REFLECTIONS ON PRODUCTION, PLANNING AND CONTROL (PPC)

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Abstract: The paper examines the current state of Production Planning and Control (PPC), identifies some technical and systems changes that have occurred over recent years and links these with the requirements being placed on companies by the market. PPC is being asked to respond effectively to these internal and external changes by being more dynamic and providing better control of resources and delivery performance. Some of the requirements to be satisfied by the new PPC systems are identified. To meet these requirements it is suggested that better understanding is required of how different factors affect PPC systems performance and that administrative systems need improving. The quantitative, administrative and behavioural aspects of PPC are discussed. A framework for developing an agenda for action and research is provided.

I. INTRODUCTION

Many technical and systems changes have occurred in manufacturing industry over recent years. The requirements being placed on companies by the market are also changing. Production Planning and Control (PPC) is being asked to respond effectively to these internal and external changes by providing a faster response and better control of resources and delivery performance.

The paper examines the current state of PPC. The discussion then reviews recent developments in the market, manufacturing and manufacturing systems and relates these changes to our understanding of production planning and control. The description brings together many threads associated with PPC and identifies some areas where there are deficiencies in our understanding. Some thoughts are then presented on how PPC systems need to respond to the changing technology, changing market needs and individual customer’s expectations.

All papers are personal in the sense that they reflect the interests and priorities of the authors. However personal opinions have deliberately been given greater weight in this paper than is conventional. Indeed, several sections of the paper contain ideas that have been partially tested but not fully evaluated. In that category are the personal classification and organisation of PPC described in section 4, the concurrent engineering views and figures in section 7, the framework for production management in section 8.1 and the tabular representation of actions in section 9. How the tabular representation leads to a possible research agenda also needs further evaluation.

The paper uses some general principles which, although not proven, have been reinforced over the years by personal experience and research investigations. Hopefully these principles will also be useful to you. They include:

- theory, simulation and practice should complement each other;
- systems integration is important;
- system commonality and structures are a useful basis for transferring experience;
- people are an integral and essential part of systems;
- automatic provision of data can greatly assist system maintenance;
- information is important;
- provision of PPC systems or information systems should be based on a proper economic assessment.

II. WHAT IS PPC?

Companies wish to satisfy market demands expressed in terms of real or forecast demand. To do this companies in general produce a Master Production Schedule (MPS) that states the number of each product to be made over some planning horizon and a Sales Programme that states the number of each product to be sold. The PPC function and its associated systems aim to plan and control production so that a company meets the production requirements as effectively as possible. PPC systems are hierarchical. A hierarchical planning process is used for PPC to help a manager understand and control the operations for which he is responsible. A high-level plan sets the context within which the next lower level plans
operate. The different levels in the hierarchy operate on different time scales. Typically, aggregate planning is associated with long planning horizons and detailed planning is associated with short planning horizons. A common operational starting point for planning production is the Master Production Schedule from which the requirements of materials, parts, machines and labour are derived. Modifications may be made to the plans if the derived requirements are thought to be inappropriate. The consequences of the chosen plans, usually expressed as a list of requirements of made-in and bought-out parts, become the basis of the work schedules placed on individual men and machines and orders placed on suppliers.

The prime objective of production planning and control is to ensure that parts and products are produced so as to achieve the Master Production Schedule (MPS) in a way that is consistent with meeting the company’s other performance measures. The MPS states the number of each product to be produced period by period over some time into the future known as the planning horizon. The MPS, in conjunction with the sales programme, is the company’s planned response to the demands of the market. In particular, the MPS, company production and inventory policies and knowledge of inventory levels, are used to determine the number of items to produce, the planned inventories of raw material, work-in-progress, finished parts and finished products and the manufacturing resource requirements such as machines and labour. Plans should be realistic and avoid asking for the impossible.

III. Consequential Production Planning and Control Needs

Production planning and control technology needs to change from a craft process into a properly engineered process where the consequences of changing system parameters are clearly understood. When change was relatively slow, experience was a reasonable basis for action. However, in times of rapid change, conceptual understanding becomes progressively more important and trial and error, which is the basis of experience, is too slow and risky. Better conceptual understanding and improved operational performance of PPC is particularly important because it drives much of the rest of the organisation.

Companies need to plan and co-ordinate all functional stages related to introducing a product from the initial product design, through production, distribution and sales and after sales service to scrapping and possible recycling. They also need to choose and create the associated systems that enable the stages to be planned, co-ordinated and controlled. There is a need to provide better responsiveness to the external changes discussed in Section 5 including competitors’ actions and changing market demand. This means that companies should be able to reduce or increase production levels without ceasing to be profitable, to change models to meet new perceived needs, to change systems without excessive consequential costs, etc. It is desirable to reduce lead times while maintaining or even improving service levels. This requires a better understanding of the consequences of choosing specific values of the parameters such as safety lead times, frequency of scheduling, effect of delays and inaccuracies of recording, etc. It probably needs the dedicated development of lean manufacturing methods (total quality, dedicated workforce, reliable and accurate machines, reduced set-ups and small batches). There is a need to develop better ways of evaluating investment in appropriate capacity.
Figure 1 is a structured representation that links product, process and manufacturing system design with 'system design'. Figure 2 is a more detailed representation of the process of determining the 'PPC system' part of 'system design'. Figure 3 represents the planning hierarchy of an MRP system, which is a possible output of the design process illustrated in Figures 1 and 2.

The requirements for this are essentially what is called good management. Behavioural effectiveness is closely linked with the administrative needs discussed in the next paragraph. The actions required include:

• Educating people so that they know why things are being done;
• Training people so that they feel ownership of the system and can operate the proposed new system with confidence;
• Involving people and changing things in a way that motivates;
• Doing the things that are required e.g. for
legislative reasons to meet Health and Safety requirements, employment law, etc. in addition to the actions needed to control production:

- Ensuring that the results are consistent with the needs and wishes of the people operating and affected by the PPC systems;
- Monitoring and modifying systems so that they are maintained and improved.

IV. Understanding and Administering Changes to PPC Systems – An Example

Multi-product, multi-level production is very common, yet current methods for planning and controlling multi-product, multi-level production are not satisfactory. The most commonly used system is MRP but, as indicated in Sections 3 and 7, MRP does not completely meet users' needs. The main needs include determining the MPS, overcoming the contradictions related to lead times and capacity, changing the MRP system representation from a static, deterministic representation to a dynamic representation, maintain highly accurate stock records, reschedule more easily, link MRP with design, link MRP with investment appraisal models, etc. The extensive needs, the ongoing difficulties and the importance of the appropriate planning, suggest that PPC of multi-product, multi-level production is suitable to illustrate how systems may respond to the kind of changes described in this paper. The rest of this section discusses how to use the ideas discussed earlier in the paper to improve performance.

Changing PPC systems takes time. There is therefore a choice whether to improve the PPC systems within the existing structure or whether to consider changing the structure. Whichever is chosen, it is useful to consider administrative, behavioural and quantitative actions that are needed to improve PPC performance. Administratively we want the system to work better. Preferably the administrative steps should include obvious simplifications, being consistent, improving the quality of data, etc, as discussed earlier. Behaviourally we want people to be involved and to operate the system better and this requires acceptance and ownership of the PPC system by the staff. The quantitative actions need to be based on sound theory.

For reasons of comprehension, a hierarchical approach to PPC is used. In MRP, the hierarchy is illustrated in Figure 3. The three steps are usually: producing the MPS, secondly the procedural breakdown into requirements of parts and materials and, thirdly, action plans interpreting the requirements into make (shop scheduling) and buy (purchase scheduling) decisions. Ideally one wants first to improve Master Production Scheduling, an area that currently is more of an art than a science. This can be achieved by choosing feasible solutions and then move some way towards optimised programmes. To make this more manageable these plans may be set into an aggregate long term planning context and the schedules may be split into plans for different shops, suppliers, etc. In the context of the framework shown in Figure 4 these are parallel actions in the disaggregation procedures. For discussion purposes improvements are considered within the context of the current system structure e.g. continuing to use MRP and maintaining the current levels of hierarchy which are assumed to be MPS, requirements planning and scheduling purchases and the shops.

The main improvements under the administrative, behavioural and quantitative action headings are summarised in Table.

<table>
<thead>
<tr>
<th>System</th>
<th>Administrative actions</th>
<th>Behavioural actions</th>
<th>Quantitative actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Improve MPS realism, using resource planning</td>
<td>Agree on make, order and financial control</td>
<td>Simulate proposed MPS</td>
</tr>
<tr>
<td>Data</td>
<td>Improve and maintain data e.g. product structures and stock records</td>
<td>Encourage ownership of data</td>
<td>Use new methods to derive data automatically</td>
</tr>
<tr>
<td>Planning</td>
<td>Formalise the planning steps</td>
<td>Training and team working</td>
<td>Improve resource requirements planning, work better with suppliers scheduling and other methods</td>
</tr>
<tr>
<td>Syst.</td>
<td>Improve shop scheduling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Control
Improve
feedback
Improve
rescheduling
Use local
visual
planning
load control
and combine
with best
features of
JIT

<table>
<thead>
<tr>
<th>Output</th>
<th>Plans etc.</th>
<th>Improve MIS and documentation</th>
</tr>
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Table – Summary of actions to improve PPC System.

V. CONCLUSIONS

Production planning and control is probably different in every company, yet the need to determine when and how many items should be produced is common to all. It is interesting to ask whether changes to manufacturing and information technology will, by speeding up manufacture and ensuring better data accuracy etc., eliminate the need for PPC in its present form. Alternatively should the emphasis of production control change to meet the challenges of the different technological and market context? The author’s opinion and the discussion in this paper have indicated that PPC systems need to change so that the emphasis of PPC will be on how to design and manage manufacturing operations for responsiveness, globalisation and supply chain issues. If so, the proposed research agenda should also reflect these new needs in addition to the problems that remain from current technology such as MRP as described in the previous section.

This paper has discussed the needs of PPC arising from changes occurring in the market and in technology. One of the needs is to obtain a better understanding of PPC. Some steps have been proposed that would help to achieve this better understanding. It has been suggested that it may be advantageous to consider PPC systems quantitatively. Yet, at the same time, it has been recognised that the behavioural and organisational effects of changes also need to be considered. There is a need to examine these problems in a generic way.

Despite the length of this paper there are still many unstated assumptions. The implicit model used to develop the needs of PPC is a hard systems approach that is nevertheless holistic in that it provides a clearly defined framework within which softer issues may be incorporated. The work has been set within the context of enterprise design tools and enterprise databases. Some of the proposals such as the structured analysis representation of the product introduction process clearly link product design and marketing issues to planning and manufacturing. Different design for manufacture proposals may also be evaluated within this hard systems framework and so this model may be used as a simulation to assist decision-making.

Success with the proposed research agenda would provide new methods that would enable the feasibility of plans to be more thoroughly checked with regard to resource availability and stability prior to their acceptance. Hence manufacturing and purchasing requirements are more likely to be achieved. System visibility should be improved so that appropriate remedial action can and will be taken by the users in response to over-loaded or under-loaded resources. One method for this has been outlined. The high visibility and better capacity planning will make it more likely that performance will match plans. Thus rescheduling arising because of limitations in the planning procedures will be required less frequently.

REFERENCES


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