THE ECONOMICS OF MRPII

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The use of computers for Material Control and Production Control has led to the development of Material Requirements Planning (MRP) and Manufacturing Resource Planning (MRPII) systems. Because MRPII is often considered to be an extension of MRP, and the management techniques used for selection and evaluation are similar for both systems, MRP and MRPII will be referred to as MRPII for convenience of discussion.

Surveys of companies show that MRPII is one of the most common AMT investments but, although MRPII involves considerable initial expenditure and high on-going running costs, most companies have regarded its introduction as "inevitable", rather than as an investment which has to be evaluated. This attitude has been encouraged by a belief that computer systems, such as MRPII, are somehow different to machine tools and can not be evaluated in the same way. This attitude to MRPII can have serious consequences, such as:

- Withdrawal of management support if the benefits which result from the use of MRPII can not be attributed to the system.
- MRPII can require major expenditure before any returns are forthcoming, but the lack of quantified objectives prevents progress being monitored in terms which are understandable to top management, such as costs, benefits and return on investment.
- Without financial objectives, the type of system selected, and the time scale for implementation, is decided by subjective means. The problem is normally compounded by a lack of MRPII experience in the company.
- Introducing MRPII represents a long-term commitment, with the implementation normally extended over several years; without detailed financial objectives any disruption caused by failures elsewhere in the company may be blamed on MRPII.
- In the absence of a financial justification, with the decision to invest often being made by a 'project champion' who is convinced it is essential, MRPII becomes vulnerable to management changes or priority reappraisals.
- Introducing MRPII may be championed because it is the 'fashionable' thing to do, as a result there is a danger that, if the financial advantages have not been calculated, it will be abandoned if 'fashion' changes, as has occurred with techniques such as Group Technology.
- Companies which could achieve substantial benefits from MRPII may fail to introduce it because of the high costs involved and the inability to show that it will be profitable.

Any company considering MRPII is faced with a number of decisions, the first is whether to invest in MRPII, or to concentrate financial and management resources on improving other aspects of the company's operation. Assuming that MRPII is identified as the required area of investment, the next decision is to define the level of sophistication needed.

Managers trying to select the most appropriate system may be very knowledgeable about Material Control and Production Control, but have little or no previous experience of computers and computerised MRPII. At the same time they may be faced with a choice of over 100 systems, with the suppliers of each being able to produce arguments as to why their own system is the most suitable.

When installing a new CNC machine tool, it is often possible to influence the initial cash flows by selecting those components which will provide the greatest savings as the first to be programmed. With MRPII, the scope for influencing the initial profitability can be much greater, partly because of the much longer implementation period, and partly because of the ability to change the sequence in which the various elements of many MRPII packages can be installed.

COSTS AND BENEFITS OF MRPII

The main ways that a company is affected by MRPII are:

- Reduced paperwork and lower clerical costs.
- Reduced disruption of production.
- Controlled stock levels.
- Shorter and more reliable product delivery times.
- Increased ability to supply customers with the required product specification.

The first three areas are those considered when MRPII is viewed as a way of improving manufacturing productivity, and contain the direct savings which managers are normally able to quantify. However, it is the last two areas which contain the major financial benefits and these represent the effect which manufacturing can have on the total company.

Just as important as quantifying benefits is the need to quantify both initial and running costs. Companies that have no previous experience of MRPII may be unaware of the major long term commitment being made with an investment whose running costs over the system life are likely to be considerably greater in total than the initial cost.

The following checklists have been compiled to help managers identify potential areas of costs and savings; it is not claimed that they are fully comprehensive, but they are designed to help identify the main areas to be included in an evaluation.

COSTS

Installation and Start-up Costs

- Computer hardware.
- Computer installation, including building alterations.
- Software purchase.
- Internal costs for customising purchased software.
- External costs for customising purchased software.
- Writing software in-house.
- Consultancy costs to assist with both system selection and implementation.
- Project team costs for selection of system.
- Company-wide education of personnel, such as senior managers, who need to understand the system.
- Education and training of people who will directly operate the system.
- Cost of temporary staff to input data or to run duplicate system.
- Overtime or shift premium for existing staff to input data or run duplicate system.
- Cost of temporary staff for checking and reconciling stock levels.
- Overtime or shift premium for existing staff to check and reconcile stock levels.
- Cost of disrupted production during implementation, including lost sales.
- Cost of sub-contract or overtime to avoid lost production during implementation.
- Redundancy costs.

The costs of a feasibility study should not include any expenditure which would still be incurred if the decision can be made not to proceed, thus the only costs included are those which will arise after a decision has been made to invest. Two categories of education are included to emphasise that it is not just the people who will directly operate the system that need training, managers in other disciplines (eg. sales and design) need to understand what MRPII does and how it can help their departments.

There is not a rigid division between initial costs and running costs, for example, a company may introduce MRPII in a number of discrete stages or modules, with the installation costs being spread over several years and the annual running costs increasing in line with the expansion of the system.

Running Costs

- Hire or lease of hardware and/or software.
- Maintenance contract for hardware and software.
- Insurance.
- Operating costs, eg. electricity.
- Consumables, eg. special stationary.
- Hardware expansion.
- Software updates.
- System management.
- Computer support staff.
- On-going education and training, such as for new personnel.
- Additional clerical personnel for data entry.
- Additional works personnel, such as for perpetual inventory checking.
- Staff up-grading.
- System back-up facilities.
- Premiums for regular overtime or shift working by computer staff.
- Concentrating on implementing MRPII may prevent other planned improvements being undertaken.

Most authors emphasise the labour savings which can be achieved with MRPII, but MRPII involves high levels of data entry, controls such as perpetual inventory checking are needed, and computer support staff may be required. Therefore, as well as identifying savings, it is equally important to identify departments where extra staff may be needed to operate the system.

BENEFITS

When evaluating MRPII, care must be taken to include all potential costs and benefits, while at the same time avoiding any duplication. Several factors can lead to savings of the same type, for example, both improved product specification and improved delivery performance may result in increased sales. At the same time, a single factor can lead to several types of savings, for example, shorter lead times may both reduce inventory and increase sales. To try and avoid duplication, the list of benefits has been divided up into the type of saving, rather than by the cause.

Labour Savings

- Clerical labour (from reducing paperwork systems).
- Indirect production labour (from reduced progress chasing, work moving etc.).
- Stores labour (reduced kitting).
- Inventory control labour (reduced need to reconcile stock levels).
- Direct production labour (fewer set-ups of split batches and improved productivity.
- Direct support labour (eg. inspectors and supervision).
- Reduced overtime payments.
- Lower recruitment and training costs (from lower personnel numbers).

Some improvements will not directly reduce labour; for example, while supervisors should spend less time progress chasing, the number of supervisors may not be reduced, rather, they will spend more time improving the efficiency of their departments. The saving therefore is not reduced labour, but improved productivity.

Stock Reduction

Various factors within a company can contribute to an overall reduction in stock levels:

- Manufacturing WIP (as a result of shorter lead times).
- Assembly WIP (reduced delays from avoiding unplanned shortages).
- Raw materials (improved ordering policy and supplier progressing).
- Finished components (resulting from shorter lead times and improved ordering).
- Unwanted stock (avoid ordering duplicate or unnecessary parts).
- Bought out components (orders placed to bring in parts as required).
- Obsolete stock (identified for disposal).
- Spares stock (achieved through improved spares requirements planning).
- Scrap material (scrap improvements from a range of separate areas).
- Lost stock (improved systems prevent components being either 'lost' or wrongly re-ordered).
- Finished product stock (reduced need to build for stock).
- Component and material standardisation (increased ability of designers to reduce variety of raw material and components held in stock).

Direct Savings

- Machine running costs (associated with reduction in direct labour).
- Increased capacity reduces need for regular sub-contract.
- Reduced load fluctuations reduces need for short term sub-contract to meet delivery dates.
- Capacity created to take on sub-contract work.
- Sub-contract work taken on (ability created to control such work).
- Lower capital expenditure (improved utilisation of machines).
- Reduced stores and production facilities (eg. fewer lift trucks).
- Reduced floor area (cash flow savings only).
- Reduced scrap and re-work caused by making parts to obsolete specifications.
- Reduced scrap from making unwanted components.
- Reduced scrap and re-work associated with having fewer split batches and 'panic' jobs.
- Reduced cost of late dispatch (eg. air freight and express delivery).
- Reduced payment on penalty orders.
- Reduced warranty and service costs by dispatching correct specification.

- Products made to customer specification rather than a universal design which has unnecessary features.
- More accurate parts lists avoid dispatching unnecessary components.
- Reduced production costs from component standardisation.
- Avoidance of planned expenditure needed to maintain existing systems.
- Reduced cost of annual stock check.

Purchasing Savings

- Bulk orders with call-off can be established.
- Forward planning of purchase requirements can avoid premium payments for quick delivery.
- Orders can be geared to quantity/price optimisation.
- Staff can concentrate efforts on competitive buying, vendor appraisal etc.

Cost Management

- Better cash flow management, achieved by controlling stocks and deliveries, reduces bank overdraft costs.
- More accurate quotations reduces unprofitable orders.
- Feedback control relates production costs to sales estimates.
- Improved variance analysis enables corrective action to be taken.
- Reduced internal and external cost of annual audit.

Sales Improvement

(Either increasing sales or preventing loss of potential sales).

- From shorter deliveries.
- From more reliable deliveries.
- From lower costs (ability to offer a cheaper customised product)
- Increased ability to match product specification to customer's requirements.
- From an improved reputation for quality (fewer incorrect or missing parts).
- Increased sales of spares, achieved by improved delivery and stocking policy.
- From more frequent introduction of new product designs and design changes.
- Higher initial sales, achieved by earlier launch of new products.
- Increased market penetration over product life due to earlier launch.

A DCF evaluation considers cash flow changes over a project's life, therefore an estimate is needed of this 'Life'. While it may be assumed that MRPII will be a permanent company feature, with periodic replacements of computer hardware, it should be remembered that MRPII itself may be replacing a 'first generation' computer system installed ten to fifteen years ago for stock control and costing. In the same way, MRPII may in turn be replaced in another ten or fifteen years by some advanced integrated system which directly links design with machine operation. Fortunately, variations in project life beyond ten years have very little effect on the DCF return, so that little error is introduced into the evaluation by assuming a ten year project life.

Investment appraisal has got to be used as an integral part of the process of producing the technical specification and comparing vendors, as well as helping to establish the objectives and timetable for introduction. Many of the problems faced by companies when installing MRPII in the past may be a result of their not having established clearly defined, quantified and measurable objectives and timetable for implementation.

The ability to carry out a financial evaluation, which includes all the factors identified as relevant, prior to the introduction of MRPII has important implications for a company considering such a system, namely:

- The financial analysis enables management to view MRPII in understandable terms and can show that it will be a very profitable investment, thereby increasing management support and ensuring allocation of adequate resources.
- Quantified and measurable objectives can be set which enables progress to be monitored and, when necessary, corrective action can be taken.
- A system can be selected which allows the major potential benefits to be obtained.
- Implementation can be planned to ensure that the g[redacted]est financial benefits are achieved at the earliest date.
- Because the benefits of MRPII are company-wide, the evaluation must involve managers from non-production departments, thus leading to a much wider understanding of the system.

Because of the complexity of MRPII, and the long time span of its introduction, carrying out periodic re-evaluations during implementation as experience is gained of MRPII operation can help to identify any factors which were not foreseen during the initial selection and evaluation. In addition, because it may take several years to install a complete system, the needs of the company's market place may well change during that period so that the original priorities will need to be revised.

One of the most expensive things that a company can do is to invest in a MRPII system and start to implement it, only to find that, as they gain experience, there are major benefits which their system is incapable of achieving.

About the Author

Dr. Peter Primrose has spent 30 years in engineering, working for companies whose products included Diesel Engines, Gas Turbines, Textile Machinery and Chemical Plants. He has worked in Industrial Engineering and Works Management and his jobs have included Production Manager and Manufacturing Manager.

In 1983 he joined the Total Technology Department at UMIST to research into the economics of Advanced Manufacturing Technology. He has written over 80 papers and articles on this subject and was responsible for the development of the computer programme IVAN for investment appraisal, which is now widely used in industry.