic legacy. The site is also home to the Thorp and Magnox reprocessing plants, the Sellafield MOX plant and a wide range of waste management and effluent treatment facilities. It is responsible for the operation of the Sellafield Site Contract, on behalf of the Nuclear Decommissioning Agency.

The nuclear industry has invested substantial amounts of money in new plants to treat and package waste from reprocessing operations. High-level waste (HLW) is waste that remains when



the uranium and plutonium have been reprocessed.

Sellafield Ltd has utilised process data analysis using MS2 software in the 3 vitrification lines that convert concentrate liquid waste arising from reprocessing operations into glass for safe interim storage prior to long term disposal.

AJM Consulting was initially selected to undertake a range of process investigations at the Sellafield site, using the advanced data mining and diagnostics facilities provided by its MS2 Process Diagnostics system. Following this successful activity, Sellafield Ltd purchased their own MS2 system and several senior staff were trained in its use by AJM Consulting. Further staff are now being given access to MS2, and additional consultancy by AJM is focussing on specific areas for further improvement.



'We approached AJM Consulting initially to evaluate the advantages of using multivariate process analysis.

Following a successful trial using the software we were able to demonstrate the business benefit through the knowledge gained. So far the software has provided enough information to support a justification to make changes within our process operations for acceptance of batch composition.

It has also made it easier to interrogate non-numerical databases and gain a better understanding in equipment performance and reliability.

Further work is ongoing to develop the use of multivariate techniques to support continuous improvement activities within the business.'

Dr Carl Steele, Sellafield Ltd

Competition - Name the new flagship!



With the imminent release of the new real time system, codenamed Project Hawk, and also the new top-of-the-range MS2 which will inherit some of the functions developed for Hawk, we need a name for the new level. Currently we have:

- Express (parallel coordinates only)
- Professional (adds principal component analysis)
- Premier (adds Manhattan and batch trend analysis).

The new system, in addition, will include all the functions described on page 3 (some will be included in other versions

but details of this are still not decided).

There is a bottle of Moët et Chandon champagne for the person who submits the best name (in our opinion!) for the new off-line flagship.

Just email Cathy with your idea (cathy.oswin@ajm.co.uk) by January 30, 2009. That's all you have to do! The winner will be announced in February 2009 and the prize will be presented at the User Group Meeting in May.

CASE STUDY

Advancing Process Knowledge at px Biodiesel using MS2 Process Diagnostics

Operations at the two Greenergy biodiesel production facilities at the port of Immingham on the East coast of England are handled by px Biodiesel Ltd. With a combined capacity of 200,000 tonnes/228 million litres a year, both biodiesel plants are located on a brown-field site at Immingham West Terminal which has existing sea, rail and road access as well as pipeline links to local petroleum oil refineries. Its sea-fed location enables effective logistics and trading with the UK and European vegetable oil and biodiesel markets as well as the wider world vegetable oil markets.

The plants are capable of using a variety of feedstocks including rapeseed, soy, palm and used cooking oils. A mix of different feedstocks is used to get the best balance of quality, price, carbon and environmental impact. Optimum



management of this highly complex and innovative process requires a deep understanding of the production variables. To assist in understanding how these interact to affect plant performance, the company has invested in the MS2 Process Diagnostics System from AJM Consulting.

Data sets acquired by the Wonderware control systems are analysed by MS2 using a unique combination of advanced diagnostic algorithms and visualisation techniques. The knowledge gained is used by the plant management and technologists to increase the yield and quality performance of the plants.

"We recognised during plant commissioning that there were substantial opportunities for performance improvement to be achieved by identifying the causes of subtle variability in this complex production process.

It was clearly a situation in which many variables interact, so we knew that we required a tool that could handle multivariate problems.

We initially assessed the MS2 system by applying it to a known issue and it proved that it could identify and visualise the cause.

We have now invested in the system and are using its powerful multivariate visualisation functions to further identify the opportunities to reduce variability, enabling us to optimise the profitability of the manufacturing operation."

Martin Milburn, px Biodiesel

MS2 Pilot Projects provide a low cost introduction to the many advantages of MS2 process diagnostics

Many companies know they could potentially gain real benefits by utilising the powerful variability cause analysis facilities which MS2 provides.

However, it may be difficult to justify investment unless the practicality of applying MS2 to their process can be confirmed.

For this reason we are offering a pilot project scheme. This addresses a problem of the client's choice and we build a model within MS2, ending

with a workshop session at which the conclusions are demonstrated and the client has an opportunity to query the model.

We then provide a restricted licence copy of MS2, including the study model, for the client's own use. This has all the analysis and visualisation functions of the full system except that no other data sets can be imported.

Should the client then wish, part of the cost of the pilot project can be offset against licence purchase. This



approach to starting to apply process diagnostics has proven to be very popular with clients.

Contact us for more information.

CASE STUDY

Performance improvement in Complex Chemical Processing at Ciba using MS2 Process Analysis



Ciba's Bradford site is one of the largest and most productive plants in the UK, with an output of over 250,000 tonnes of which 84% is exported. Together with its sister plant at Grimsby, it manufactures products used to enhance industrial processing in various industries such as papermaking, mining, oil extraction, wastewater treatment and textile processing.



These sites form part of the Ciba group, a leading global speciality chemicals company which is dedicated to producing high value effects for its customers' products.

Highly innovative, Ciba brings new and creative thought to the processes and products of its customers in more than 120 countries.

Innovative process technologies are utilised to produce the advanced products made at these sites.

To assist in improving understanding of the complexities involved, Ciba invested in the MS2 Process Diagnostics system and, with a team comprising in-house technologists augmented by specialists from AJM Consulting, has developed models which highlight causes of process variability.

"Our production processes at Bradford and Grimsby are world class and highly innovative. We constantly strive to improve performance of these multiple step processes and, a deep understanding of the chemistry and interactions of the individual stages is required.

We selected the MS2 Process Diagnostics system from to assist in this because of its visualisation tools and integrated analysis techniques within the system.

The ease of use of the MS2 system has been much appreciated by our highly qualified technical staff, who have been able to identify significant events that have been caused by subtle interactions further up stream. This has enhanced our understanding of our processes, enabling us to focus our improvement efforts on the critical areas in our plants.

We see this as a key tool to achieve the next level of performance in our journey to operational excellence."

John Barratt, Head for Process Innovation and Development

Organisational Membership

We place great emphasis on understanding the industries which we serve and are fortunate that several organisations exist to foster advancement and innovation in them. We are members of the organisations listed below.

If your company is a member of any of these and you are interested in using MS2, talk to us because discounts may be available.



CASE STUDY

Improving Efficiency at the National Industrial Biotechnology Facility using MS2 Process Diagnostics

The Centre for Process Innovation develops products, processes, services and businesses in the process and manufacturing sectors. Its unique portfolio of activities includes provision of services to the global business community in process innovation, consultancy and research. Substantial investments in innovative bio and chemical process technology have enabled an open access facility, available to commercial customers and research organisations alike.

The National Industrial Biotechnology Facility was launched by CPI in July 2007. It possesses state of the art process development facilities providing



a unique gene to kilo service for industrial biotechnologists. From development laboratories to 1000 litre fermentors, it can produce trial quantities and scale-up, assisting its clients to develop proof of concept.

Development of knowledge is a key aspect of any process development and, at CPI's facility, the MS2 Process Diagnostics system developed by AJM Consulting will link to comprehensive control and data acquisition systems based on Emerson's DeltaV Distributed Control System.

The MS2 system's breadth of complex data analysis and visualisation tools will enable both the technologists at CPI and their clients to gain a far deeper understanding of highly innovative processes, helping to move towards full commercial realisation.

"This capability means the data produced and subsequently interrogated will deliver for the future creating systematic integrated developments for new manufacturing processes for new products by design."

"In simple terms CPI will produce new more efficient and robust processes at a lower cost."

Dr Chris Dowle , Director, Advanced Processes

"The use of the MS2 software is as an excellent addition to the tools and technologies employed in the National Industrial Biotechnology Facility."

"The software allows the Centre for Process Innovation (CPI) to deliver better and faster services to our clients."

Steve Donegan, Process Technology Manager

Consultancy

As more people hear about the opportunities for understanding their variability, and how this can be used to improve consistency of quality and yield, we are now being asked increasingly for consultancy.

Sometimes, companies simply want a specific problem solving, and do not

want to implement a permanent MS2 system. To meet this need, we now provide assistance to investigate the problem, using MS2. No licence purchase is required and, unlike a Pilot Project, a restricted licence copy is not provided. In this way, a problem can be solved at very low cost, sometimes in as little as a day or two.

This can be a particularly effective approach where the client can provide a process expert (who has the plant knowledge) to work alongside our process diagnostics expert (who has MS2 knowledge).

Contact us for details.

User Group Meeting

The 2009 User Group Meeting will be held at our Grimsby offices on May 8 2009. This will be an exciting and interesting day and we recommend that you confirm your attendance as soon as possible.

Version 5.1 will be released first at this meeting (copies will be distributed to all current maintenance contract

holders) and a tutorial will cover the new and upgraded features.

New for this meeting will be papers from users, describing how they have applied MS2 and what they have achieved. Dr Carl Steele of Sellafield Ltd has kindly agreed to present a paper, and several others are in the pipeline. If you would like to contribute, you will be most welcome.

Please contact us for more details.

The event is free but must be booked in advance. There will be other opportunities to attend a V5.1 tutorial but these will be chargeable, so we suggest that you come along to this event which is free!

FREQUENTLY ASKED QUESTIONS

What are the different functionality levels of MS2?

With the imminent release of the real time Project Hawk system, there will be four levels of functionality provided as standard within MS2:

- **Express Edition** provides data import and screening functions, together with univariate data analysis using parallel coordinate visualization
- **Professional Edition** also includes multi-variate functions including Principal Component Analysis
- **Premier Edition** also includes Multiway PCA batch trend analysis and Manhattan significant change detection.
- **Ultimate** (we haven't decided on a final name yet—see the competition details on page 4) includes the real time functionality developed in Project Hawk.

What are the top 10 business benefits of using MS2 Datamining?

- Early warning of deviations from normal production
- Greater understanding of complex processes
- Enables rapid analysis of performance parameters including operators, shifts, plant items and more

- Easy to use environment
- Provides integrated rule-based data screening for speed and consistency of data preparation
- Integrated univariate and multivariate techniques to address a wide variety of process problems
- Designed with chemical engineers and process technologists in mind, not statisticians
- Low investment cost in terms of money and time
- Real time and historic data collection direct from primary sources into MS2
- Handles both numeric and non-numeric data

Who are the most usual users of MS2?

Companies which purchase MS2 and its associated consultancy activities are, in the main, within the process manufacturing sectors, such as chemicals, nuclear, oil, pharmaceuticals and advanced materials. We are also seeing increasing interest from food processors.

Within those companies, many users are either responsible for process investigation, for quality initiatives such as Six Sigma, or for performance initiatives such as lean manufacture.

MS2 TRAINING

The training courses we provide for MS2 users have proved very popular indeed throughout the year; every one has been fully booked. Delegates are limited to 5 per course and are very "hands on", with a PC provided for each person.

All the basic functions of MS2 are covered, and at the end of the course delegates should be able to import and screen a data set, create a process analysis model, and analyse it using the tools provided within the MS2 system.

A very comprehensive tutorial guide is

provided, together with copies of all the tutorials used during the course.

A full schedule of courses is planned throughout 2009; these will be announced on our website; <http://training.ajm.co.uk/>

Because of the ever-increasing complexity of MS2 and feedback from previous delegates, for the first time, we will be offering an advanced course in addition to the basic course. Contact us for more information.

AJM Consulting

*Transforming Data
Into Knowledge*



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