

OPPORTUNITIES IN APS – A BROADER VIEW

Günther Kruse, FIOM, Scope Management

CHANGING BUSINESS NEEDS

Every business is concerned with the need to remain competitive against increasing local, national and international competition. To be smarter means using available business tools and techniques effectively and innovatively to meet business objectives. There are many mathematical approaches in business theory around at the moment. Many have been applied in certain circumstances; others have not left the laboratory or the business literature.

In product design it is normal to use advanced scientific methods and complex modelling tools to develop safe products of optimal performance. In manufacturing we seem to be content to remain as amateurs with pencil, paper and O-Level maths. Slowly, as we are all getting more computer literate, that is beginning to change and we are starting to realise that mathematics can make as big an impact on business process management as it has on product design in the past.

APS: A NEW WAY OF WORKING WITH ROOTS IN OR

Over the last few years we have seen the emergence of APS (Advanced Planning and Scheduling) as a management tool which is now used increasingly by companies in many industry sectors. APS finds its roots in Operations Research (OR). OR has been used for many years in sophisticated industries where mathematical techniques were required to model business situations, either because that was the only way to do the work or the payback was so great that there was obvious benefit in using OR specialists as part of the business team. OR departments in airlines, steel mills and some automotive companies used computers to develop solutions to complex problems. They did, however, tend to be somewhat separate from the rest of the company – they were the boffins who would solve a problem and then go away. In some instances they would develop and install programmes which non-mathematical staff members would subsequently use as an operational tool but that was relatively rare.

Computers, of course, made OR what it is today. There is nothing new about mathematical models but only computers offered the computing power to be able to solve problems of realistic complexity to model real life business situations. Standard techniques such as linear programming and various scheduling algorithms have been around for a long time, of course.

As the power of computers increased it became increasingly feasible to build more complex models which more realistically mirrored real life and which could be run within affordable run times and computer costs. There is no doubt that computer cost and power were the main constraints to the use of OR in day-to-day business in the past. Now computer power is cheap and many things can be done which only a very few years ago were absolutely impossible – and that is getting better all the time. Clearly at the current rate of progress we can see that soon IT will not be a constraint on virtually OR modelling problem in business.

APS is now a household name in most companies. There have been a number of articles in *Control* and other magazines so that there should be no need to go into definitions of APS anymore. It should be remembered, however, that APS is essentially a software tool which is implemented in the business user environment. It takes data such as bills of materials, routing, capacity, stock and WIP together with

demands to generate one plan which considers many constraints. The APS model generates manufacturing and purchase orders to meet the plan, very much the way MRP does, but taking account of many constraints to produce a realistic, achievable plan with a high degree of optimisation logic. The software develops a plan which considers a wide range of constraints to balance conflicts and presents its 'optimum' plan to the planner for consideration.

The APS tool is used as an operational IT tool, based on OR principles and mathematics. In modern APS packages there is invariably a planner screen to help planners to make model changes to resolve constraints or modify production parameters and priorities to resolve those conflicts so that planners can use APS as a day-to-day operational planning and plan execution tool in their business environment. It is no longer a boffin's toy – it is a planner's and manager's tool, even though it has embedded within it complex mathematics from the OR textbook.

APS ACCEPTANCE IS NOT ALWAYS EASY

APS packages have had a major impact on businesses. For the first time ever companies have been able to get the benefits of complex OR work in the form of a simple software package, ready for users to use. There are still a few barriers to overcome. In general in the UK companies distrust mathematics. We have been brought up with the attitude that mathematics cannot adequately model the shop floor and that we must always be able to trace back what the computer has done so that we, as users, can override it if it has patently created unrealistic plans. We intuitively distrust 'black boxes' in our planning programmes.

Within MRPII, transparency was always a key issue and any user with a small amount of training could trace back through MRP reports to satisfy him or herself that the MRP logic was right. To a degree that was reasonable since, in the days of shoddy discipline and poor data accuracy there were always nasty surprises, and tracing the source of the surprise was important. With APS there is a worry that it will be much more difficult to trace back what the computer has done. To a degree that is true: a user will not readily be able to work out what optimisation algorithm has been used and why the work has been planned and scheduled the way it has. Most APS packages do, however, provide excellent pegging links through the data structure to make it easy to track the relationships and trace likely sources of error if there is a strange plan.

More serious is the accusation that APS models are too simplistic. For a long time that might have been true. These days computers allow the running of very complex models with many constraints and rules so that there should be little reason to dismiss APS as too simplistic. APS models can manage a lot of data and generate realistic plans, generally close to optimum. APS these days will invariably produce better plans than a planner. The computing power also makes for short run times and interactive use by planners.

A typical APS model might run for a few minutes. The planner can quickly get results, review the outcome and make amendments to parameters to resolve issues. For example, factor in overtime or transfer work to outside suppliers (though both of these would normally already have been included in the model as planning constraints). The fact that changes can be made all the time and the model rerun frequently makes APS into a truly interactive planning tool.

IS A PACKAGE APPROACH THE BEST WAY TO APPLY APS?

So, to summarise, OR has been used for many years to provide problem solutions where computers provided the platform for the development and solution of real operational models. Today IT power is such that we can use OR as an operational working tool and that has led to a tremendous enthusiasm for APS over the last few years. Much of the credit is given to the 'big' players in APS, the pioneers such as Numerics (JD Edwards), i2 Technologies and Manugistics and now the ERP giants such as SAP and Oracle. In parallel there have been increasing applications of OR techniques, the same techniques used within APS packages, to deliver 'point solutions' to specific problems. That is much more the traditional OR approach: the boffins use appropriate IT tools to develop bespoke solutions to specific business problems and deliver them to planners. Typical examples are:

- Blending and mixing of materials, for example in a steel mill where different materials and scrap need to be mixed optimally to minimise cost and maximise product availability
- Optimal blending of food ingredients where different batches have different characteristics and potency
- Scheduling of machinery with complex constraints, such as steel mills, process plant and automotive assembly plants
- Scheduling trucks for loading and unloading ships in ports
- Allocation of landing slots at airports
- Development of optimal shift patterns in hospitals and factories
- Allocation of inventories to balance profit with customer service
- Generation of optimal transport routes, taking account of legal constraints, driver and truck availability and customer requirements
- Generation of logistics supply networks
- Optimisation of tax payments across international boundaries.

There are many further examples which can be described. Many of them are complex or even impossible to manage without OR-enabled APS. Many can be dealt with by standard APS packages. Others are so special that packages cannot deal with them. In other cases the use of an APS package may be too expensive a solution in any case and building a model in-house may be a much better solution. We can generally these days distinguish between three levels of APS application:

- Package-based factory planning and scheduling providing operational systems in day-to-day work
- Point solutions, where APS software modules are used to develop bespoke models
- Fully blown APS implementations for the integrated management of a company's supply chain, probably using APS packages from i2 Technologies, SAP or another tier 1 supplier.

It is worth dwelling on the point solution option since these have had little exposure in the press in the past. Many of the ASP package vendors use proprietary software components from specialist firms to build their APS products. These software components are available to industrial companies to build their own APS point solutions. Leading vendors, in particular Ilog Limited, which ranks i2, Manugistics, JD Edwards and SAP amongst its clients, will provide the intelligent components as well as the systems infrastructure tools, including graphical user interfaces (GUI) and reporting tools, so that complex, user friendly APS systems can be generated with reasonably low IT effort.

The approach seems almost like a retrograde step – back to the days when many unenlightened companies would prefer to write their own software rather than implement a standard package. The analogy is a bad one though: the software is developed by specialist vendors, similar to package suppliers, and the customer assembles the components and develops the model, using standard software. It is not like starting with COBOL or C++ and building software from scratch. There is also, as most people now appreciate, a significant effort involved in implementing a complex software package whilst the point solution approach avoids much of that work.

In practice it is usually a simple question of 'horses for courses'. Where the business is happy with its IT infrastructure and requires a point solution to a particular problem, then a point solution should be used. If the business wants to redesign its supply chain management processes around APS principles, then a package is likely to be the right approach.

The other criterion is one of functionality. Some point solutions are well catered for by best-of-breed package solutions. Finite scheduling is a typical example – it is unlikely that anyone would build a factory scheduling package from scratch, using generic OR software components. But even there a company might just have a special situation which makes it difficult for standard packages to meet the required functionality. If that is the case and if there really is no package on the market with the required functionality there might just be a case to start from scratch.

CONFIDENCE IN THE RETURN IN INVESTMENT (ROI)

Systems investments are triggered by the need to improve business performance and the key reasons are, of course:

- Cost reduction
- Customer service improvement, including flexibility and lead time reduction
- Quality improvement, in the context of APS, delivery performance improvement.

In every case APS should be implemented in response to business pressures. We are currently at a similar stage as the early MRPII implementers: we know we need to invest and it will be very beneficial to the business. Unfortunately most potential investors don't know enough about APS to be able to take a considered view of the costs, benefits and implementation issues to make a balanced decision. The software sales person promises the earth and the consultant often is not much better. In general there is no doubt that there is currently a role for the consultant since he/she can deliver the knowledge which the business needs to have to make the right investment decision. I would like to describe one approach which has been tested in practice and which should give companies the knowledge and comfort to make the correct decision. We call that 'delivering proof-of-concept' and use a Process Optimisation Survey (POS) which has, as its objective, the delivery of the proof of concept and the business case.

APS investment is still seen by many as a leap into the unknown and we had to have a simple mechanism to bring realism to the business case. The result of our deliberations was the POS which, in a simple and relatively inexpensive study should bring together answers to four key questions:

- How will APS work in our business?
- How much will it cost and save?
- How will it affect our processes, people and procedures?
- Can we demonstrate that it will work?

Those four aspects are at the heart of the POS which provides an assessment of the business opportunity and develops conceptual solutions and proof of principle very quickly by

using prototype software - in our case OPLStudio from Ilog (see figure) - to develop a prototype model of the problem and its solution. The technical work demonstrates the ease of development and use of the prototype. In parallel there is a business process analysis which assesses a realistic cost/benefit profile of the opportunity and delivers to the client a Board proposal to proceed. The objectives of the POS are:

- To understand and articulate the operational problems and issues under consideration
- To develop an operational modelling solution and to quantify its impact on the business (cost/benefit analysis)
- To clearly define a target result
- To map high level 'to-be' processes
- To demonstrate proof-of-concept with an OPLStudio software model
- To create an outline implementation plan:
 - Define implementation phases
 - Identify IT resources required - hardware & software
 - Identify time scales and resource requirements.

Even though we use OPLStudio for this work this does not in any way prejudice the technical solution – it merely provides the proof of concept. In very simple cases OPLStudio might be the platform on which the APS product is developed but usually it will be either an APS package or a semi-bespoke solution utilising APS software components.

PROCESS OPTIMISATION: THE FUTURE

There is no doubt that APS will be a key IT application area for the future. As computers get more powerful and cheaper we will see a wider range of APS applications in more diverse

areas and greater modelling speed. Models will get to be more realistic and detailed. Currently the technical barriers to APS are still high and already we are seeing a lot of work being done to take the apparent complexity out of APS software products. That will lead to greater ease of constructing models and more realistic models with greater capability.

I have no doubt that in future APS will be a part of good operations management and soon we will just use it and not think very much about it.

Whilst with a product like Ilog's OPLStudio there is already a relatively simple modelling tool for proof-of-concept work, I am sure that this approach will be taken further to make such a tool very easy to use and powerful for the construction of realistic working business models by non-mathematical planners with little formal APS modelling training – perhaps more like using a general application like Excel or Access. Quite some time and work is required though, I suspect, until we get that degree of intuitive model building and capability.

If you want to know more, why not come along to the seminar. **'APS: From Myth to Reality' on Thursday, 28th September** – full programme is available from the Institute.

About the author

Dr. Günther Kruse, FIOM is Vice Chairman of The Institute of Operations Management and Director of Scope Management Limited, the change management and business performance improvement consultancy firm. Until recently he was the Director, Manufacturing Strategy for KPMG, South Eastern Region in the UK. Following his early career in manufacturing he has held senior consultancy appointments at ICL, Hoskyns Group and PA Consulting Group. Latterly he was Director of Group Manufacturing and subsequently Managing Director, Germany for London International Group plc.

