

THE VALUE OF SYSTEMS THINKING IN OPERATIONS MANAGEMENT

A CASE STUDY

BY
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Thesis prepared in partial fulfilment of the requirements for the degree of MSc in
Operations Management.

I, the undersigned, hereby declare that the work contained in this thesis, is my own original
work, and has not previously in its entirety, on in part, been submitted at any university for a
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SUMMARY

This thesis demonstrates the differences between the traditional reductionist approach and the systemic approach to problem solving, and is based on a case study in the manufacturing field. It explains how each approach interprets real life problem situations differently, and emphasises the superiority of systemic approach.

The philosophical framework that is used in the thesis is developed in CHAPTER 1. The continuous and accelerating change in all areas of management is considered to be an important characteristic of our times. This ongoing change contributes considerably to the complexity of today's problems. Systems thinking is seen as an approach that can deal more effectively with this complexity.

The thesis is primarily concerned, with the application of systems thinking, as a problem solving approach in an operational environment. Different approaches to Operations Management are considered, and interpreted into a systemic approach.

The principles that are set in CHAPTER 1 are demonstrated in a case study. The background information about the case is given in CHAPTER 2. The way, the operating system has been managed in the past, the problems that have been encountered, the actions that have been taken to solve them and the results of these interventions are explained in this chapter.

The following four chapters, are about the phases of the learning process that I have gone through, while developing an understanding of the operating system which is introduced in CHAPTER 2.

The first phase is concerned with the materials coming into the system, processed by it and leaving the system as well as the physical lay-outs.

The second phase is about the production planning function of the operating system. Here, the current methods used in production planning, the weaknesses of these methods, and simple but effective ways of addressing these weaknesses are introduced.

In the third phase, the actual production capacity is studied in details and some figures are obtained about the available capacity. Historically, management made assumptions about capacity, since there was no available data. The results produced from this phase, highlighted the weakness of these assumptions.

In phase four, the insight developed of different parts of the operating system this far, is

integrated into a general understanding of the whole. This is achieved by the use of a systemic approach called System Dynamics (SD). SD did not only act as an integrating agent, but it has also provided a deep structural understanding of the operating system. The alternative ways of improving the actual situation have eventually emerged from this understanding. These alternatives were tested on the computer model that was developed in this phase.

The last chapter, **Conclusion and Recommendations**, focuses on the outcome of the thesis and on the implications of this outcome for the operating system. A systemic interpretation of the actual situation, which contrasts with the interpretation of the management, is presented in this chapter. Suggestions are made about the ways of implementing previous decisions. Systemic thinking is proposed as a useful management philosophy which is promoting the viability of the organisation in today's changing environment.

The thesis is also a description of the gradual shift of thinking that I have experienced. The learning phases that I have gone through, and the resulting change in my thinking are written in a story like format, to emphasize this aspect of it.

CHAPTER 1 : INTRODUCTION

This introduction is divided into four parts. The first part, *A Systems Framework for Managerial Decision Making and Problem Solving*, is mainly concerned with the nature of today's business problems and with different approaches for dealing with them. The effects of ongoing *change* on the nature of these problems, and the strengths of *systemic thinking* as problem identifying and problem solving approaches, are emphasized.

In the second part, *The Nature of Operations Management*, an overview of operations management is given. The perspectives of different authors and some recent operations management concepts like *MRP*, *JIT* and *Synchronized Manufacturing* are introduced.

The third part, *The Research Argument*, deals with the application of *systemic thinking* in an *operations management* context. Here, it is argued that, when a systemic approach is used together with the principles of operations management in manufacturing environment, it can overcome the weaknesses of the classical approach. It is also explained, why *System Dynamics* is chosen as the systems methodology to be used in the thesis.

Finally, the fourth part, *The Structure of The Thesis*, gives the main headings of the thesis and their contents.

1.1 A Systems Framework for Managerial Decision Making and Problem Solving

Continuous and accelerating *change* in all areas is one of the most important characteristics of today's World. To a large extent, the change is stimulated by the *information explosion* resulting from inventions and innovations which are increasing in number with a snowball effect. Inventions and innovations do not only add to the pool of knowledge of human race but they also make information flow much easier and faster than ever before (like global computer networks). On the other hand the availability of more information stimulates new inventions and discoveries. This vicious circle of invention/innovation and information acts as a generator supplying the necessary energy for more and more changes.

In fact the mechanism of change is more complicated than the model in FIGURE 1 and many more key elements are involved in it. For example more change create more needs, and to fulfil these needs become the target of new research and development projects that will lead to more inventions and innovations.

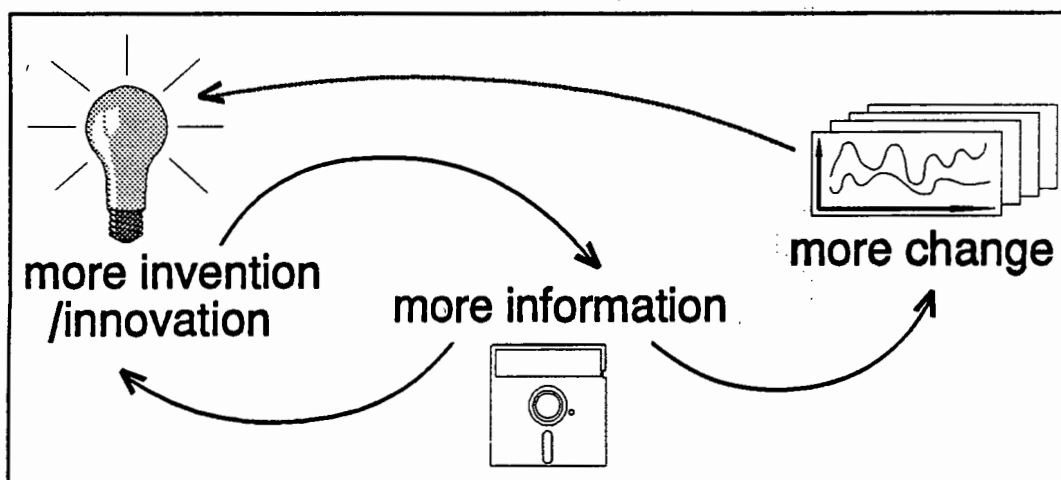


Figure 1

In his book *Systems One : An Introduction to Systems Thinking* Draper L. Kauffman, Jr. (1980, p21, p23) states :

Back in prehistoric times, knowledge accumulated very, very slowly. Then the pace began to pick up slowly until... it turned into a knowledge explosion. [...] The more knowledge you have, the better off your society is, and the more people it can support to spend their time looking for more knowledge. One figure that is widely quoted illustrates this very well: 90% of the scientists who have ever lived are alive and working today!

The abundance and the availability of information brings along the necessity for an information processing and management system. Without such a system, it is very difficult to capture, filter, classify and structure the information and to draw meaningful conclusions from it. *It is no good expecting computers to overcome this, because though they can manipulate very large numbers of components, manipulation is not the same as understanding* (Carter et al., 1984, p3).

Change will continue to happen and it will make the World a different place than it is today. To keep up with it, is becoming more and more difficult every day, as its pace goes beyond the individual adaptation capabilities of people. This is true for the business life as well as for our private lives. A typical example from the private life, is the struggle of some parents in understanding different world views and value systems adopted by their kids. This leads to a lack of communication between generations.

In the business environment, the effect of continuous change can be felt in different areas like technology, markets, industrial relations, etc... Managers are accepted to be problem solvers of this environment. Therefore the impact of the change on the nature of real life problem situations has a particular importance for them.

Most of today's business problems are not well defined. They are initially detected as a feeling of discomfort about a situation. To define them clearly is as difficult as to try to solve them.

It is also quite intricate to trace them as they have a dynamic and metamorphic nature which is mainly caused by the environmental change. We may be indifferent to the change, but our problems will not be. They will disappear and reappear with a totally different face and they will deceive us. We will not be able to detect the reoccurrence of the same chronic problem. We will think that we are facing a new one.

Today's business problems are generally multidimensional. They can effect simultaneously different aspects of the same business. Therefore it is almost impossible to crystallise these problems in order to experiment on them. Also, the idea of experimenting brings together the concept of *trial and error* and not many businesses can afford to learn about their problems by running real life experiments on their organisations.

Problem situations are usually observed in an environment which cannot be controlled by the observer. The outcome of the observation is a set of data about the variations of critical parameters. Parameters that are considered to be critical can vary from business to business. The focus of the observation can also effect this consideration.

The skill of the manager lies in his/her ability to interpret the data in an insightful way. This requires some level of experience, availability of relevant tools, updated background knowledge about the situation and, the most important, a *relevant approach* for a given situation. Once the problem has been defined, these prerequisites will be necessary this time, to implement the corrective action.

In his book, *The Fifth Discipline* Peter M. Senge (1990, p52) states :

There are multiple levels of explanation in any complex situation. In some sense all are equally true. But their usefulness is quite different.

The graphical representation of *multiple levels of explanation* is given in FIGURE 2.

If the approach of the manager trying to interpret a problematic situation, is purely symptomatic, i.e. if his/her focus is mainly on *events*, then this approach is described as a *reactive* one.

On this topic, Senge (1986, p133) makes the following comment in his article *Systems Principles for Leadership* :

Our normal tendency is to understand problems by isolating the symptoms and analyzing the system piece by piece. While providing short-term symptomatic relief, this

normal tendency generates little control over the longer term dynamics of an organizational system.

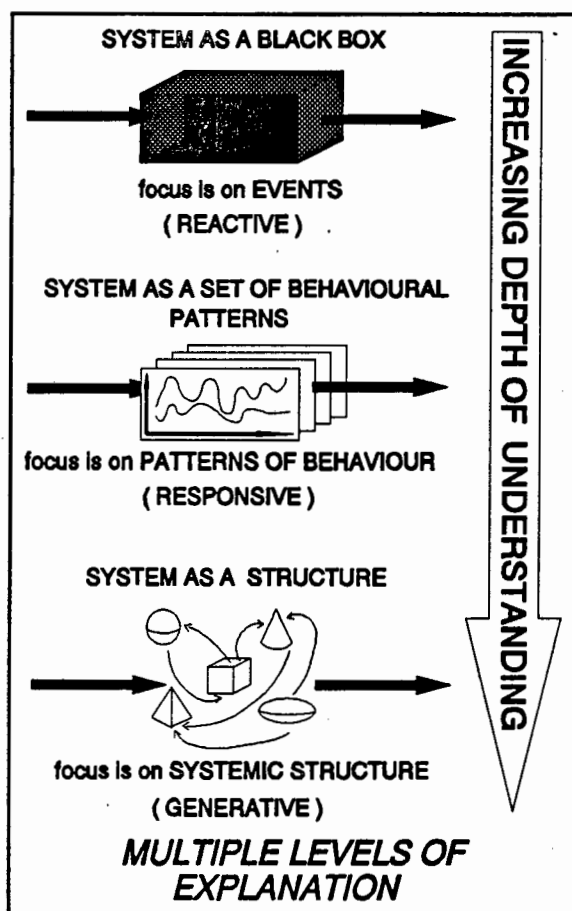


Figure 2

Dealing with problems in this way is quite natural for most of us who have been conditioned to use reductionist methods since the primary school. This kind of approaches usually miss the synergic nature of organisations. Organisations are more than a bunch of departments that are put together. To understand the parts does not necessarily bring an understanding of the whole.

Interpretations based on *behavioural patterns* can identify longer term trends. At the global level, they can give some guidelines about how to respond to shifting trends. As Senge (1990, p52) says, they begin to break the grip of short term reactivity. Although they cannot bring a specific explanation to a situation, they can give a better insight than event explanations. In fact interpretations based on *behavioural patterns* are quite cautious about running into conclusions. They report the pattern of behaviour of a variable observed over a period of time. But they do not relate this behaviour directly to a cause. In other words, they do not give a precise answer but they do not misguide the decision maker either.

About the third level of explanation which is focusing on the structure itself, Senge (1990,

p53) makes the following comment :

The structural explanation, is the least common and the most powerful one. It focuses on answering the question, "What causes the patterns of behaviour?" [...] Though rare, structural explanations, when they are clear and widely understood, have considerable impact.

The level of explanation used by managers while interpreting a real life problem situation is crucial for the long-term success of any corrective action. For example *event explanations* tend to establish a fairly direct and obvious causality relationships between the events and their assumed causes. Because of the simplistic image that they create, they give the impression that they can bring the fastest and the most effective relief. Therefore, they are a very attractive alternative for managers who are under the pressure of *doing something quickly about the problem situation*. [Unfortunately, most of the times, they only bring a short-term symptomatic relief. The problem that disappears after the intervention reappears sometime in the future at the same place or at some place else in the organisation.]

In complex systems, cause and effect are generally not closely related in time and space. As managers, we typically assume they are (Senge, 1986, p133). This misconception about causality can be very misleading. Approaches neglecting the complexity of the causal relations in organisations condemn their followers to waste their time and energy with low-leverage intervention points.

In an organisation which is experiencing a problematic situation, usually there is a small number of intervention points that can bring dramatic and enduring improvements. But unfortunately the complex causality structure hides these points from the eye of managers using traditional reductionist approaches. Therefore these points are called *non-obvious high-leverage points*.

In the same situation, a reactive approach that interprets the causality structure in a simplistic way, can highlight quickly a few *obvious low-leverage points*. An intervention directed to one of these points, which is normally easy to locate, will make the symptom disappear but it will not cure the problem. When the long term success of an intervention is considered, to focus on low-leverage points is a waste of time, energy and resources. It may also lead to intervention addiction.

According to Senge (1986), there are two situations that can aggravate the intervention addiction :

- *better before worse behaviour* giving the false idea that the intervention was the correct one,
- inability of identifying reoccurring problems which causes them to be treated as new ones.

Traditional approaches focus mainly on problematic behaviours, and try to find the causes in the external environment that cannot be controlled directly. They do not help much to develop a general understanding about the ways organisations are operating.

On the other hand, the *systemic approach* focuses on the organisation as a whole. It argues that, to develop a holistic understanding of an organisation will give us a deep insight about the nature of its problems. It also argues that, improvements that will be sustainable in the long term, will emerge from this understanding.

The following list summarises the basic contrasts between two approaches :

Traditional Approach

- * Reductionist
- * Focus on problematic behaviours (symptomatic)
- * Focus on obvious low-leverage points
- * Non-controllable external environment as the cause of the problematic behaviour
- * Intervention addiction

Systemic Approach

- * Holistic
- * Focus on systemic structure (structural)
- * Focus on non-obvious high-leverage points
- * The system itself as the cause of its problematic behaviour
- * Improvement sustainable in the long term

The essence of systems perspective is the notion that problems arise from the interactions of different parts of a system. The system itself causes its behaviour. This perception liberates the system of being the victim of its environment. It highlights the possibility of improving the systemic behaviour, even under very unfavourable environmental conditions. Systems perspective does this by focusing on the underlying structure of interconnected relations among different processes and elements, that gives each system its unique character.

1.2 The Nature of Operations Management

Today's concept of *Operations Management* evolved from *Industrial Management* and *Manufacturing Management* concepts that were first used some fifty years ago. The reason for the change in terms was that, concepts and techniques for managing production in factories have been found to be useful in government and services as well.

When we look at different modern textbooks in operations management (also known as *Production and Operations Management - POM*) we observe that more or less the same topics are covered in all of them. The difference is in the framework used to cover these topics and in the area where the main emphasis is put on.

The first approach to operations management, that will be considered here, is the one of Richard J. Shonberger. According to Shonberger (1985), there are three basic functions that must be managed in any organisation. These are money, demand and operations. These are said to be line functions.

In his book *Operations Management*, Shonberger (1985, p5) defines operations management as the *management of ends and means*. According to Shonberger, productive *operations* resulting in goods and services, are the *ends*, and *operating resources* are the means. He uses his *Functional Model of Operations and Operating Resources Management* to cover different areas of operations management.

Shonberger's model divides the functions into two groups. The ones concerned with *operations themselves* and the ones concerned with *operating resources*. Then, these functions are further grouped into zones of *advance planning*, *action planning* and *control*. Shonberger (1985, p11) describes these zones in the following way :

Advance planning is longer range and strategic. Action planning is shorter range and tactical. Control involves keeping track of how well the operations are conforming to the plans.

On the other hand Chase and Aquilano have a different approach to production and operations management. They call it *a life cycle approach*. They define it in the following way (Chase and Aquilano, 1989, p16) :

The structure, which we have termed the life cycle approach, follows the progress of the productive system from its inception to its termination.

They divide the *life cycle* of the productive system into following stages :

- *Birth of the system*
- *Product design and process selection*
- *Design of the system*
- *Startup of the system*
- *The system in steady state*

Chase and Aquilano, put a special emphasis on direct resources. They define operations management as *the management of direct resources required to produce the goods and services provided by an organization* (Chase and Aquilano, 1989, p7). Topics like inventory management and scheduling, that are directly relevant for this thesis, are mainly found in the last stage of the life cycle, i.e. in *The System In Steady State*. In addition to *MRP* and *MRP II* which are included in inventory management, concepts like *JIT* and *Synchronized Manufacturing* are also covered under section called *Improving The System*.

Materials Requirement Planning (MRP) which is pioneered by Joseph Orlicky of IBM and consultant Oliver Wight, is an approach that ties together in a computer program all the parts that go into complicated products. This program then enables production planners to quickly adjust production schedules and inventory purchases to meet changing demands for final products.

Chase and Aquilano (1989, p626) define MRP in the following way :

Based on master schedule derived from a production plan, a material requirements planning system creates schedules identifying the specific parts and materials required to produce end items, the exact numbers needed, and the dates when orders for these materials should be released and be received or completed within the production cycle.

Manufacturing Resource Planning (MRP II) is an expansion of MRP. Its primary objective is to plan and monitor all the resources of a manufacturing firm. *It is generally conceived now as being a total, companywide system with everyone working with the same game plan, using the same numbers, and capable of simulation to plan and test strategies* (Chase and Aquilano, 1989, p649).

Just-in-Time (JIT) production systems are changing the way manufacturing organizations do business, like MRP did in the 1970s. The Japanese are the major developers and users of the JIT approach. JIT requires the production of precisely the necessary units in the necessary quantities at the necessary time. It is a management philosophy applying the *pull system* through the plant. According to JIT concept, *producing one extra piece is just as bad as being one piece short. In fact, anything over the minimum amount necessary is viewed as waste, since effort and material expended for something not needed now cannot be utilized now* (Chase and Aquilano, 1989, p743).

Another important concept discussed by Chase and Aquilano is the *Synchronized Manufacturing* approach of Dr. Eliyahu M. Goldratt. Synchronized manufacturing refers to the entire manufacturing process working together to achieve the goals of the firm. According to Goldratt, *the goal of the firm is to make money*. The measurement system within a firm using synchronized manufacturing, should encourage the increase of net profits, return on investment, and cash flow. The firm can accomplish this if, at the operations level, it rewards performance according to the amount of throughput (maximize) , inventory (minimize) , and operating expense (minimize) created.

A third approach to operations management that will be reviewed here is the one of Ray Wild. This one differs from the others by the emphasis that it puts on the structure of the operating system. In his book *Production and Operations Management* Ray Wild (1980, p10) states :

Given the influence of the basic operating system structure, one principal aim of operations management will be to select the system structure to be employed or, failing that, to influence its selection.

Wild does not exactly refer to the same thing as Senge by the term *structure*. For him, the *structure* is the way physical storage (or queue), input/output flows (materials, machines and labour) and customers of the system are organised around the transformation process. Whereas for Senge (1990), the *systemic structure* is primarily concerned with interrelationships of key variables that influence the systemic behaviour over time. In this sense, Wild's concept of structure can be accepted as a subset of Senge's concept of structure.

Wild argues that there is a direct relationship between the *structure of the operating system, principal problem areas and problem characteristics*. The relationship between the *structure and principal problem areas* works in two ways. In other words, principal problem areas are a function of the structure, but at the same time, a given structure may be changed by operations management, through decisions taken in the principal problem areas. According to Wild (1980, p11) :

If a system is designed to have, or if it must normally have a certain structure, the strategies adopted by the management should reflect the needs and constraints of that system structure.

Wild classifies principal problem areas of operations management under three main headings :

- *Inventory Management*
- *Scheduling*
- *Capacity Management*

The objective of inventory management is to establish a balance between the finished goods inventory and customer service level. In other words, to keep the minimum possible inventory without affecting the customer service. In connection with inventory management, Wild (1980, p15) says that :

Inventories will normally tie up considerable amounts of capital, thus there is a balance to be struck between obtaining the benefits of inventories, such as flexibility, high customer service, and insulation against demand fluctuations, on the one hand, and minimizing the costs of such stocks on the other.

At this point, to add more perspective, it is useful to mention the way JIT philosophy looks at

the inventory. According to JIT approach, the main reason for reducing the inventory is not cutting its cost down. More important than this, inventory reduction is a way of surfacing the problems of the production system. Inventory is believed to be hiding the inefficiencies in it and to reduce the inventory should be the first step in productivity improvement.

According to Wild, the inventory management problem can be considered to be a part of a wider operations scheduling problem. *Operations scheduling is concerned with the specification, in advance, or the timing of occurrences within the system, arrivals to and departures from the system including arrivals to and departures from inventories within the system* (Wild, 1980, p15).

At every occasion, Wild emphasizes the relationship between the structure and principal problem areas. In connection with scheduling, he states that (Wild, 1980, p15) :

As with all characteristic problems, the procedures and methods deployed in scheduling may be influenced by structure, and the effectiveness of scheduling may in turn affect structure.

About the third principal problem area, the capacity management, he makes the following comments (Wild, 1980, p15, p16) :

The determination and adjustment of capacity in an operating system is an important problem area, since decisions taken here may intentionally or inadvertently change the structure of the system and/or affect the efficiency of operation of a particular system.[...] Capacity decisions will have a direct influence on system performance in respect of both criteria, i.e. resource productivity and customer service.

The structure has also a major effect on capacity management. *Since structure affects the nature and complexity of the capacity planning problem, the methods, procedures and techniques appropriate for tackling the problem may also be influenced by structure* (Wild, 1980, p16) .

Wild (1979) relates the complexity in principal problem areas to the close interdependence among them.

One factor adding considerably to the complexity of inventory, capacity and scheduling problems is their close interdependence. Decisions taken in one will have a direct impact on performance in the others.

Different approaches mentioned up to now, are all concerned with operations management. But each one is looking at it from a different angle.

Ray Wild's approach to operations management, puts a special emphasis on the structure of

operating system and on the relationship between the structure and the behaviour. Of the three, Wild's perspective is the most systemic one. Therefore it is used together with the overall systemic approach of this thesis.

1.3 The Research Argument

Its general structure (as defined by Wild) is a good starting point to study an operating system. As the structure effects the behaviour, to understand it, will give some insight about the general characteristics and possible patterns of behaviours that can be expected from a specific operating system. But on its own, this global understanding, will not help much to go to the root of a problem situation, to determine high-leverage points, and to develop alternative ways of bringing sustainable improvements. In order to reach these objectives, operations management methods have to be used together with systems methodologies within a systemic framework. Different perspectives adopted by these two approaches and their complementary nature is illustrated in FIGURE 3. Once the structure has been defined from operations management perspective, one can use systemic thinking to develop an understanding of the parts and to integrate this understanding back into a larger whole.

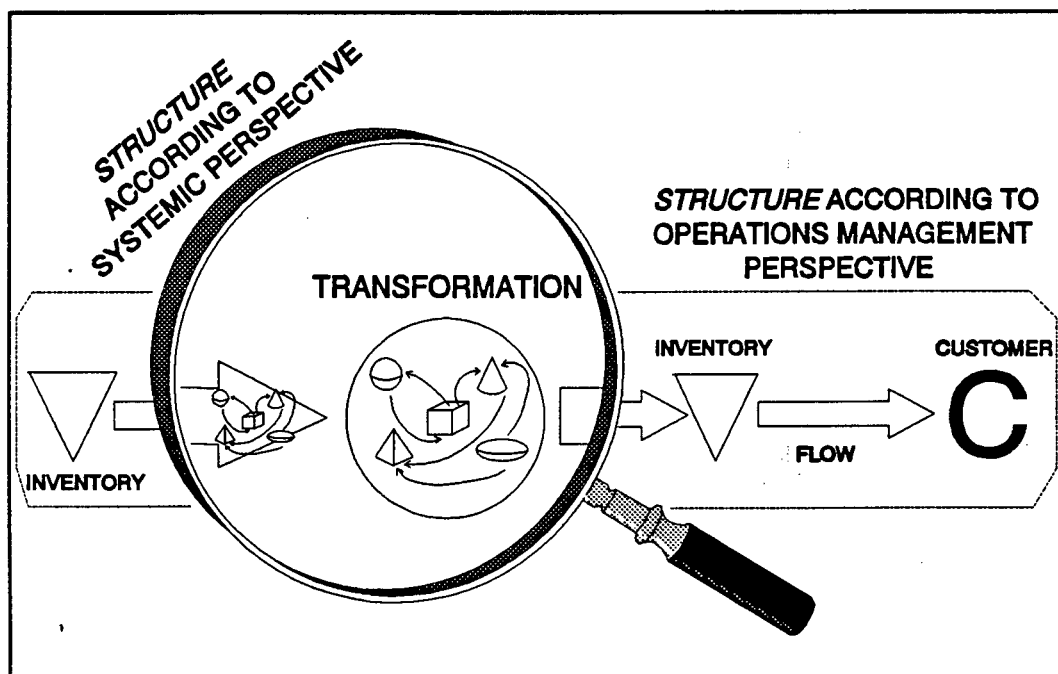


Figure 3

In the thesis, Wild's definition of structure will be referred to, as *operational structure*, and Senge's definition of structure as *systemic structure*. It is argued that a holistic understanding of an operating system is possible by discovering its operational structure and its systemic structure. Alternative ways of improving an actual problematic situation will emerge naturally

from this understanding.

A holistic understanding of an operating system enables the *problem solver* to identify the underlying causes of symptoms, and to distinguish high- from low-leverage intervention points in the system. As it is mentioned earlier, interventions at high-leverage points have a dramatic and enduring impact whereas interventions at low-leverage points have only an ephemeral effect on the system. A large number of interventions adopted within organisations are low-leverage. They concentrate on obvious symptoms rather than non-obvious causes, and therefore they only bring short-term symptomatic reliefs. The ability to identify high-leverage points is essential to formulate corrective actions that will have a long-term beneficial impact on the system.

However, it is not easy to identify high-leverage points, especially if the approach used is non-systemic. The high-leverage points are, most of the time, non-obvious. In other words, *they are not closely related in time and space to the obvious symptoms of the problem. Because the connection between short and long term response is often unrecognized, intervenors can get drawn into a reinforcing spiral of intervention. The longer the delay between short and long term response, the more likely is the repeated use of an ineffective intervention* (Senge, 1986, p143).

A systems thinker who is dealing with a problematic situation will have to decide, at some stage of the study, about the systemic approach(es) that he/she will use. There are several methods available in systems literature. But the choice is not straightforward. About this issue Flood and Jackson (1991, p31, p32) make the following statements :

A major difficulty for managers and management scientists seeking to use systems thinking is knowing how to employ the range of different systems approaches available. [...] Each approach has been tried and tested and works well in some circumstances. [...] Fortunately, it is possible to provide guidelines that point to the respective strengths of different systems approaches and suggest when a situation favours the use of one rather than the other.

There are important similarities between the elements of Wild's *operational structure* and Senge's *systemic structure* as shown in FIGURE 4. Senge's perspective is based on a systemic approach called *System Dynamics* (SD). These structural similarities naturally make system dynamics a suitable systemic approach to be used in a manufacturing context where Wild's principles of operations management are adopted.

In addition to material flows shown in FIGURE 4, SD can also represent information flows between different elements of the operating system. Information flows generally influence *rates* and they add important behavioural characteristics to the model. Practical details about system dynamics modelling, system elements, material and information flows among these elements will be given later in PHASE 4. At this stage some conceptual information will be presented.

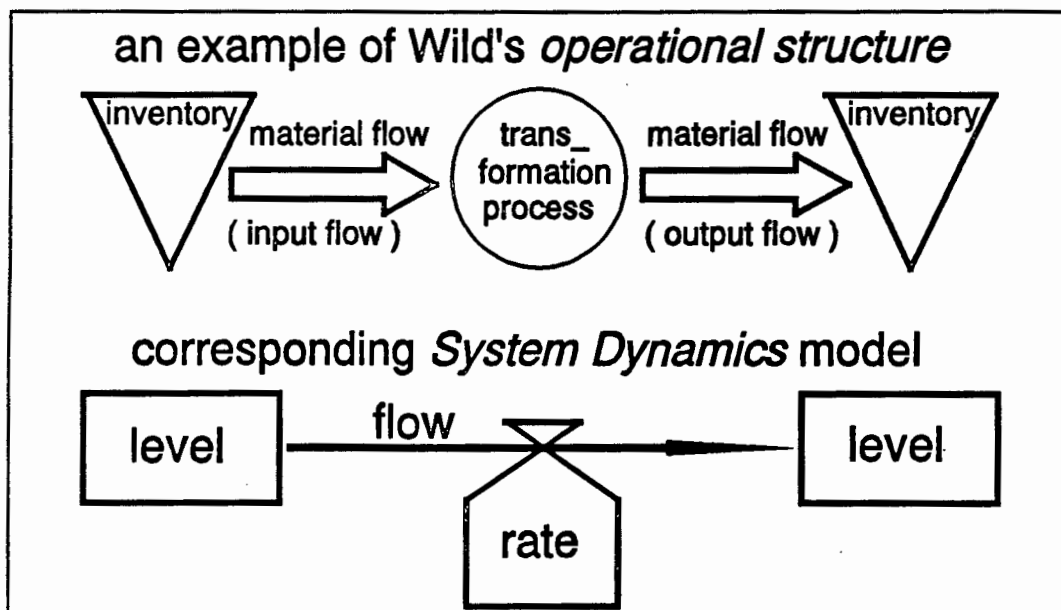


Figure 4

SD is a methodology for understanding certain kinds of complex problems. It began some thirty years ago as industrial dynamics, focusing on problems arising in the corporate setting. The initial ideas of SD can be attributed to Jay Forrester and his work at MIT.

Flood and Jackson (1991, p62) define the philosophy of SD in the following way :

A system dynamics view is one that places emphasis on structure, and the process within that structure, assuming that this is how dynamic behaviour in the real world can best be characterised. SD, then, considers behaviour as being principally caused by structure, it is a theory of the structure of systems and dynamic behaviour. [...] SD assumes that analysis of a situation can be undertaken from an external objective viewpoint and that the structure and dynamic process of the real world can be re-created in both systems diagrams and mathematical models.

However in the thesis, it is accepted that, the real world is too complex to be re-created in any kind of model. Therefore none of the models developed in this study should be seen as the exact representation of the real world. They should rather be taken as the ways of organising our thinking about realities.

About the practical use of system dynamics modelling Flood and Jackson (1991, p62, p63) make the following comment :

Many businesses and social situations can be characterised by the complexity of their element structure and the multi-causal feedback loops that exist between the elements. [...] Representing this in a SD model is a step towards coding into computers, which can then rapidly simulate the mass of interactions and interconnectedness of loops, thus creating for us future business scenarios. This, it is argued, is an effective means of

enhancing human intuition [...] Since we can determine structural changes to the model and control the inputs (model perturbations), as if we had this capability over the real business situation, we are able to test out our ideas and plans to simulate what future outcomes these may lead to. We then apply ideas of feedforward control

The characteristics of a problematic situation are also important in the selection of a suitable systemic methodology to be used in given problem context. According to Flood and Jackson (1991), the initial step of this selection should be, categorising the situation according to two criteria :

- system in which it occurs (simple, complex),
 - > *simple* :
 - * a small number of elements with predetermined attributes and with few highly organised interactions in between;
 - * well-defined laws govern behaviour;
 - * the system does not evolve over time, it is unaffected by behavioural influences and it is largely closed to its environment;
 - * sub-systems do not pursue their own goals.
 - > *complex* :
 - * a large number of elements with non-predetermined attributes and with many loosely organised interactions in between;
 - * probabilistic behaviour;
 - * the system evolves over time, it is subject to behavioural influences and it is largely open to its environment;
 - * sub-systems are purposeful and generate their own goals.

- its participants (unitary, pluralist, coercive).
 - > *unitary* :
 - * they share common interests;
 - * their values and beliefs are highly compatible;
 - * they largely agree upon ends and means;
 - * they all participate in decision making;
 - * they act in accordance with agreed objectives.
 - > *pluralist* :
 - * they have basic compatibility of interest;
 - * their values and beliefs diverge to some extent;
 - * they do not necessarily agree upon ends and means, but compromise is possible;
 - * they all participate in decision making;
 - * they act in accordance with agreed objectives.
 - > *coercive* :
 - * they do not share common interests;
 - * their values and beliefs are likely to conflict;
 - * they do not agree upon ends and means and genuine compromise is not possible;
 - * some coerce others to accept decisions;
 - * no agreement over objectives is possible given present systemic arrangements.

These two criteria with their options, offer a three by two matrix that can cover all possible problem contexts.

	UNITARY	PLURALIST	COERCIVE
SIMPLE	Simple-Unitary	Simple-Pluralist	Simple-Coercive
COMPLEX	Complex-Unitary	Complex- Pluralist	Complex-Coercive

TABLE 1

The categorisation of problem contexts is made with the aim of grouping different systems methodologies [...] it is not meant as a grid into which different problem situations in the real world can be easily fitted (Flood and Jackson, 1991, p32). In other words, the matrix structure given in TABLE 1 is just a guideline or a starting point. Real life problem situations may exhibit a mixture of these characteristics. For example some aspects of a situation may be defined as *simple-unitary* while some other aspects of the same situation as *complex-unitary*. But even in this case, one can possibly categorise a situation according to its dominant characteristics.

Flood and Jackson (1991) argue that different system methodologies work well in different problem contexts. For each category of TABLE 1, they suggest a separate set of systems methodologies (except for complex-coercive). Therefore, if a problematic situation can be associated with any of these categories (except with complex-coercive), then it is possible to choose a suitable systems methodology from the ones suggested by Flood and Jackson (1991). In connection with complex-coercive problem contexts Flood and Jackson (1991, p41) state :

We do not yet possess the tools to tackle such contexts when they arise in the real world.

The problem situation studied in the thesis can be best defined as a simple-unitary one. Systems Dynamics (SD) is one of the methodologies suggested by Flood and Jackson for simple-unitary problem contexts.

Both discussions (one based on structural similarities between Wild's and Senge's model and the other based on the relevance for a given problem context) about the suitability of SD lead to the conclusion that SD is a relevant system methodology to be used in this study.

In the thesis, it is demonstrated that, behavioural influences that are difficult to quantify, can also be incorporated in a SD model in the form of parameters. It is also argued that the objective of SD is not to re-create the reality. In fact to obtain the final model is only a part of its objective. The understanding that the modeller develops while building the model is as important as the final model itself. The final model is only a tool that can approximate the behavioural patterns of key system variables, and thus, that can contribute to the decision

making process.

The thesis is based on a case study demonstrating a problem solving exercise in manufacturing environment. In the thesis, it is argued that, *systemic thinking* can be used in operations management context as an approach that can :

- identify the underlying causes of problematic behaviours in today's manufacturing environment by ensuring a holistic understanding of relevant operating systems,
- develop and evaluate alternative ways of bringing sustainable improvements to actual problematic situations.

1.4 The Structure of The Thesis

In the next chapter called **THE BACKGROUND INFORMATION**, some general background and historical information about the organisation is given and the initial situation of the operating system is described. Also my first impressions about the system and my preliminary plan of action are included in this part.

The following three sections are describing the phases that I have gone through and the methods that I have used while developing a more insightful understanding of the operating system. **PHASE 1** is concentrated on materials, material flows and physical lay-outs. Planning methods used to organise the processing of these materials is discussed in **PHASE 2**. **PHASE 3** is focused on the capacity aspect of the materials processing function which is considered to be problematic.

After having developed an overall understanding of the operating system in the first three phases, in **PHASE 4**, the system dynamics approach is used to understand the systemic structure and behavioural patterns generated by it. This insight is then used to analyze the actual problematic situation and to find out about the ways of improving it.

The outcomes of the thesis are summarised and recommendations are given in the last section called **CONCLUSION AND RECOMMENDATIONS**.

CHAPTER 2 : THE BACKGROUND INFORMATION

This chapter gives some background information about the operating system and its history. Commonly shared ideas about problem issues, my perception of the system and my initial plan of action are also included here.

2.1 First Contact and General Background

I had my first contact with the production management and decision making functions of Moir's in May 1993. That was after their Factory Manager had approached Prof Tom Ryan for a postgraduate student who will help them to improve their factory lay out.

Moir's is a company making instant desserts, cake mixes, food additives and baking aids. These are all seasonal products with demand patterns fluctuating (usually in a cyclic way) throughout the year. Their three major production operations are milling, mixing and packing. These are carried out at a production area which is consisting of two levels. Ground floor (Packing Floor) is used for packing and first floor (Mixing Floor) for milling and mixing.

Their market is a very competitive one. Therefore customer service level is monitored closely and it is considered to be an important criteria for measuring the performance. Roughly, it is calculated in the following way.

$$\frac{\text{ORDERS DISPATCHED}}{\text{ORDERS PLACED}} \times 100$$

Initially I have met factory and production managers. Factory Manager is responsible for two factories - Moir's and a cool drinks factory. His role is more of an operations manager's, for cool drinks factory where his office is located. Due to the presence of a competent production Manager at Moir's, he is functioning there as an interface between the Production Manager and Operations Director. He is also responsible for production planning, and production budget of both factories. Production Manager is mainly responsible for day to day management of the shop floor.

I have been perceived by the Factory Manager and by the Operations Director, as a masters student who is there to help them to improve situations that they consider as problematic. For most of these situations the problem and a possible way of solving it, have already been

defined by them. For some others even the implementation had been started. This predetermined study frame did not disturb me much in the beginning as I was free to decide about the methods for tackling these problems.

I have got the initial information from the Production Manager, the Factory Manager and the Operations Director. At that stage it looked like there was a consensus among them about the type and the nature of present problems. I was not sure though, whether this was a real consensus. Generally the point of view of the Operations Director is accepted without much questioning. During my stay at Moir's, I witnessed several debates between the Operations Director, the Factory Manager and the Production Manager. The Operations Director has the tendency to impose his ideas on others and that was the main reason why I had doubts about the significance of *shared* ideas among managers.

2.2 Historical Background

Mixing Floor has always been considered as the bottle neck of the production system. Especially during peak demand periods, this floor is blamed to have an insufficient capacity which is causing a decline in customer service level. The Factory Manager believes that it is necessary to keep a considerable amount of finished goods inventory to maintain the customer service at the desired level. Being the person responsible of production planning, he has built in his plans a finished goods cover corresponding to four weeks market demand. This four weeks figure is purely based on his intuition.

On the other hand Packing Floor seems to be coping better with the demand. It was generally accepted that, Mixing Floor has to work overtime to catch up with the pace of Packing Floor.

Originally, metal hoppers with a limited holding capacity (maximum two days stock), have been used to store and to transport processed batches at the Mixing Floor. Overtime work has been used extensively to catch up with the production of the Packing Floor. Growth of the market and the market share increase made Moir's more and more dependent on overtime work.

Finally, overtime became such a big burden that something had to be done about it. A suggestion came from Production Manager. He proposed to increase processed batch holding capacity. By this way it would have been possible to built some work in progress inventory during low demand periods. During high demand periods, on the other hand, this inventory could have been used as a buffer that would reduce the overloading of the Mixing Floor. The idea has been approved and it has been implemented. It has been perceived as *the solution* of overtime and fluctuating customer service level problems.

Processed batch holding capacity has been increased by replacing metal hoppers by *tuft bags*.

Tuft bags are large bags made of strong synthetic fibres allowing to keep and to transport bigger amounts of semi-processed materials. Although the purpose was to keep one weeks' production at the maximum, as a contingency measure, tuft bags are designed to keep two weeks' production of the Mixing Floor.

This method has reduced the overtime work and has also improved the customer service level, but it was far from being *the solution* of the problem. In fact, it has only shifted the burden. The symptom has disappeared but the problem has not been cured. It was still in the system and waiting for a favourable time to reappear, probably with a different face and as the problem of a different department.

Tuft bag storage and transport facility has smoothened the negative effect of fluctuating demand patterns. That is how it has increased the efficiency of Mixing Floor and reduced the need for overtime work. As a result of this improvement, they have been more successful in meeting the planned production figures and in keeping the finished goods inventory at a level which is believed to be necessary for a good customer service. This level was set Factory Manager as four weeks demand.

Everything has gone fine until this facility gave rise to a new burden (reappearace of the problem). This was the cost of inventory. Especially during low demand periods the amount of work in progress and finished goods inventory have gone beyond targeted levels. The average work in progress has reached \pm two weeks demand and the average finished goods inventory \pm eight weeks demand. Capital tied up this way and the cost of keeping these stocks became an issue which is as serious (if not more) as overtime cost and declining customer service level were in the past.

The remedy which is used, has been the source of another problem. In fact the problem has not been solved but has been moved in time and space. The conventional management perspective assuming a fairly obvious causal relation between problems and their symptoms has only provided a short term symptomatic relief.

This is the typical consequence of the reductionist approach focusing on the symptom rather than the cause of the symptom. The implicit assumption behind this sort of intervention is that, a problem symptom can be controlled by a remedy closely related to the symptom.

2.3 Actual Situation

In the actual situation the challenge for management, is to bring down the work in progress and the finished goods inventory while keeping the customer service at the desired level.

Up to now there have been several meetings on this matter. Managers have reached a *consensus* about the type and the nature of the problem and also about the possible ways of solving it.

This is the stage at which I became involved with Moir's. According to the management, the problem has already been defined and the solution has already been found. They were at the beginning of the implementation phase. In this framework I am asked to help them to improve the factory lay out.

2.4 Management's Perception About Problem Issues

Problem issues and their solutions (as perceived by the management) are presented to me in the following way. I will call them, *Assumptions of The Management*.

Assumptions of The Management :

- There is a capacity problem at Mixing Floor and this is the bottleneck of the system. Packing Floor is doing well and it can cope with the actual demand.
- We are keeping high work in progress and finished goods inventory just because we can not rely on mixing floor. Mixing floor cannot react to market fluctuations quick enough because of its capacity constraint.
- Therefore it is necessary to increase the capacity of mixing floor. This can be done by buying new machinery and by modifying the lay out.
- Once we have enough capacity at the mixing floor then it will be necessary to plan according to demand and to monitor inventory levels. We will use a computer software called BPCS (Business Planning and Control System) to achieve that objective.
- MPS (Master Production Schedule) module of BPCS will be used to plan the production and MRP (Material Requirements Planning) module to organize and monitor the flow of raw materials.
- That is how we will achieve our objective of reducing the inventory while keeping high customer service level.

In this preset frame, my function was to study the capacity problem at the Mixing Floor, i.e to determine the machines with capacity constraints, to investigate possible ways of increasing the capacity and to find out about lay out modifications that can improve the throughput.

2.5 How Did I Perceive The System

After having contacted the managers and having heard their interpretations, my perception about the system in focus was as in FIGURE 5.

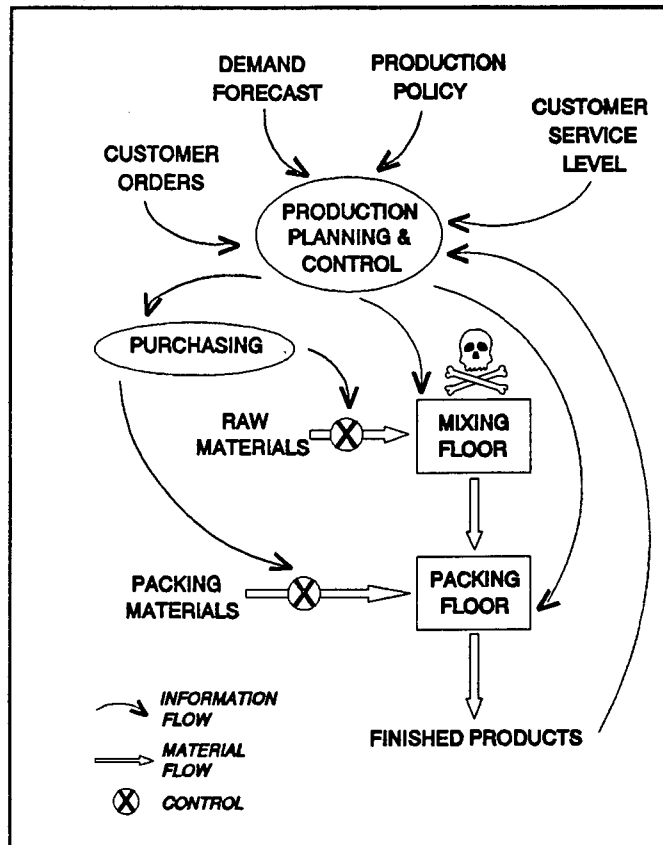


Figure 5

This figure can be explained in the following way. *Production planning and control* function generates production plans by using the *customer orders*, *demand forecast*, *finished products* inventory and *customer service level* informations and according to rules set by *production policy*.

Purchasing controls the flow of *raw materials* and *packing materials* according to the information coming from *production planning and control*.

In addition to supply necessary information to *purchasing*, *production planning and control* also generates shop floor orders for *Mixing* and *Packing Floors* and monitors these orders until they are completed and closed.

Mixing Floor is accepted to be an area with a serious capacity constraint. It is highlighted as the bottleneck of the production system. Therefore up to now, all attempts to improve the general performance of the system are focused mainly on the *Mixing Floor*. It is believed that any capacity increase at the *Mixing Floor* will increase the overall capacity of the factory and the *Packing Floor* has at least double the capacity of the *Mixing Floor*.

2.6 Objective and Plan of Action

The general purpose of my study, is initially to determine a problematic behaviour which is under discussion and which is important to all concerned parties, then to analyze this behaviour to bring about an improvement.

After having spent two weeks at Moir's and having heard the speculations of managers, I came to the conclusion that the apparent capacity shortage at the *Mixing Floor* is a problem area fitting to the general purpose of my study. Before starting to examine this issue however, I had to learn more about the system.

I have set a plan of action that will be a guideline along the study. This is not a hard frame which is putting rigid boundaries, but rather a set of soft reference points that can be modified throughout the study. Therefore, at this stage, I have only detailed the Phase 1 and I have described the other phases with their broad headings only.

Plan of Action :

- Phase 1 : Developing an understanding of the problem context by studying the materials list and factory lay outs, i.e. :
 - * understanding the coding system which is used to classify materials at different production stages,
 - * getting a categorised list of materials,
 - * obtaining lay outs of both floors and marking on them different activities that are carried out at different areas,
 - * conclusion.
- Phase 2 : Study of the actual production planning methods.
- Phase 3 : Spreadsheet analysis of the actual capacity status.
- Phase 4 : *System dynamics* study of the actual situation.
- Phase 5 : Conclusion.

CHAPTER 3 : PHASE 1, DEVELOPING AN UNDERSTANDING OF THE PROBLEM CONTEXT

To study the materials list (i.e. the list of raw materials and finished products) and factory lay outs was a good starting point to get more familiar with the operating system. But this phase is not purely concerned with the study of these documents. It is more about the difficulties that I have experienced in obtaining these documents and the mistakes that I have found in them.

To a large extent, I was taking for granted that somebody in the organisation would have updated copies of these documents. I thought that this kind of reference documents were necessary to run an operation of this scale. Well, I was wrong. The materials list that I have obtained was full of mistakes and redundant items and factory lay outs were too old to have any relevance.

Materials list have been filtered and corrected, and factory lay outs are redrawn. The process of getting the documents in their final form, has been more informative for me than the contents of these documents. Problems that I have experienced have shown that the situation that I was dealing with was more complex than it had been presented to me in the beginning.

3.1 Short Description of Materials Coding, Materials Flow And Transformation Process

At Moir's, any material coming from outside into the production system gets a code at the moment it enters the system. This code changes as the material is used or processed. There are four general classification codes.

- E-codes : Raw materials.
- M-codes : Packaging materials.
- P-codes : Mixed batches (at the Mixing Floor).
- F-codes : Finished, packed products ready to go to the warehouse.

Raw materials are stored at the Mixing Floor and packaging materials at the Packing Floor. Raw materials (E-codes) go first through milling and/or mixing. For some products a series of milling and mixing is necessary. Raw materials that have been processed at Mixing Floor, are called mixed batches (P-codes). They are stored in tuft bags until they are transferred to the Packing Floor. Mixed batches are transported from Mixing Floor to Packing Floor by

vertical pipes going from first floor to the ground floor. Packing machines are coupled to pipe outlets. During packing, tuft bags are connected to inlets of pipes and their contents are transferred to the packing machine by the gravity. Packing machines fill mixed batches into different packaging materials (M-codes). Finally finished products (F-codes) coming out of packing machines are taken to the storage and dispatch area.

Materials flow and overall operational structure are illustrated in FIGURE 6.

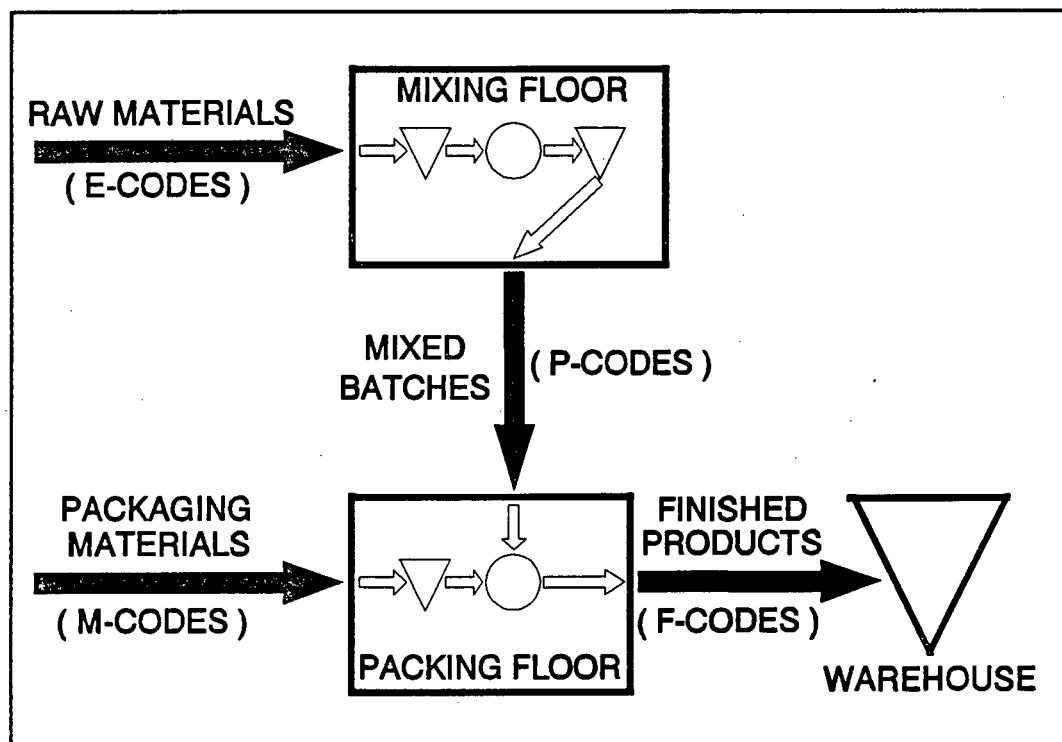


Figure 6

3.2 Obtaining And Grouping The List of Raw Materials, Mixed Batches, Packaging Materials and Finished Products

In the beginning I did not foresee any problem when I have decided to study the materials list. I was taking for granted that I would be able to get it from somebody. But I found out that, an updated copy of this list was simply not available.

The most useful information came from the manager of computer department. He gave me an ASCII file (copied from the mainframe computer) that was containing a blended list of code groups. This list was not updated since five years. Therefore it was full of materials which are not used any more and of discontinued products. Also, some of the items were relevant for

other factories of Moir's but not for the one that I was studying.

It took me three weeks to filter this list to obtain a set with some relevance. The reason why this process has taken this long was that, nobody, on his/her own, had the overall knowledge of raw materials and finished products. Different people knew about different parts of the list, but nobody had integrated this partial knowledge into a general background about materials. Therefore I had to work with different people having expertise in specific areas. They were namely The Chief Chemist, Production Manager, Purchasing Manager, Warehouse Manager, Warehouse Supervisor, Mixing Floor Supervisor, Packing Floor Supervisor and Mixing Floor Coordinator. Sometimes I have received contradictory information from different individuals. Then I brought them together and let them discuss the situation and come to an agreement. Consequently, this exercise has been as educating for them as it has been for me. A flow of information between different managerial levels that had never occurred in the past has been realized during this exercise.

In the beginning, I had a mixed list of more than 2000 materials. After the filtration and classification exercise, I have ended up with 726 items categorized according to their codes. 164 of them were raw materials (E-codes), 140 mixed batches (P-codes), 287 packaging materials (M-codes) and 135 finished products (F-codes). The categorized list of 726 items is given in the APPENDIX A.

To study the flow of 726 items was a very complex and time consuming task. In order to reduce the complexity and to make the information more manageable, I have divided the code lists into groups according to some common characteristics of the materials (i.e. raw materials which are used for the same purpose, additives having similar compositions, products containing similar ingredients, etc...). I have worked with same people as in the filtration exercise. At the end, I have managed to classify all 726 items in 195 groups. Raw materials had 29 groups, mixed batches 61 groups, packaging materials 34 groups and finished products 71 groups. By this way the high variety of items has been reduced without reducing the significance of the list. These groups are given in APPENDIX B.

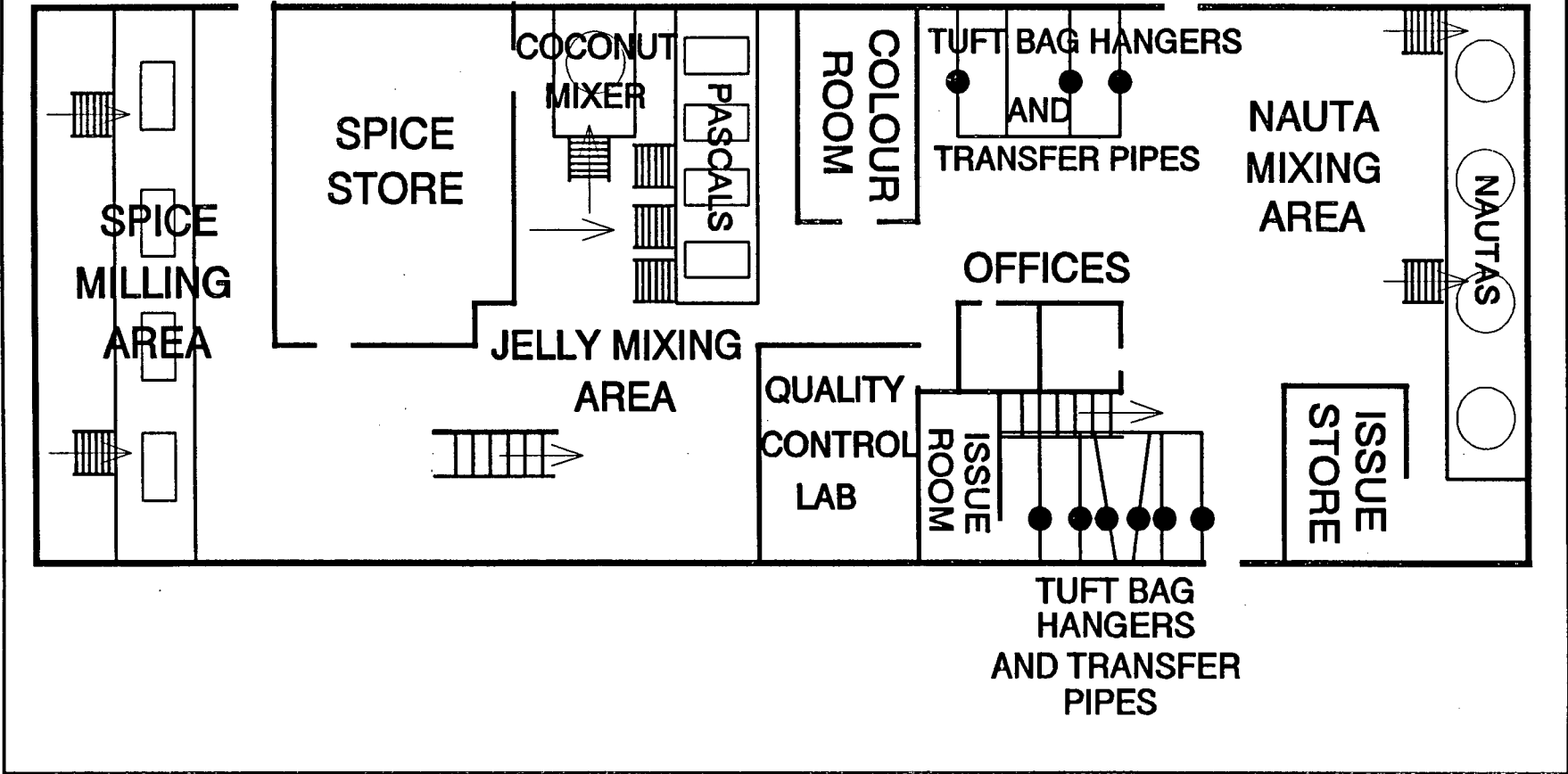
3.3 Lay Outs

I was quite surprised when I have discovered that there was not any drawing showing the actual situation of the factory. The latest that I could find was from The City Council. It was done in 1975 and was not relevant any more.

I have explained to the production manager that an updated set of drawings can help to :

- visualise the flow of the materials,

MIXING FLOOR LAYOUT



PACKING FLOOR LAYOUT

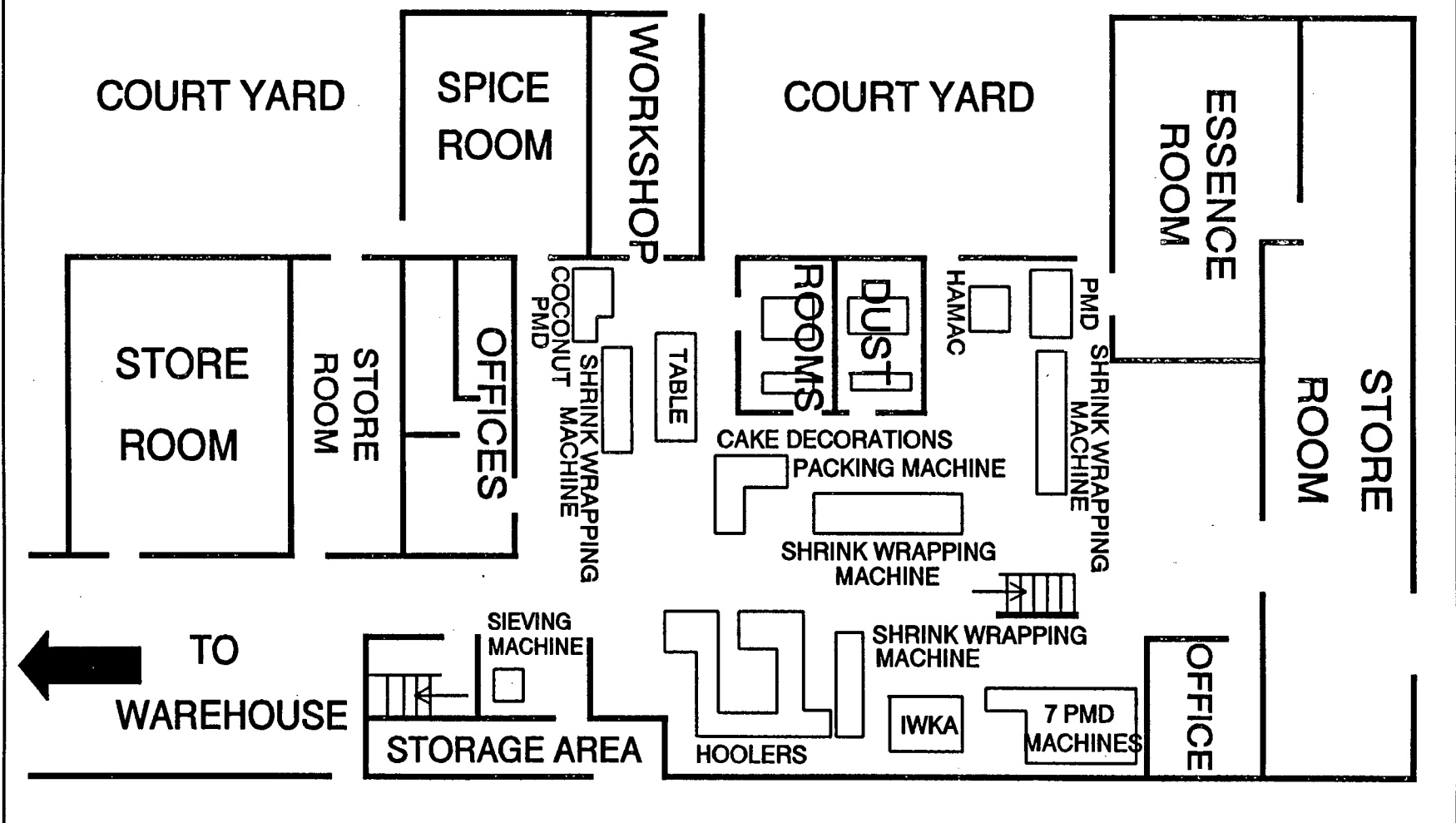


Figure 8

- see the effects of a lay out modification,
- better understand some of the actual problems,
- discover some potential solutions,
- develop a more global perception of the factory.

He is convinced about the usefulness of these drawings and gave me support on this issue. He has organized somebody to draw these plans and to mark the actual lay out of the factory on them.

Lay outs of Mixing and Packing Floors are given in FIGURE 7 and 8 to make the reader more familiar with the factory.

At The Mixing Floor there are milling (for spices) and mixing machines (Pascals and Nautas), colour mixing room, storage areas, tuft bag hangers, inlets of transfer piping, quality control laboratory and offices.

At The Packing Floor there are different packing machines (IWKA, PMD, HOOLER, HAMAC), shrink wrapping machines, store rooms, dust rooms (where baking powder is packed), essence room, spice room, workshop and offices.

3.4 Conclusion

At the end of the first phase I have adopted a more cautious attitude when evaluating the validity of commonly shared opinions at Moir's. This was a consequence of my findings related to bill of materials (BOM).

Bill of materials (BOM) is a very important data base for the production planning and control software that will be implemented at Moir's. Especially its MRP module which is organizing and monitoring the flow of E and M-codes is based on the bill of materials. Therefore the correctness of BOM, is crucial for the successful implementation of BPCS (Business Planning and Control System).

When working with code lists we have used BOM extensively as a reference document, to clarify confusions about the validity of items in the list. Although checking BOM was not the primary objective of this exercise (because it was generally accepted to be 100% correct), it has been reviewed by this occasion. With the surprise of everybody working with me on code lists, we have discovered some very important errors in BOM. These errors alone, were

enough to cause the failure of a very sophisticated and expensive system like BPCS.

Immediate action has been taken and all bill of materials have been revised. The tedious work of correcting BOM has been done mainly by Chief Chemist. I have not been directly involved in it but I have reported the mistakes that I have found.

There was only one document that could be used as a reference, when correcting BOM. It was called the recipe book. This book was containing the original recipes of all the products manufactured at Moir's. While correcting BOM, it has also been discovered that, there were some incorrect recipes and some of the products were not being made exactly according to recipes.

These findings have started a process of query and revision at the factory, about things that have been thought to be 100 % correct. Consequently this exercise has been very educational for me and very informative for people at Moir's. They had a chance to question things that they have taken as given until then.

By asking questions about *absolute realities*, I found out that they were not as absolute as they have appeared at the first instance. At the end of PHASE 1, I came to the conclusion that, an assumption should be treated as an assumption and not as a fact, no matter how many people agree on it, unless it is proved by hard facts.

The query process that I have started through my findings has delayed the implementation of BPCS for a while, but at the same time it has increased the chance of its successful implementation.

After having found out that a major assumption like 100 % correctness of BOM was not reflecting the reality, I had a big question mark in my mind about the validity of the *lack of capacity assumption*.

At the same time, I have also discovered that the structure of the operating system that I was dealing with, was more complex than it has been presented to me in the beginning. Therefore before tackling a complicated issue like capacity, I have decided to develop some understanding about a less intricate related issue.

Production planning policy has a major influence on the utilisation of the capacity. Whatever is the planning method, manual or a computer based one, production planning policies will be made by people and to understand the logic of this process will give an insight about capacity considerations.

CHAPTER 4 : PHASE 2, PRODUCTION PLANNING AT MOIR'S

The initial objective of this phase was to study the actual production planning methods, and to understand the logic of the production planning policy, in order to have some more insight about functioning of the operating system.

But, the major contribution to my understanding came from a by-product of this phase. This by-product which is called *The Planning Module* is a Lotus spreadsheet designed by me as a simple planning tool. Although it was a simple tool, its systemic implications were quite important.

4.1 Analysis of The Actual Production Planning

Production planning is done once a week for six weeks period. The reason for planning six weeks in advance, is to give enough time to purchasing department to place the orders to suppliers and to make sure that raw materials and packing materials will be at the site on time.

Scheduled amounts are revised and modified every week according to latest developments. By this way every week has been rescheduled five times until it became the current one. Only then, at the sixth time, it has been consolidated.

The following procedure which is summarised in FIGURE 9, is used for making the production plans :

- A sales forecast of all products for the next ten weeks is obtained from Marketing Department.
- Actual finished goods inventory is deducted from ten weeks forecast, and then the balance is distributed into six weeks.

$$\begin{array}{rcl} \text{AMOUNT TO BE} & & \text{10 WEEKS} \\ \text{PRODUCED IN} & = & \text{SALES} \\ \text{NEXT 6 WEEKS} & & \text{FORECAST} \end{array} \quad - \quad \begin{array}{l} \text{FINISHED} \\ \text{GOODS} \\ \text{INVENTORY} \end{array}$$

- By this way a production plan for the next six weeks is obtained. Ten weeks forecast has been squeezed into six weeks production plan to keep a finished goods inventory which is equal to four weeks market demand ($10 - 6 = 4$ weeks stock cover). This is a contingency measure taken according to the current production policy to ensure a high customer service level.

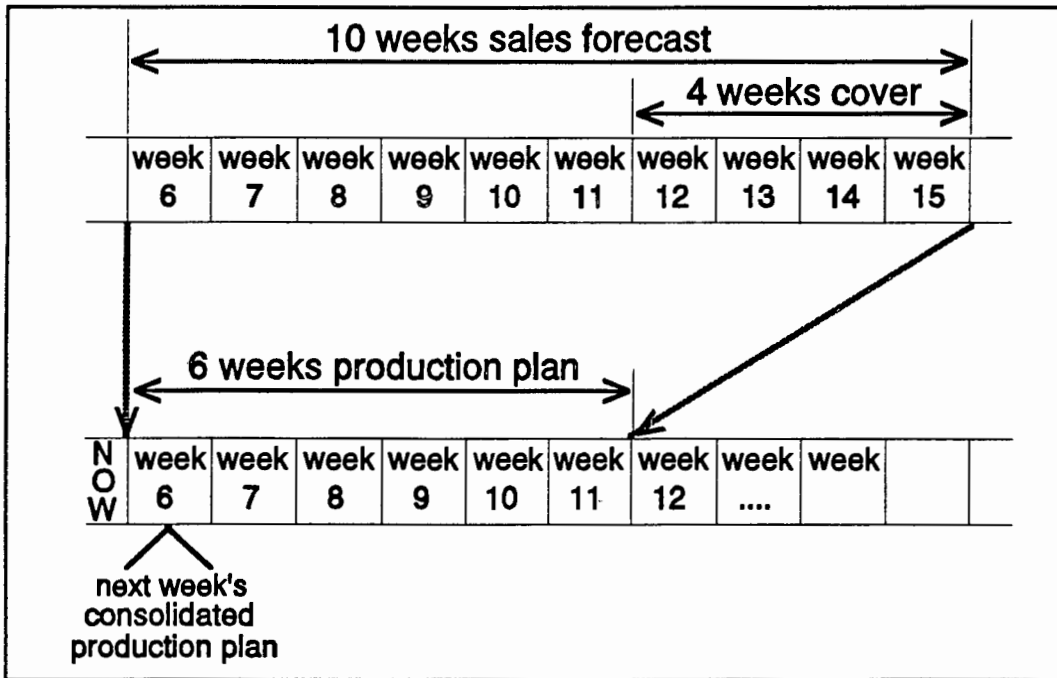


Figure 9

The participants of weekly planning sessions are the Factory Manager, the Production Manager and the Purchasing Manager. For each scheduled product, the Purchasing Manager is asked whether he can organise the necessary raw and packaging materials to be on site at the required time. The only data available to him, is the actual inventory of raw and packaging materials. For items that are out of stock he has to assume a delivery time. These assumptions are mainly based on his past experience. As a person dealing with suppliers, he is expected to know them and to make reasonable estimates about delivery times. This is already a weak point of the planning system bringing a considerable uncertainty in it. Once the planning team is happy about raw and packaging materials, than they make production plans according to the procedure described before.

When I looked at the situation from a systemic perspective (see FIGURE 10), I found out that, the production planning process was missing a very important information link. Planning team was generating production plans without knowing whether these plans were feasible. Although he had some feel about it, The Production Manager did not have any tool that would enable him to see whether he has the sufficient capacity to realize production plans. This situation has two major consequences :

- As it is not known whether it is possible to manufacture the scheduled amounts, production plans resulting from these sessions are taken (although not said openly) more as a guideline than a realistic target.
- People in the planning team don't exactly know about the outcomes of their plans. In a fairly complex manufacturing environment, where there is not a capacity monitoring

function, it is very difficult to follow the initial orders and find the reasons why they are not completed. Therefore the planning team does get a feed-back about their previous plan. They don't know whether their plan was not a realistic one or there were other reasons for manufactured quantities to be below the planned ones. Consequently they lose the valuable opportunity of learning from their past experiences.

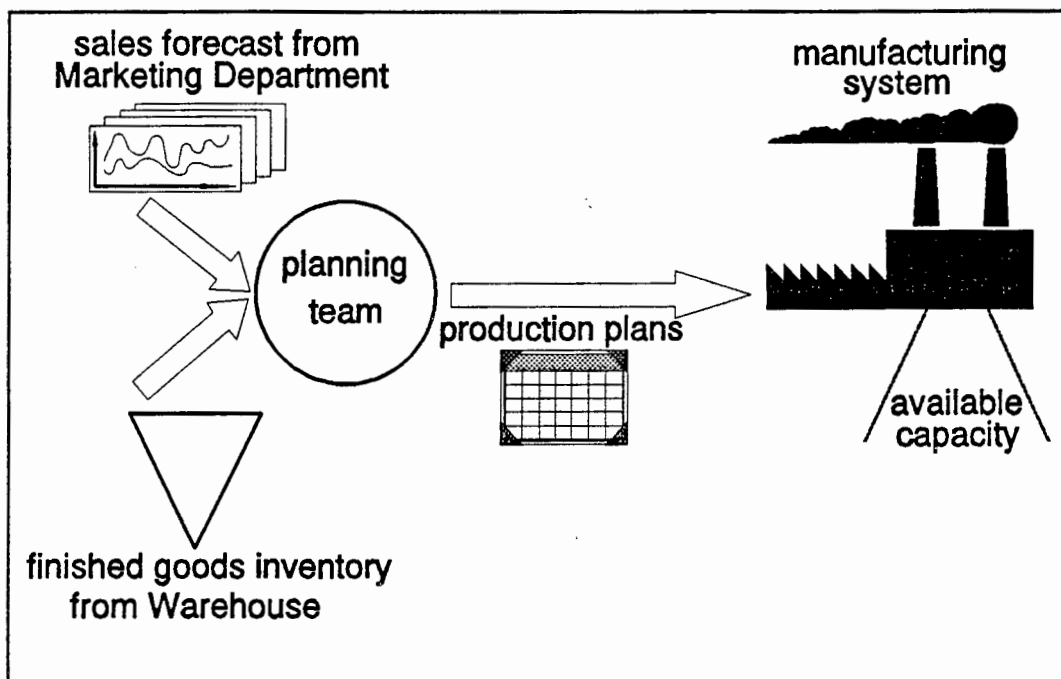


Figure 10

This situation gave me idea of designing a tool that will show the machine loads corresponding to a specific production plan. From practical point of view, this will give to the planning team, the opportunity to see the capacity implications of their plans immediately, to make some modifications, if necessary and to learn directly from the capacity decisions that they make. From systemic point of view, this is more an attempt to improve the systemic structure of the planning process.

4.2 The Planning Module

The *Planning Module* is designed to facilitate the initial planning calculations, to take the resulting planned production figures and to generate machine load bar charts corresponding to these planned production figures. It consists of three spreadsheets that can make data transfers from each other. Detailed information about the *Planning Module* is given in APPENDIX C.

In this section, the function of each spreadsheet is explained briefly.

The first spreadsheet called *Planner*, contains the demand forecast figures coming from marketing department and finished goods inventory information coming from the warehouse. This data is used to calculate the total production requirements for the next six weeks. A sample printout of *Planner* is given in APPENDIX C.

The second spreadsheet is called *6Wkspln* (6 Weeks Plan). In this spreadsheet there is a function copying the total required production figures from *Planner*. These figures are then distributed into six weeks by the planning team. The spreadsheet has a structure facilitating this distribution. By this way a preliminary schedule is obtained. This preliminary schedule is modified later according to the feedback coming from the last spreadsheet. A sample printout of *6Wkspln* is given in APPENDIX C.

The last spreadsheet which is called *Macload* (Machine Loads) transfers the preliminary schedule from *6Wkspln*. Then by using built-in process time tables, it generates bar charts showing the machine loads corresponding to the preliminary schedule. These charts show whether it is possible to produce the scheduled amounts. After having observed these charts, the planning team may decide to modify the production plan or to use overtime work or to do both. Sample printout of *Macload* and *Machine Load Charts* are given in APPENDIX C.

4.3 Conclusion

Planning Module is not a sophisticated tool that can replace the MPS (Master Production Schedule) module of BPCS (Business Planning and Control System). Although it can still be used after the implementation of BPCS as a control tool for checking the manufacturing schedules generated by BPCS, this was not the initial purpose of its design.

Planning Module does not automatically generate an optimum production plan but it enables the planning team to see the *Machine Loads* resulting from their production plans and thus gives them the opportunity to improve these plans or to take other measures, like overtime work. In other words, it enables them to generate feasible production plans that can be taken as realistic targets.

A major contribution of the *Planning Module* is the improvement that it brings to the systemic structure of the production planning process (see FIGURE 11). The information channels that it adds, enables the managers who are involved with planning, to get an immediate feed-back about the consequences of their decisions. This aspect of the *Planning Module*, makes it an effective training tool that can accelerate the learning process in this area.

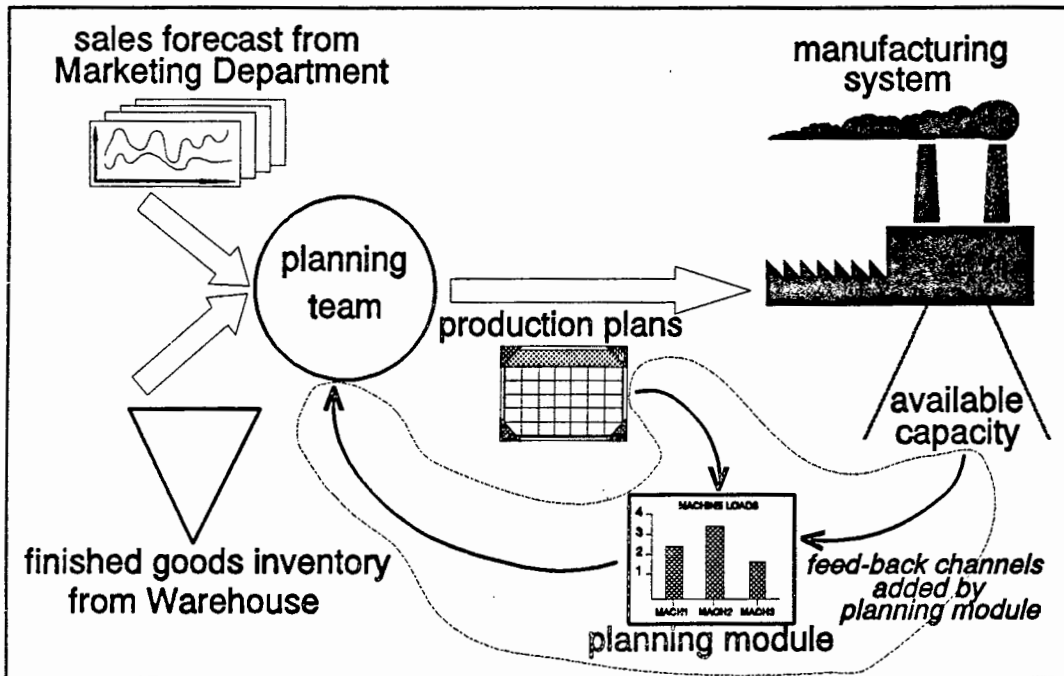


Figure 11

Outputs of the *Planning Module* have supported my suspicion about the validity of insufficient capacity assumption. When I have observed the *Machine Load Bar Charts*, I have seen that machines were not loaded in an even way. While some were overloaded, others had some ample idle time. That was more a situation of unsatisfactory machine allocation rather than a capacity shortage. That observation gave me the idea of doing a thorough analysis of the actual capacity status. According to the general belief, the capacity shortage was the main problem at Moir's. But there was not any hard proof of it. Therefore it could easily be another misconception.

CHAPTER 5 : PHASE 3, SPREADSHEET ANALYSIS OF THE ACTUAL CAPACITY STATUS

This section is concerned with the thorough study of the capacity situation at Moir's. The objective of the study is to obtain some reference figures that can be used to evaluate the assumptions of the management on this issue.

Capacity decisions have a direct influence on the performance of the operating system. *Excess capacity inevitably gives rise to low resource productivity, whilst inadequate capacity may mean poor customer service* (Wild, 1980, p16). High resource utilisation, ability to adjust the throughput according to market demand and high customer satisfaction are critical for the viability of a manufacturing system in the long-term. These critical characteristics are, to a large extent, effected by capacity decisions. Therefore these decisions that have a major impact on the future of an organisation, should be based on carefully investigated hard facts, rather than some loose assumptions.

In the case of Moir's, shortfalls of the production to meet the market demand are usually related to capacity shortages. Although there is no hard proof of such a relation, managers and supervisors strongly believe that the essential problem is insufficient capacity. Furthermore, they argue that, this shortage is mainly felt at the Mixing Floor. They estimate the capacity of the Mixing Floor to be half of the Packing Floor.

In this section, I have used spreadsheet techniques to analyse the actual capacity situation and to evaluate the correctness of the above assumptions. Details of the analysis method are given in APPENDIX D. Here, the complexity of the context and the logic of the analysis are explained

5.1 Complexity of The Context and The Logic of The Analysis Method

The analysis is based on calculating the available capacity and comparing it with the market demand in order to evaluate its adequacy.

The complexity of the situation comes from the nature of the capacity concept. At Moir's, each machine is used to process more than one product. Usually the process time on the same machine varies from one product to the other. Or, if the unit time is considered, one machine can have different capacities for different products. In other words, capacity is a product dependent concept and it is only possible to talk about the capacity of a machine for a given product. In more global terms, total capacity available will depend on the product mix that will be manufactured.

Unfortunately, in the case of Moir's, the market demand fluctuates all the time and therefore planned product mix changes every week. Because of the product dependent nature of the capacity, it is necessary to know the product mix and corresponding planned quantities in order to make a capacity analysis. For this purpose the historical data of a typical production plan corresponding to an average demand period is used.

Once the production plan is known, the capacity available to realize this production plan can be calculated through a tedious process (which is explained in APPENDIX D). Then the available capacity can be compared with the initial plan, and the adequacy of the available capacity can be evaluated.

5.2 Observations

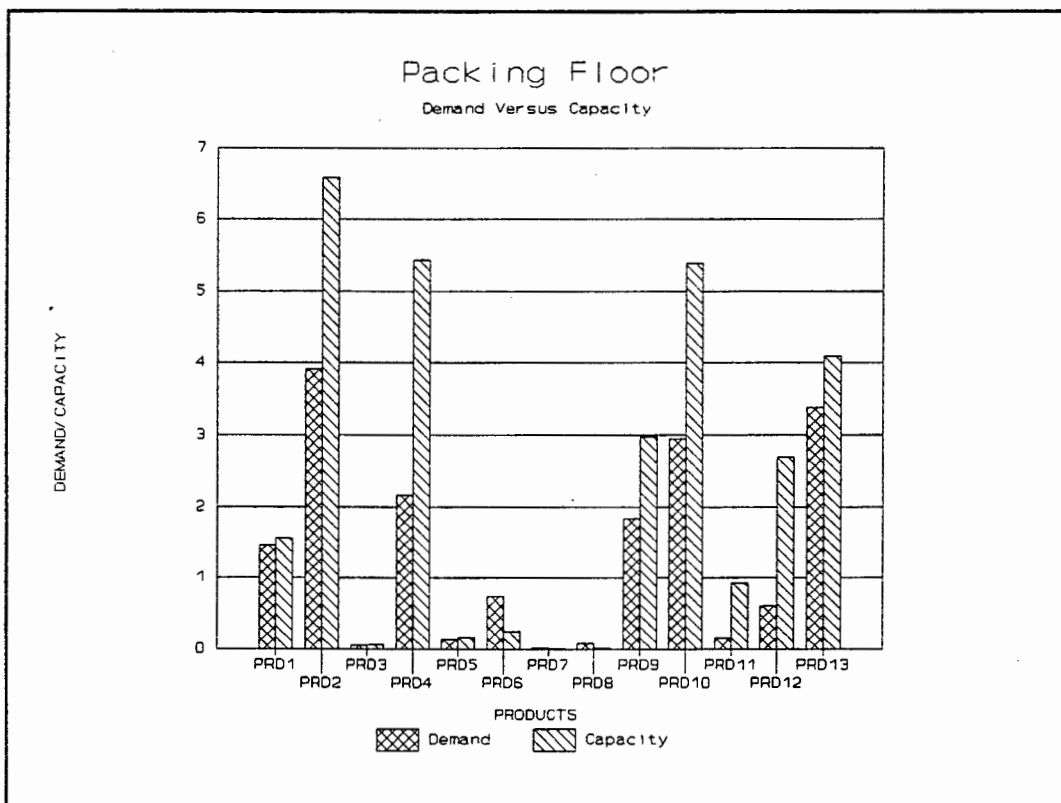


Figure 12

Results of the complete analysis are summarised in the final spreadsheet (APPENDIX D, Page 19, Spreadsheet 6). Graphs in FIGURE 12 and FIGURE 13 are based on the data of this spreadsheet. They illustrate the capacity situation at the Packing Floor and at the Mixing Floor. In these graphs, the available capacity is compared with the planned production.

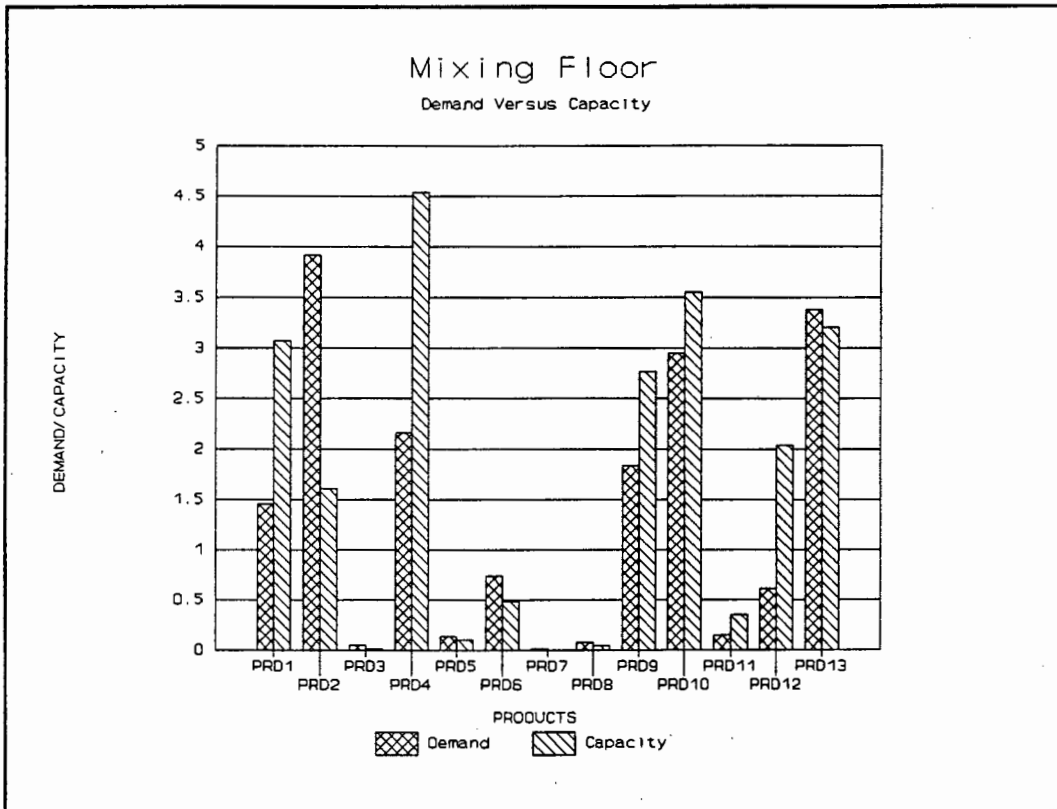


Figure 13

The following points are observed in Spreadsheet 6 (APPENDIX D, page 19) :

- The capacity available at the Packing Floor is only 1.4 time higher then the capacity of the Mixing Floor. This is a contradictory figure. The initial estimate of managers and supervisors was suggesting a ratio of 2.
- For 10 out of 13 comparable products, the *Relative Capacity Constraint* is at the Mixing Floor (*Spreadsheet 6, column 7*).
- There is a capacity shortage for 10 out of 19 listed products (*Spreadsheet 6, Column 11*). For 5 of these products it is at the Mixing Floor, for 2 of them at the Packing Floor and for 3 of them at both floors.
- There are shortages for individual capacities, but when the *Total Capacity* of Mixing and Packing Floors are compared with *Total Planned Production* (*Spreadsheet 6, columns 4, 5 & 6*), no capacity shortage is observed. That can be interpreted as an unbalanced capacity distribution which is not matching the demand profile rather than a capacity shortage. In APPENDIX D an example of this situation is given and a possible way of redistributing the capacity is illustrated.

5.3 Conclusion

When products are considered separately, a capacity shortage can be observed for some of them. But at the global scale, when the total demand is compared with total available capacity, no shortage can be observed. According to the information in *Spreadsheet 6* (APPENDIX D, page 19), *Total Planned Production* (*Column 4*) is *17.477 Tons/Day*, *Total Capacity* of *Packing Floor* (*Column 5*) is *30.138 Tons/Day* and *Total Capacity* of *Mixing Floor* (*Column 6*) is *21.782 Tons/Day*. This shows that, even at the *Mixing Floor* where the situation is tighter, there is an excess production capacity of *4.305 Tons/Day*.

These figures suggest that the production system should be able to cope, at least with the average demand, without using much overtime work. But in the actual situation, even during average demand periods, overtime is used extensively. This shows that, the present system has not been fully utilised.

Management has already taken some major decisions about the capacity upgrade, and about the implementation of a fully computerised planning and control system. These decisions are taken without being aware of the facts related to the capacity situation, and even worse, without having investigated the reasons of the existing problematic behaviour.

A fully computerised production planning and control system is an interface between people running the production system and the production system itself. It reduces the direct contact between these two parties. In production systems where the reasons of problematic behaviours have not been yet discovered, an interfacing together with a capacity increase, will cover these reasons even further. Consequently, this will reduce the chance of the management to discover them. Because of that, the same old problems or some metamorphic ones, will reappear in the future and will jeopardize the long term sustainability of improvements brought by today's changes.

In my present position I cannot influence the policy decisions that have already been taken. Therefore, instead of discussing what would have been a better alternative, I will try to find out the best way of implementing these decisions. By this way, I will be able to generate some applicable recommendations for the organisation, instead of developing a hypothetical alternative having only some theoretical value.

Two main decisions that are taken at the management level, are to increase the actual production capacity, and to use a computerised planning and control system.

It is necessary to test the effect of possible capacity increases and alternative production planning and control policies on the performance of the production system, under different demand scenarios. To run these tests on the actual production system is not only too risky but also extremely time consuming.

On the other hand, to deal with one subsystem in isolation as if it does not connect with anything else would be a major mistake. Real life is lived in a complex world system where all subsystems overlap and affect each other.

In complex systems, cause and effect generally are not closely related in time and space, therefore obvious solutions often fail to produce intended results. It is necessary to understand the general structure of the system, the nature of the cause and effect relations (i.e. the *dynamics* of the system) in order to estimate the short and long term consequences of the corrective action.

The *system dynamics* is a methodology for understanding certain kinds of complex problems. It focuses on feedback process and takes the philosophical position that feedback structures are responsible for the changes we experience over time. It also tends to look within a system for the sources of its problem behaviour. Systems behave as they do for reasons internal to each of them.

The *system as cause* perspective, changes radically the way we approach to problems. Instead of blaming external factors which are out of our control, it concentrates on the whole system as the source of the problem behaviour (Senge, 1986). The biggest benefit of the systemic viewpoint lies in distinguishing high from low leverage intervention points in the system for bringing sustainable improvements.

System dynamics modelling is used in the thesis to develop an insightful understanding of the systemic structure and the problem behaviours that it generates, and also to test the effect of alternative capacity increases and production planning policies under different demand scenarios. In this process the production system is considered as a whole and it has not been broken its components. In other words the approach that is used is holistic rather than reductionist.

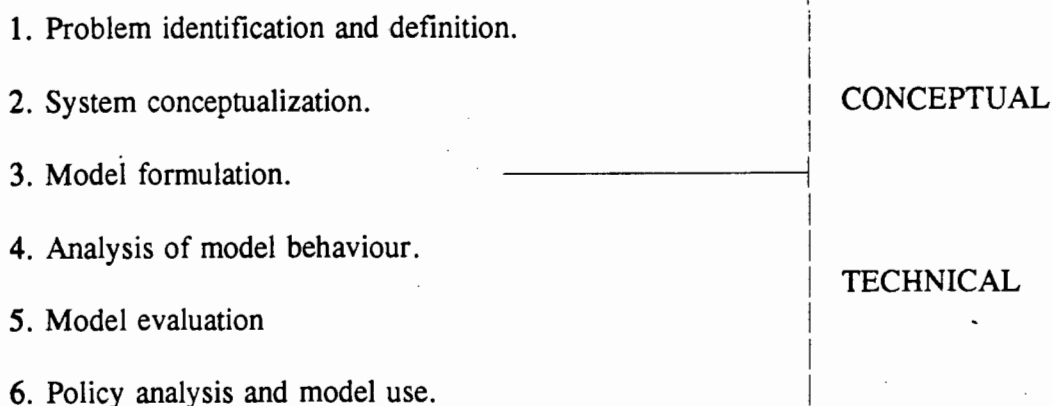
CHAPTER 6 : PHASE 4, SYSTEM DYNAMICS STUDY OF THE ACTUAL SITUATION

This phase is dealing with the application of System Dynamics (SD) approach to the actual situation at Moir's. Main stages of SD that are given at the beginning of this phase are used as section headings. Each section consists of a short description of the corresponding stage and the application of this stage to the current situation.

SD approach usually requires a large number of iterations until obtaining the final model. Details of the method and most of the iterations are given in APPENDIX E, not to divert the attention of the reader from the problem to the methodology.

6.1 Main Stages

There are roughly six stages in approaching a problem from *system dynamics* perspective :



The first three are called *conceptual stages* and the last four are called *technical stages*. *Model formulation* belongs to both groups. The process begins and ends with an understanding of system and its problems, so it forms a loop and not a linear progression. Understanding of the system and the problems are enhanced by the modelling process and that increased understanding further aids the modelling effort.

6.2 Problem Identification and Definition

The first stage in the model building process involves recognizing and defining a problem to study that is amenable to analysis in systems terms. Important properties of dynamic problems are :

- they contain quantities that vary over time,
- the forces producing this variability can be described causally,
- important causal influences can be contained within a closed system of *feedback loops*.

A feedback loop is a closed sequence of causes and effects, a closed path of action and information. An interconnected set of feedback loops forms a *feedback system*.

Defining problems that meet these characteristics is not a trivial matter. In fact, conceptual phases of the *system dynamics* approach are among the most difficult ones. Two very broad guidelines are helpful in reducing the complexity of the problem definition and conceptualization phases :

1. Have a clear purpose of the modelling effort.
2. Focus on a problem and not on a system.

A problem focus and a clear modelling purpose act as filters, screening out unnecessary details and centering the attention on the significant aspects of a feedback system.

In the case of Moir's, the primary purpose of modelling effort is, to develop an insightful understanding of the operating system. Alternative ways of improving its problem behaviours will emerge from this understanding. The secondary purpose of modelling will then be, to test the effect of these alternatives on the overall performance of the system. In this context, there will be a special emphasis on the alternative suggested by the management, i.e. on capacity increase, as a way of improving the performance.

Problematic behaviours which are under discussion and consideration for potential solutions are :

- high inventory level,
- excessive overtime work,
- vulnerability of the customer service to unexpected demand fluctuations.

All these problems are chronic in their nature. After an intervention usually one disappears and the other reappears. This observation can be related to the comments initially made about the short-term effect of symptomatic interventions used by the traditional approach (see CHAPTER 1). If we look at the situation from this aspect, these three points mentioned above, can be considered as the symptoms of the same problem rather than being three separate problems.

6.3 System Conceptualization

The second stage in the model building process involves committing to paper the important influences believed to be operating within the system.

Any problem viewed from the *system dynamics* perspective is likely to be first seen in terms of *system variables*. A *variable* is an element in a situation. It may act or be acted upon. Its value can vary up or down over time. A system variable is a category to which one time happenings belong. It is an entity which lasts through time. A *key system variable* is a system variable having an important role in the systemic structure. Therefore key system variables are critical in the analysis of a systemic structure.

With the production manager we have identified the following six key system variables for using in the initial model :

- Planned Production (Cases/Time),
- Total Production (Cases/Time),
- Finished Goods Inventory (Cases),
- Demand Forecast (Cases/Time),
- Orders (Cases/Time),
- Minimum Stock Cover (Cases/Time).

Developing an understanding of these variables does not require that the modeller has access to explicit numerical data or well-defined functions. While data is very helpful, one is often faced with a dynamic problem in which key variables are not traditionally quantified or tabulated. It is more likely that the modeller or the client knows the dynamic behaviour of interest without referring to data.

In the case of Moir's, I was acting as modeller and I did not have much idea about the dynamic behaviour of system variables. But, the Production Manager, who was one of the clients, was knowledgeable about the production system and about the patterns of change of different variables (originally he was perceiving them as critical parameters and not as system variables). He has given me a considerable assistance to identify them and to determine the relations in between.

One of the most fundamental ideas in the *system dynamics* approach to computer simulation and problem solving is the *system structure*. The structure of a system is the network of causal feedback loops necessary to explain why certain key elements within a system behave over time as they do. Representing the system structure in causal diagram form is a way of showing the relations between system variables and it must precede other forms of diagrams and equation writing for computer simulation.

Feedback processes divide naturally into two categories which are labelled *negative* and *positive*. *Negative feedback loops* attempts to negate any deviation from some equilibrium or goal state. They are also called goal-seeking loops. In contrast, *positive feedback loops* amplify deviations or disturbances around the loop. They are characterized as destabilizing, disequilibrating, growth-producing or self-reinforcing loops.

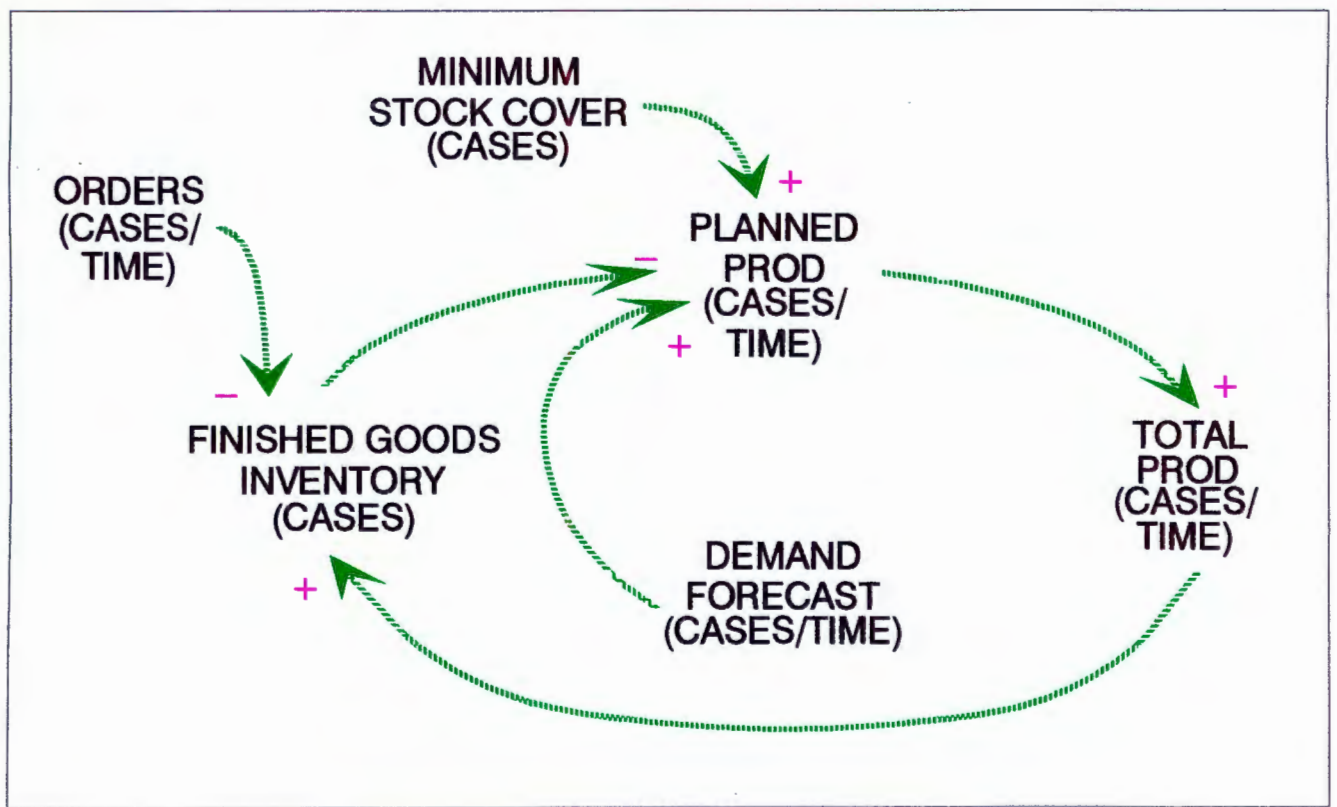
Developing the causal loop diagrams representing a system structure, is an iterative process. It starts with an initial attempt. This initial diagram helps the modeller to organise his/her ideas about the system structure, and thus enables him/her to identify more elements and relations. A causal loop diagram is, in a way, a self generating tool. Our initial causal loop diagram is given in CAUSAL LOOP DIAGRAM 1.

More information about the relation between variables can be conveyed by adding a " + " or a " - " sign at each arrowhead as it is shown in CAUSAL LOOP DIAGRAM 1. That is called *signing* the causal loop diagram. A " + " is used at the arrowhead to indicate that a change in the item at the tail of the arrow (e.g. Total Production) will cause a change in the same direction for the item at the head of the arrow (e.g. Finished Goods Inventory). The opposite is true for " - " sign, i.e. a change in the item at the tail of the arrow will cause a change in the opposite direction for the item at the head of the arrow.

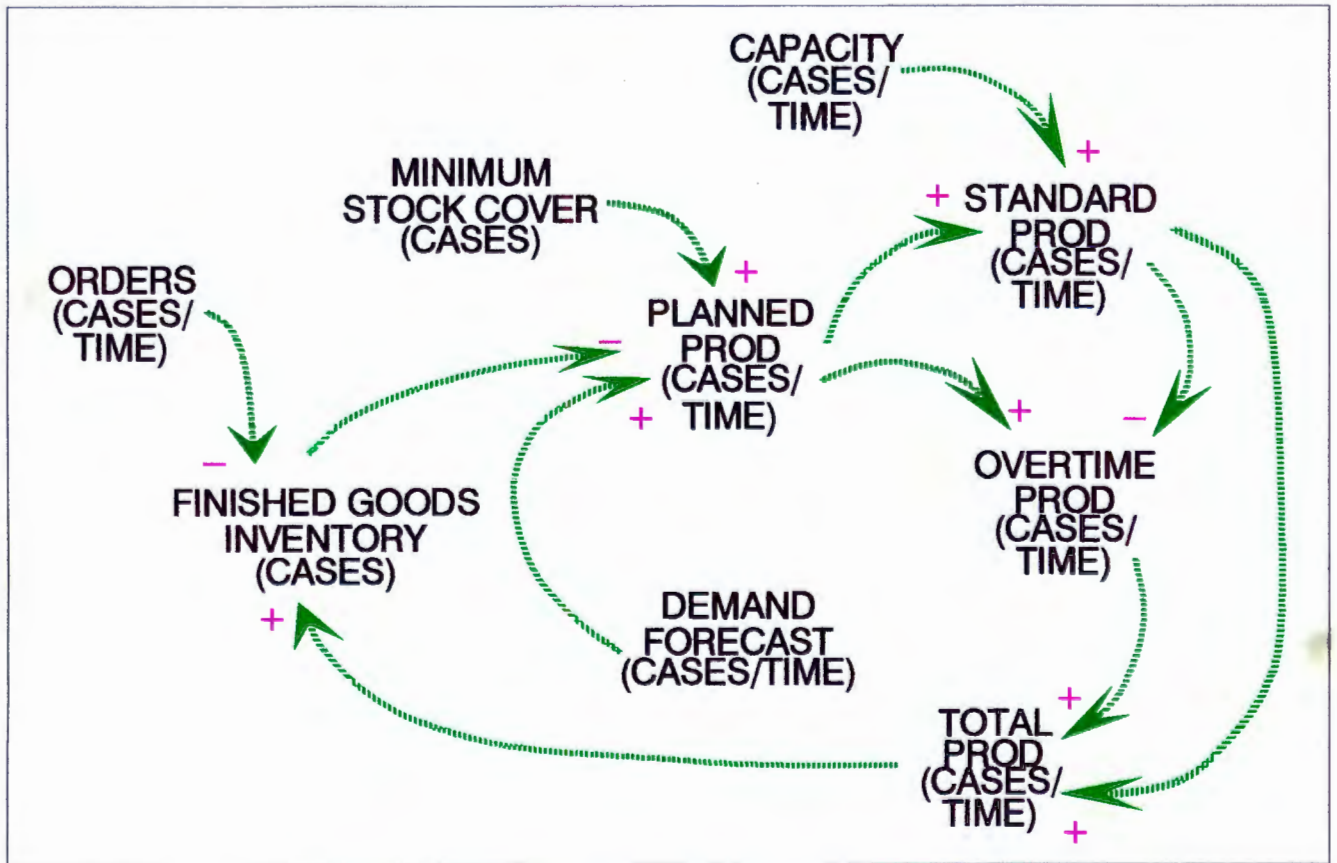
One way of reading the CAUSAL LOOP DIAGRAM 1 is given below. It is possible to start to read it from any point in the diagram, therefore there are different correct reading orders. In this example it starts from *Planned Production* and goes along the central loop.

An increase in *Planned Production* will increase the *Total Production*. As a result of the increased *Total Production* the *Finished Goods Inventory* will also increase. *Finished Goods Inventory* built-up will have an opposite effect on *Planned Production* (shown with " - " sign) and the latter will go down. On the other hand both *Minimum Stock Cover* and *Demand Forecast* have a reinforcing effect on *Planned Production*, i.e. as they go up the *Planned Production* will also go up. Finally, any increase of *Orders* will cause the *Finished Goods Inventory* to go down. The closed loop described above has a *goal-seeking* or *compensating* character. It will negate any deviation from some equilibrium or goal state.

To develop a causal loop diagram is a qualitative effort. There can be several different causal



CAUSAL LOOP DIAGRAM 1



CAUSAL LOOP DIAGRAM 2

loop presentations of the same situation, and they all can be valid in their terms. Therefore the agreement of different interested parties about the relevance of a causal loop diagram is quite important.

Feedback systems constructed by the joint effort of myself and the Production Manager are shown and explained to Factory Manager, to Operations Director and to some supervisors. More key system variables are added only after having reached a consensus about the relevance of the existing causal loop diagram. By this way we have moved from a simple general structure, to a more complex and detailed structure representing better the actual situation at Moir's.

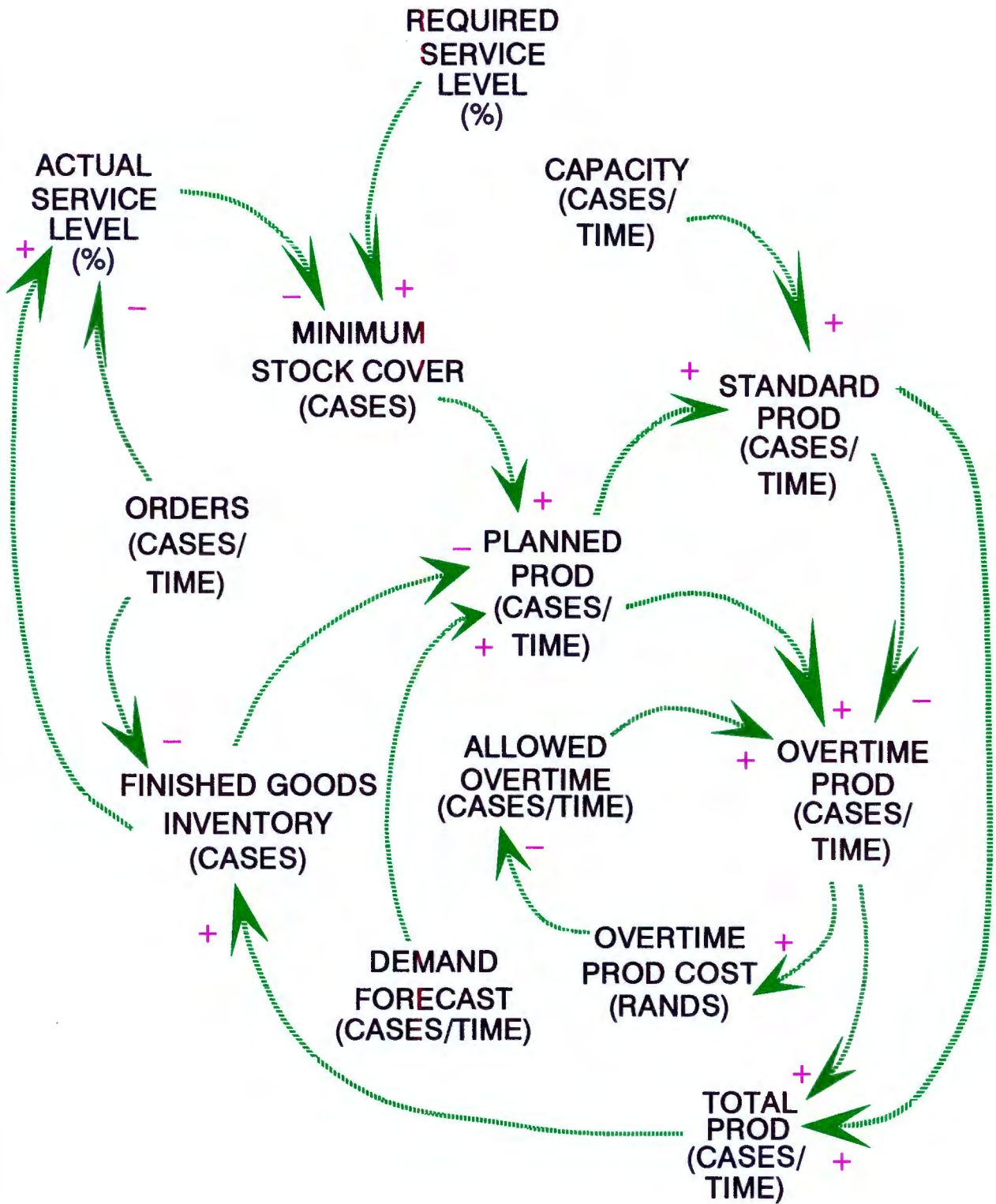
The initial causal loop diagram is enhanced step by step by adding more key variables and by connecting them to the existing feedback structure.

In CAUSAL LOOP DIAGRAM 2, three more key system variables are added to the structure. These are *Standard Production*, *Overtime Production* and *Capacity*.

Whatever is planned as *Planned Production* becomes a *Standard Production* or an *Overtime Production*. Therefore an increase of *Planned Production* will cause an increase of both *Standard* and *Overtime Production*. In the diagram this is shown by a positive arrow. The amount of *Standard Production* is related to *Planned Production* but also it is related to available *Capacity*. If there is more available *Capacity*, then it is possible to process a bigger portion of the *Planned Production* by using the *Standard Production*. This relation is shown by a positive arrow. On the other hand there is a reverse relation between *Standard* and *Overtime Production*. The more the *Standard Production* is used, the less will be the need for *Overtime Production* (shown with a negative arrow from *Standard* to *Overtime Production*). The last two causal relations are between *Standard Production* and *Total Production*, and between *Overtime Production* and *Total Production*. It quite obvious that *Total Production* is the sum of *Standard Production* and *Overtime Production*. In other word they both add to *Total Production*. Therefore these two relations are shown by positive arrows.

In the next step which is shown in CAUSAL LOOP DIAGRAM 3, the following four variables are added to the existing feedback system. *Actual Service Level*, *Required Service Level*, *Overtime Production Cost* and *Allowed Overtime*.

Actual Service Level is effected by two variables, *Orders* and *Finished Goods Inventory*. In fact, it is the gap between them that determines the *Actual Service Level*. The first one has a negative influence and the second one has a positive influence on *Actual Service Level*. There is a similar kind of relationship between *Minimum Stock Cover*, *Actual Service Level* and *Required Service Level*. *Minimum Stock Cover* is deduced from the difference between *Actual Service Level* and *Required Service Level*. In this case *Actual Service Level* is connected with a



CAUSAL LOOP DIAGRAM 3

negative and *Required Service Level* with a positive arrow to *Minimum Stock Cover*. The other two variables are added to explain better the tendency to use *Overtime Production*. The increase of *Overtime Production* will push the *Overtime Production Cost* up (positive arrow) and as the cost goes up, less and less overtime will be allowed (negative arrow from *Overtime Production Cost* to *Allowed Overtime*). This will create a pressure to reduce *Overtime Production* (a positive arrow is used because a change in *Allowed Overtime* will cause a change in the same direction for *Overtime Production*).

Three more variables are added at the last stage (*Purchase Orders*, *Raw Materials Supply* and *Raw Materials Inventory*). They are shown in CAUSAL LOOP DIAGRAM 4. But, as the final decision, they are left out of the system boundary. It is generally agreed that they were not adding significantly to the dynamics of the problem being addressed.

Therefore the final form of the feedback system is the one presented in CAUSAL LOOP DIAGRAM 3. The CAUSAL LOOP DIAGRAM 4 is given to illustrate, how the diagram can be developed further if it is necessary.

6.4 Model Formulation

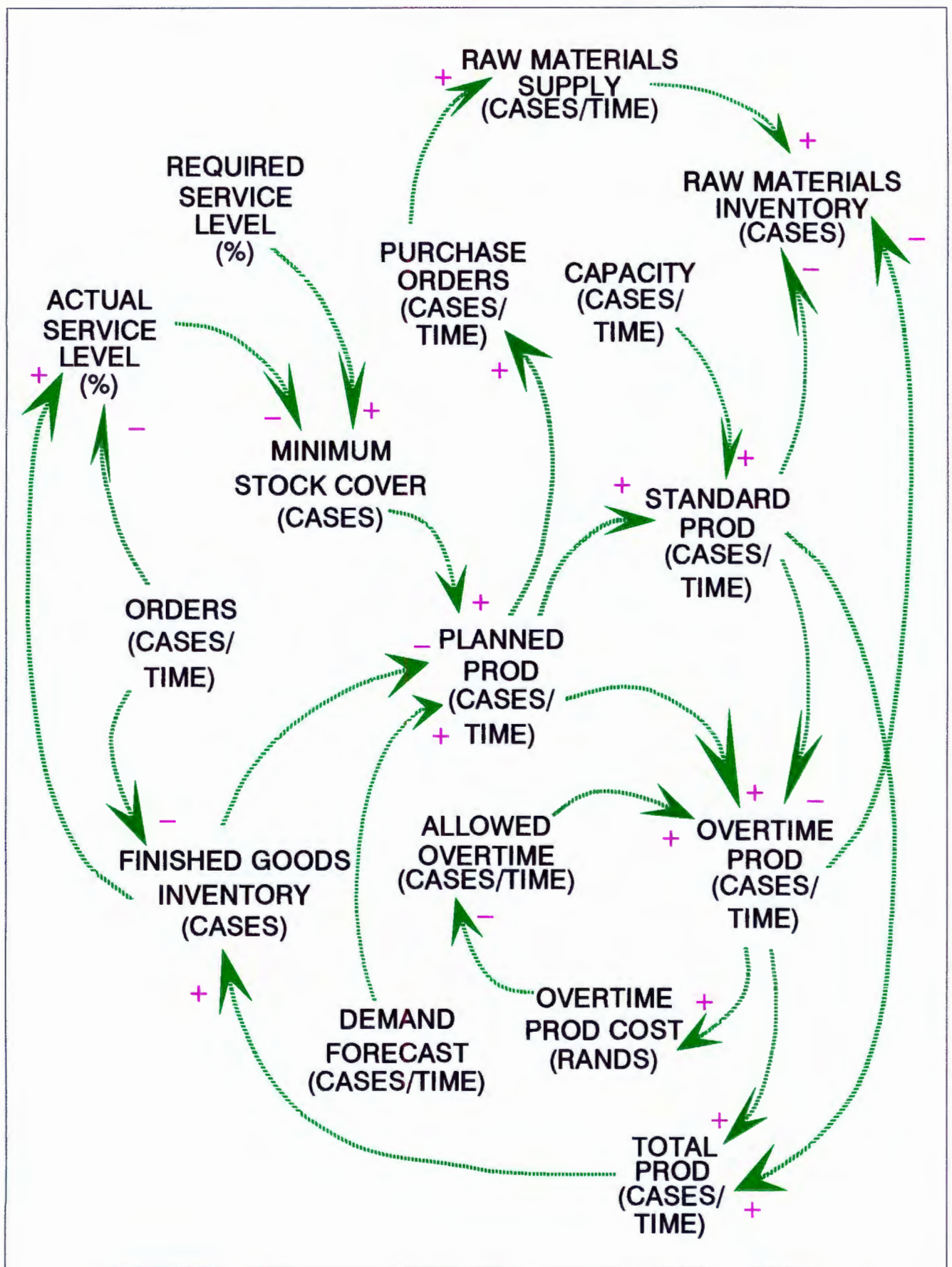
In the third stage of the model building process, causal loop diagrams developed in the conceptualisation phase, are converted into flow diagrams. These are then represented in the form of a code that can be fed into the computer.

The causal loop diagrams can provide much insight into the system's structure. But it is often difficult to infer the behaviour of the system from its causal loop representation.

The first step in moving from a causal loop representation to a computer simulation model, is the identification of system levels and rates. A level is a quantity that accumulates over time, and a rate is an activity, or movement, or flow that contributes to the change per unit of time in a level. For example *Finished Goods Inventory* is a level and *Total production* is a rate.

In identifying a system's levels and rates, it is generally helpful to represent the system in *flow diagram* form. FIGURE 14 depicts the symbols used in flow diagrams.

A level is shown by a rectangle (which is supposed to resemble a box or a bathtub), and a rate is shown by a symbol that looks somewhat like a valve. A rate might be thought of as a faucet controlling the flow of water into the bathtub.



CAUSAL LOOP DIAGRAM 4

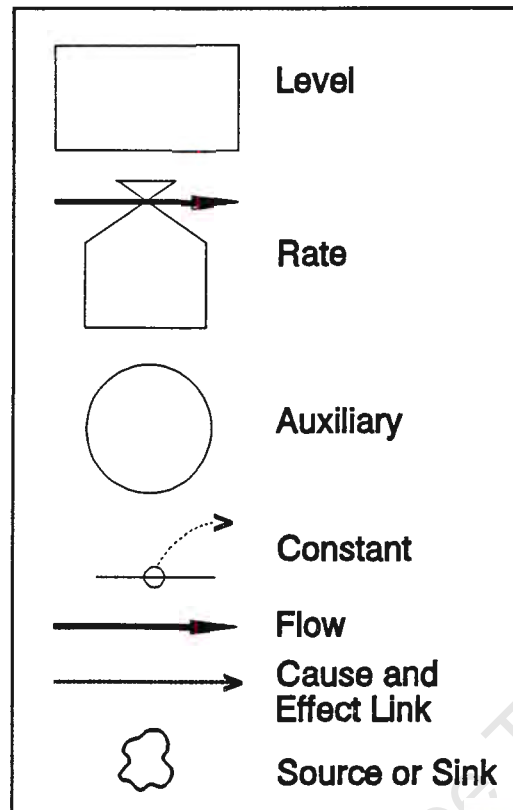
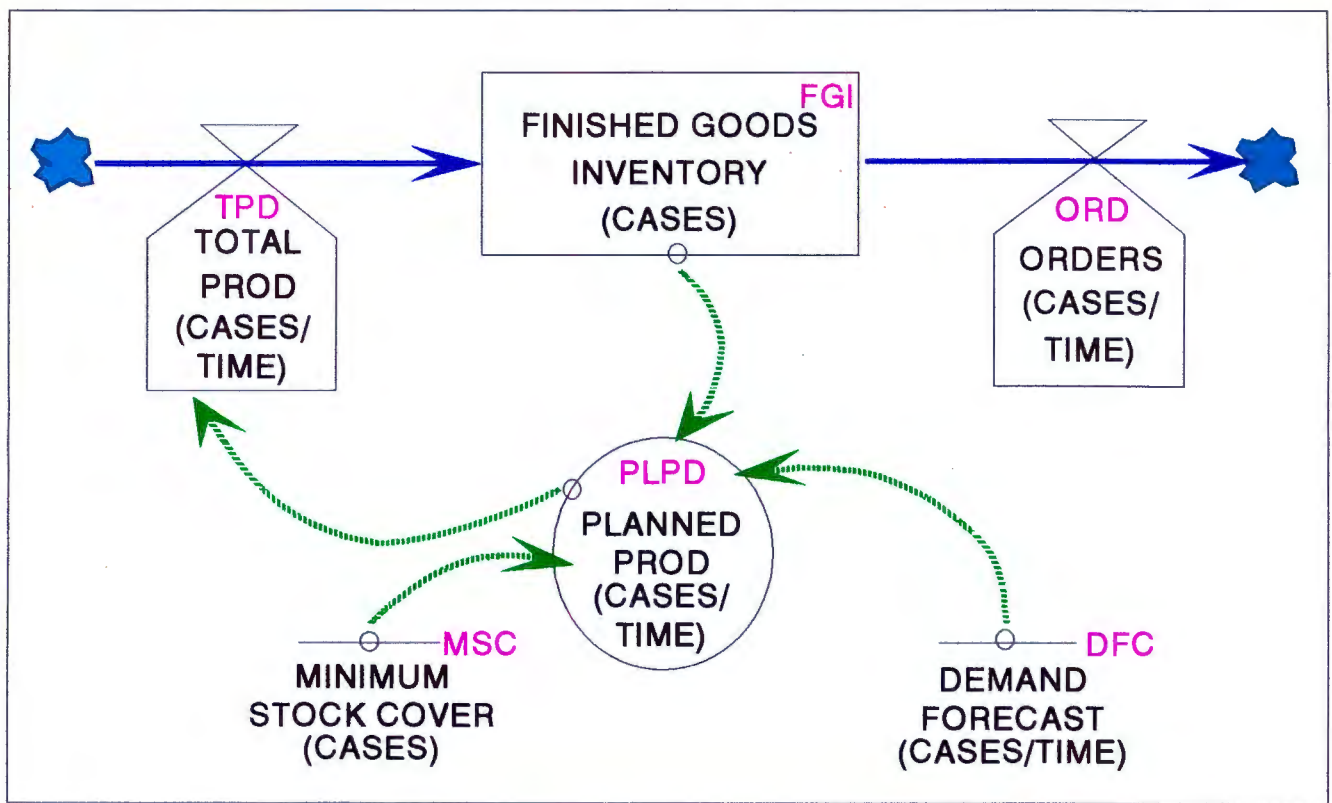


Figure 14

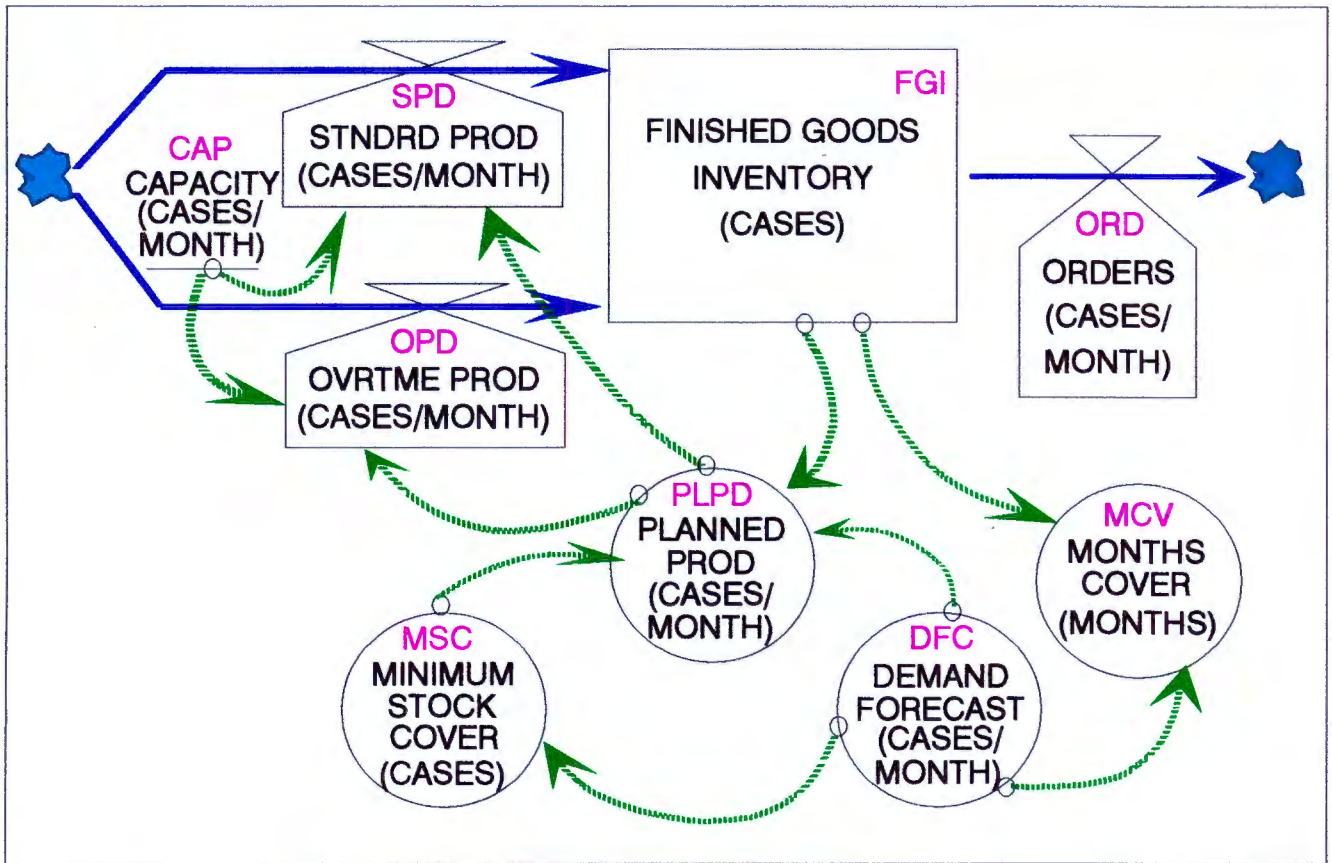
The *cloud* at the tail of the solid arrow represents the *source*. Sources are systems of levels and rates outside the boundary of the model. They can also be used to show *sinks*, where flows terminate outside the system.

The CAUSAL LOOP DIAGRAM 1 is converted to a flow diagram and the result is given in FLOW DIAGRAM 1. Material flows are shown with straight blue arrows (first one starts at the source and ends at *Finished Goods Inventory*, the second one starts at *Finished Goods Inventory* and ends at the sink). Information flows are shown with curved green arrows. The abbreviated forms of key variables are marked with red. These abbreviations are used when writing the simulation program in computer code.

The FLOW DIAGRAM 2 presents the feedback system shown in CAUSAL LOOP DIAGRAM 2 with two exceptions. The first exception is that, *Total Production* (which is simply equal to the sum of *Standard Production* and *Overtime Production*) is not shown at this stage. The second exception is that an auxiliary variable called *Months Cover* is added to CAUSAL LOOP DIAGRAM 2. *Months Cover* expresses the *Finished Goods Inventory* in terms of *Demand Forecast*. In other words, it gives the number of months that the actual inventory will last with the forecasted demand pattern, if there is no further production. *Months Cover* contains the additional information coming from *Demand Forecast*. Therefore it gives a better insight about the inventory situation than the *Finished Goods Inventory* itself.



FLOW DIAGRAM 1



FLOW DIAGRAM 2

As it is described in FIGURE 15, model formulation is a cyclic process. The model is developed further at every cycle until it reaches a stage that it can simulate the behaviour of the actual system under study. This model is then used in the later stages of the *system dynamics* approach. In fact, stages 4 and 5, *Analysis of Model Behaviour* and *Model Evaluation*, are already included, to some extent, in the model formulation process.

The purpose here, is to use the *system dynamics* model to better understand the system and its problem behaviours and also to test the effect of alternative capacity and buffer stock increases and production planning policies, in order to bring sustainable improvements. For the objective of this study, the use of the final model is more important than the way how it is obtained. Although some details are given about the way how the final model is obtained, the focus will be mainly on its utilisation.

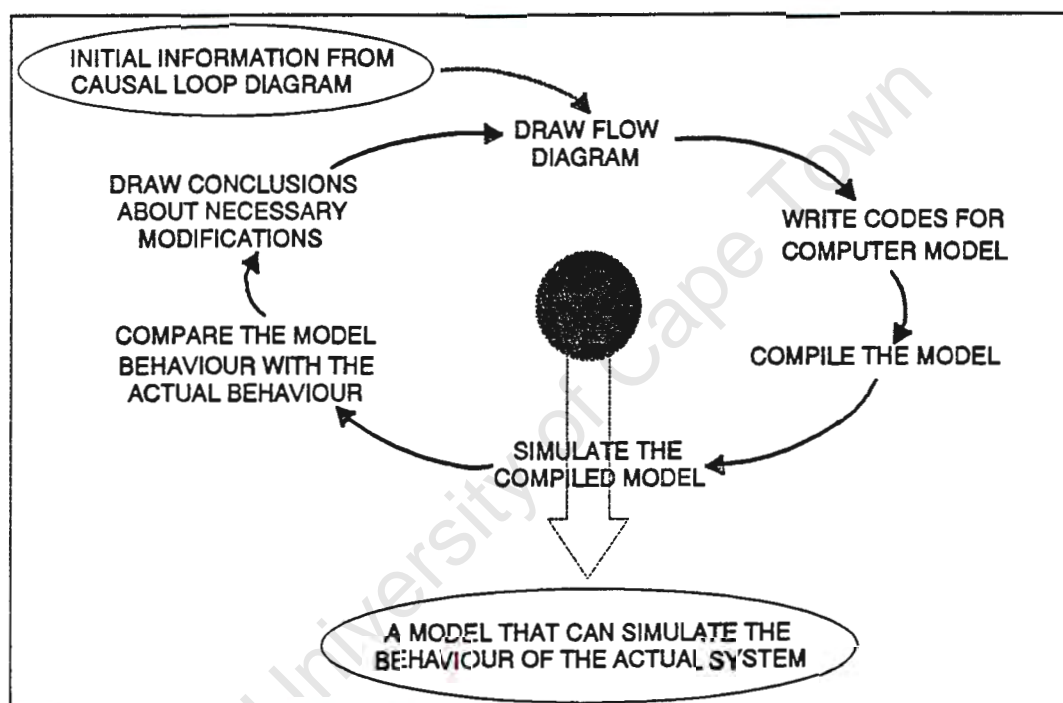


Figure 15

As it is shown in FIGURE 15, after drawing a flow diagram (by using the information supplied by the causal loop diagram), it is necessary to express it as a computer code, to compile the code and then to simulate the compiled model.

The use of computer requires a language in which simulation instructions can be given. The language that will be use in this study is called DYNAMO. DYNAMO is an acronym for DYNAMIC MODELS. Like BASIC, DYNAMO is used to direct the computer in the computations it should perform. Unlike BASIC, however, DYNAMO is not a general purpose

language. It is a special purpose language to aid in building computer models.

A DYNAMO statement begins with a letter or word to identify the type of statement. This letter or word is called the *statement identifier*. One or more blank spaces follows the statement identifier. DYNAMO uses blanks to separate different parts of a statement. The body of the statement follows the first set of blanks. Often the body is an equation, but it may direct DYNAMO to perform an output or some other function. Blanks should not be inserted in the middle of equations or other types of statements, except NOTE and * statements. DYNAMO statements may occur in any order, since DYNAMO will automatically order equations for proper computation. Hence, a variable can be referred to in an equation before its defining equation is given. The general format of DYNAMO statements and different statement types are given below.

STATEMENT IDENTIFIER	BLANK(S)	BODY OF STATEMENT
-------------------------	----------	-------------------

*	Page Heading
L	Level
R	Rate
A	Auxiliary
N	Initial Value
C	Constant
T	Table
SAVE	Variables To Be Saved
SPEC	Specification
NOTE	Comment

The use of *timescripts* is another feature particular to DYNAMO. Timescripts are postscripts like .K and .JK. They can be seen in the listing of PRODUCTION PLANNING POLICY MODEL 1.

Timescripts indicate the time relation among different variables. The first level equation of *Production Planning Policy Model 1* can be read as :

Finished Goods Inventory at period K. (*FGI.K*) = *Finished Goods Inventory* of the previous period (*FGI.J*) + whatever is produced as *Standard Production* (*SPD.JK*) + whatever is produced as *Overtime Production* (*OPD.JK*) between periods J and K (which is *DT*) - customer *Orders* during the same interval (*DT*).

* **PRODUCTION PLANNING POLICY MODEL 1**

L FGI.K=FGI.J+DT*(SPD.JK+OPD.JK-ORD.JK)
N FGI=8

```

R  SPD.KL=CLIP(PLPD.K,CAP,CAP,PLPD.K)
R  OPD.KL=CLIP(PLPD.K-CAP,0,PLPD.K,CAP)
R  ORD.KL=TABLE(TORD,TIME.K,0,19,1)
T  TORD=3/4/6/9/5/2/3/8/5/4/3/4/6/9/5/2/3/8/5/4
A  PLPD.K=DFC.K-FGI.K+MSC
A  DFC.K=TABLE(TDFC,TIME.K,0,19,1)
T  TDFC=4/5/6/8/4/3/3/7/6/3/4/5/6/8/4/3/3/7/6/3
C  MSC=6
C  CAP=5

```

```

SAVE FGI,SPD,OPD
SPEC REL_ERR=.1/DT=1/LENGTH=19/SAVPER=1

```

Production Planning Policy Model 1 is given here as an example of a simple DYNAMO model. Detailed explanation of this model and of following intermediate models (*Production Planning Policy Model 2, 3, 4 and 5*) are given in APPENDIX E.

```

*  PRODUCTION PLANNING POLICY MODEL 6
*  CHANGES: MOD> FGI, SPD, OPD, TPD, ACT, PLPD
*           DEL> FFGI, REL_ERR

L  FGI.K=FGI.J+DT*(TPD.JK-ACT.JK)
N  FGI=2
A  SPD.K=MIN(PLPD.K,CAP)
A  OPD.K=MIN(CLIP(PLPD.K-CAP,0,PLPD.K,CAP),.5*CAP)
R  TPD.KL=SPD.K+OPD.K
R  ACT.KL=MIN(ORD.KL+DOR.K,FGI.K+TPD.KL)
L  DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)
N  DOR=0
R  ORD.KL=TABLE(TORD,TIME.K,0,38,1)
A  ASL.K=ACT.KL/(ORD.KL+DOR.K)
T  TORD=3/3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4^
    /6/3/4/6/9/5/2/3/8/5/4/3/4
A  PLPD.K=MAX(DFC.K-FGI.K+MSC.K,0)
A  DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T  TDFC=3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6/3^
    /3/5/6/8/6/4/5/7/4/3/3/5/5
A  MSC.K=SCP*DFC.K
A  MCV.K=FGI.K/DFC.K
C  CAP=5
C  SCP=1

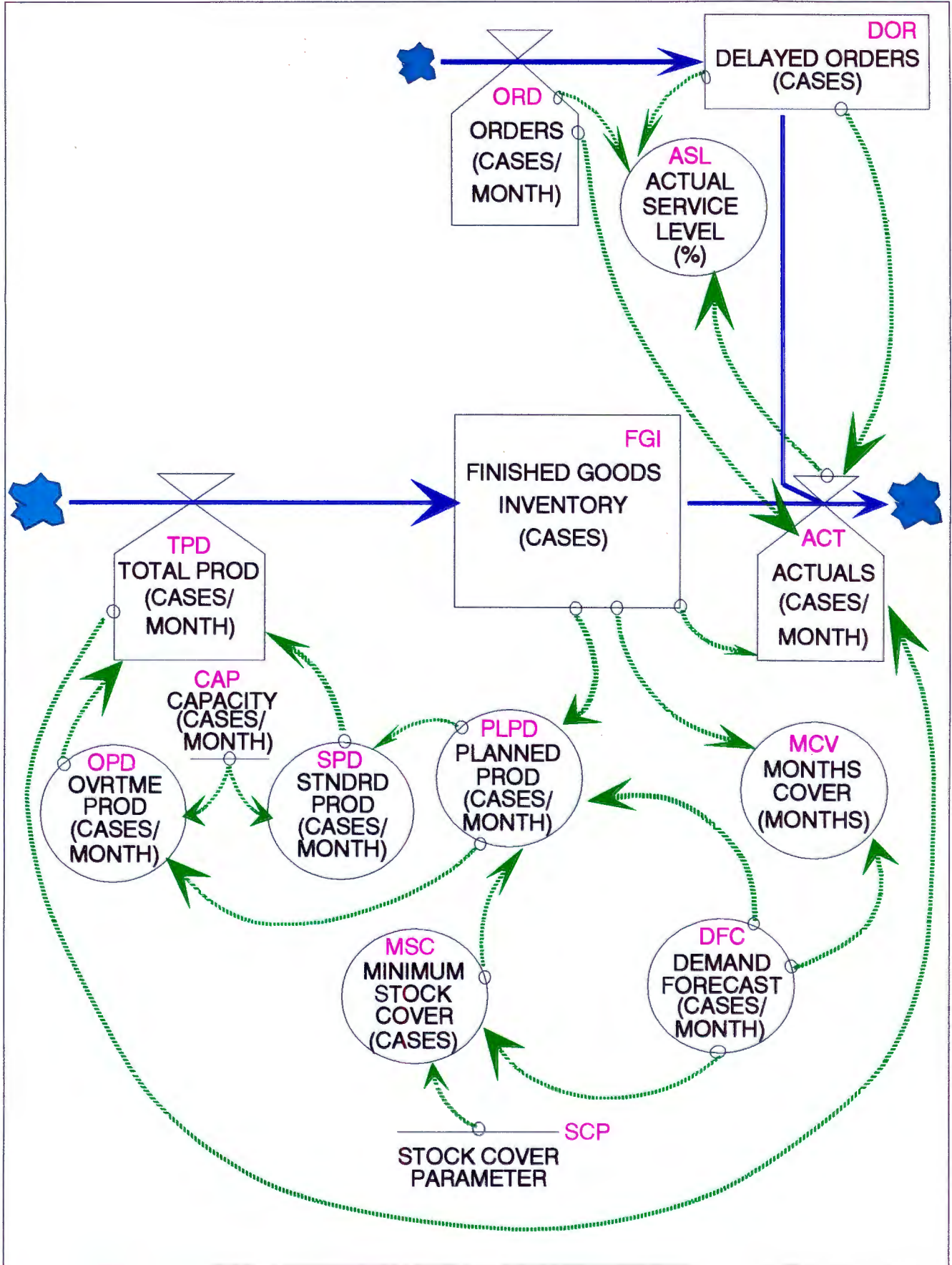
```

```

SAVE FGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD
SPEC DT=1/LENGTH=38/SAVPER=1

```

The structure which is depicted in FLOW DIAGRAM 4 and which is encoded in PRODUCTION PLANNING POLICY MODEL 6 is the final output of the cyclic process of



FLOW DIAGRAM 4

model formulation which is described in FIGURE 15. It is believed that, this model can simulate, the behaviour of the actual system under study in a satisfactory way. It is also believed that, it is not possible to re-create the reality by using a computer model. The real life is too complex to be simulated with all its perspectives. All models are some approximations of the reality. They represent some aspects of it. As this final model can generate an insightful simulation about the behavioral pattern which is relevant for this study, it can be used in the next stage of the analysis. It is necessary to keep in mind that, the model is only a tool and not the objective of this study.

6.5 Analysis of Model Behaviour and Model Evaluation

At the beginning of this section, the *critical system* variables are selected. There are two categories of critical system variables. The ones falling in the first category present directly the problematic behaviours that are at the focus of the study. These are :

- *Actual Service Level (ASL)* presenting the customer service level (problematic behaviour = vulnerability of customer service level to unexpected demand fluctuations),
- *Overtime Production (OPD)* presenting the use of overtime work (problematic behaviour = excessive overtime work)
- *Months Cover (MCV)* presenting the level of finished goods inventory (problematic behaviour = high finished goods inventory)

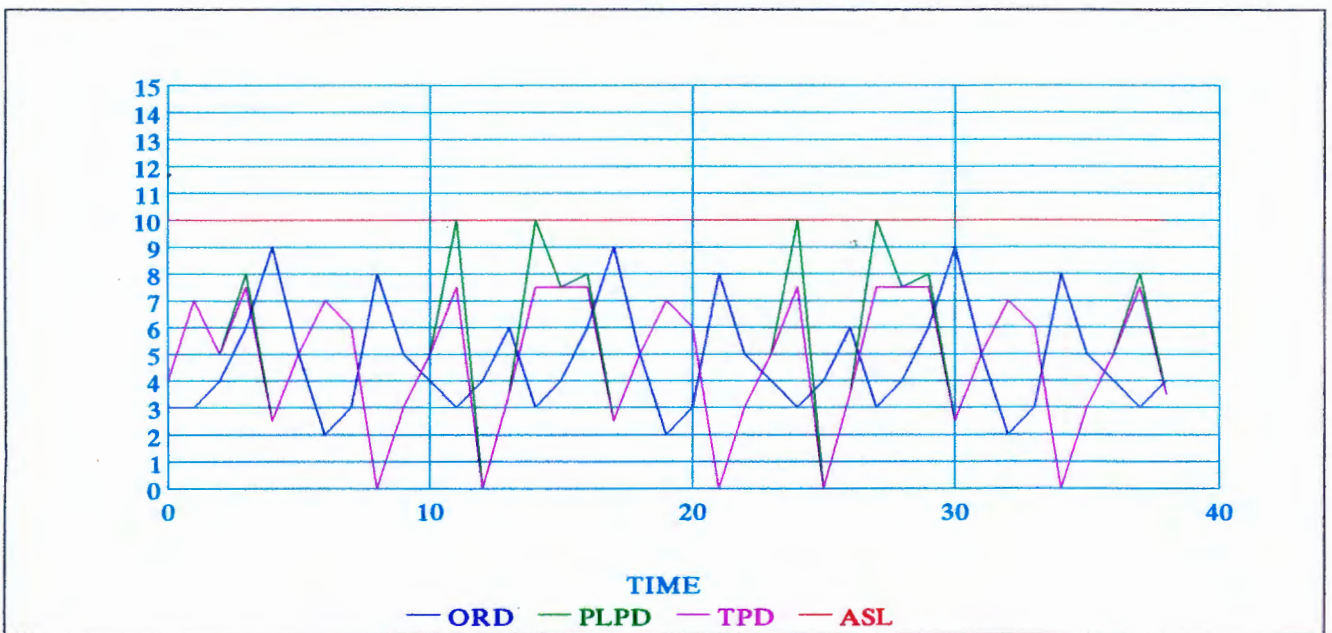
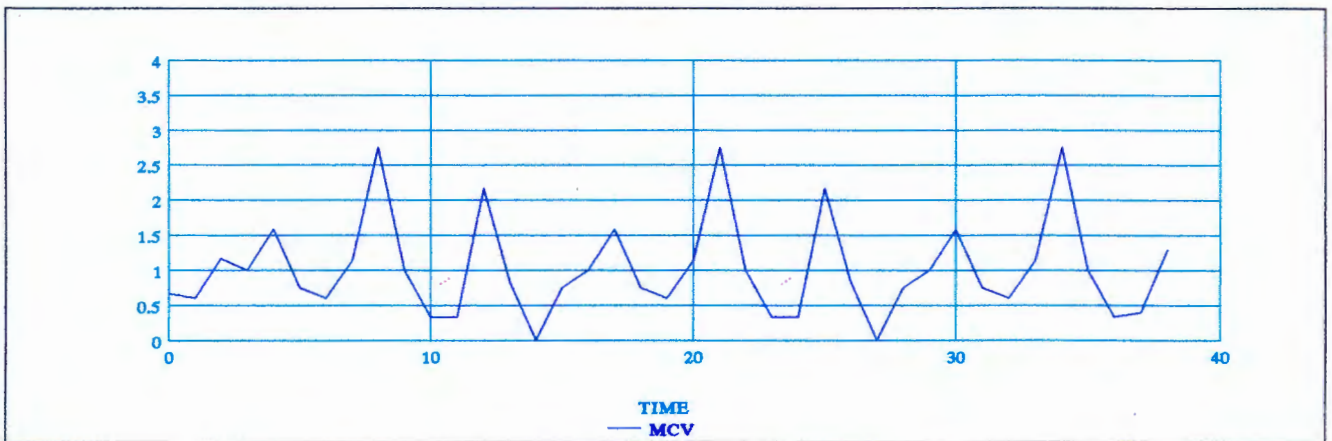
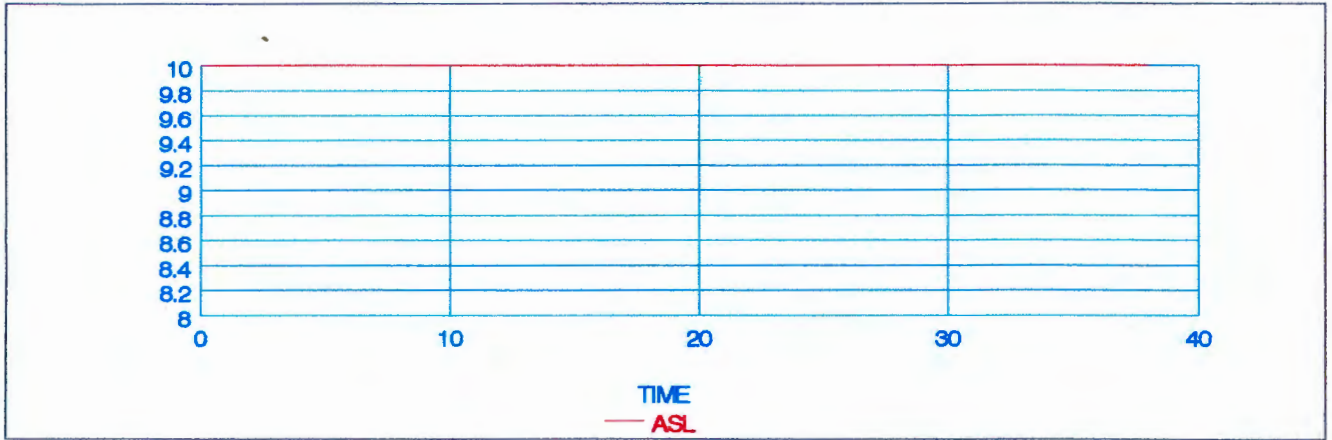
The ones falling in the second category have an explanatory function. Their pattern of change over time, that can give an insight about the behaviours of variables from the first category. These are namely, *Orders (ORD)*, *Planned Production (PLPD)*, *Total Production (TPD)* and *Standard Production (SPD)*.

PRODUCTION PLANNING POLICY MODEL 6 (PPPM6) is used to simulate the behaviour of the dynamic system depicted in FLOW DIAGRAM 4 under different test conditions. Simulated values of critical variables are plotted against time. These graphs are then used to analyse of the actual behaviour of the system and to develop alternative ways of improving them.

GRAPH SET 1.1 shows the behaviour of PPPM6 under standard conditions with present *Capacity (CAP)* of 5 hundred tons/month and *Stock Cover Parameter (SCP)* of 1 month. According to graphs presented in GRAPH SET 1.1 :

- *Actual Service Level (ASL)* stays at 100 % all along the simulation.
- *Months Cover (MCV)* goes up to 2.7 months although the target figure is 1 month

PPPM6 (CAP=5 SCP=1)



GRAPH SET 1.1

($SCP=1$), and also it drops to 0 at two points but this does not effect ASL .

- *Planned Production (PLPD)* follows *Orders (ORD)* with a more or less constant delay.
- *PLPD* and *Total Production (TPD)* are very close to each other, i.e, the system can produce most of the planned quantities.

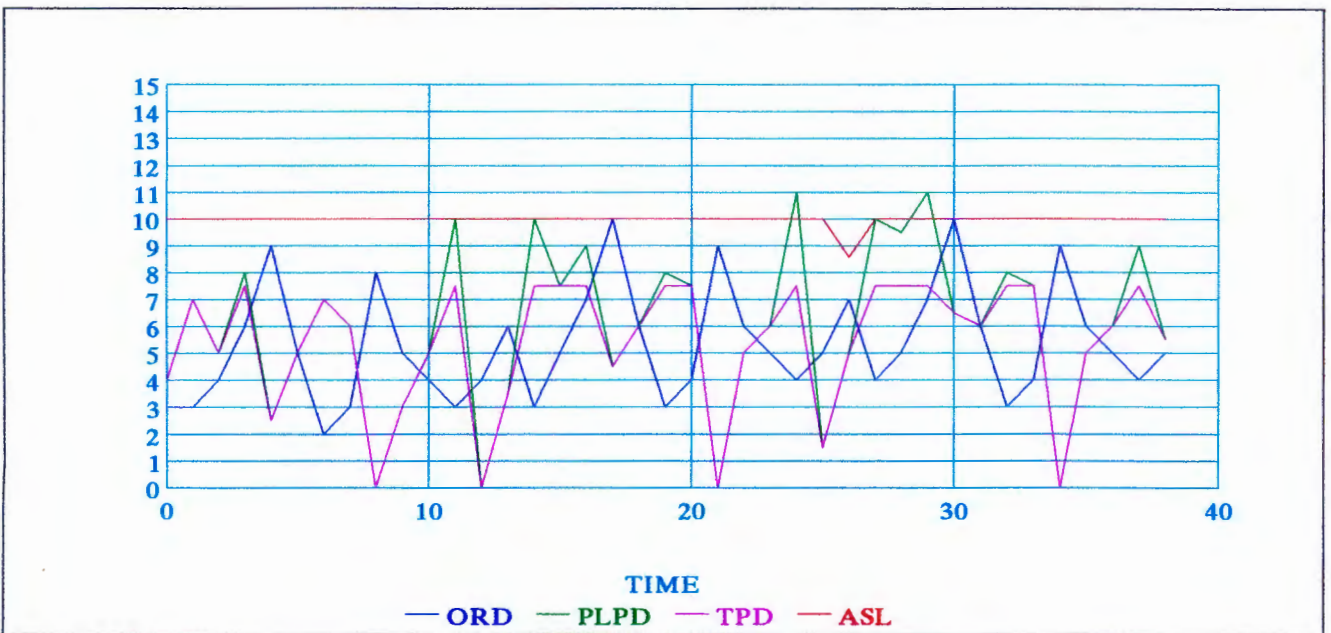
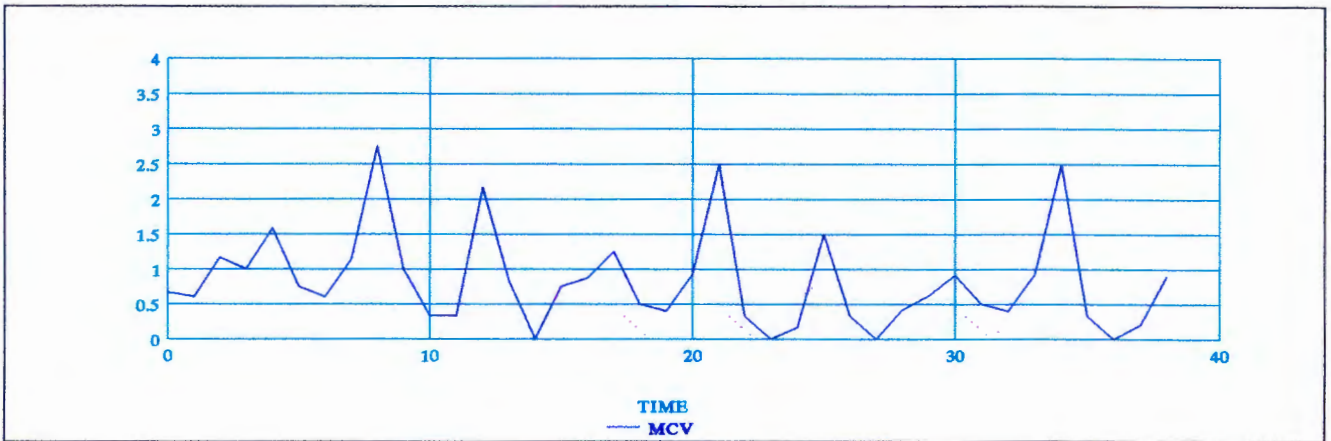
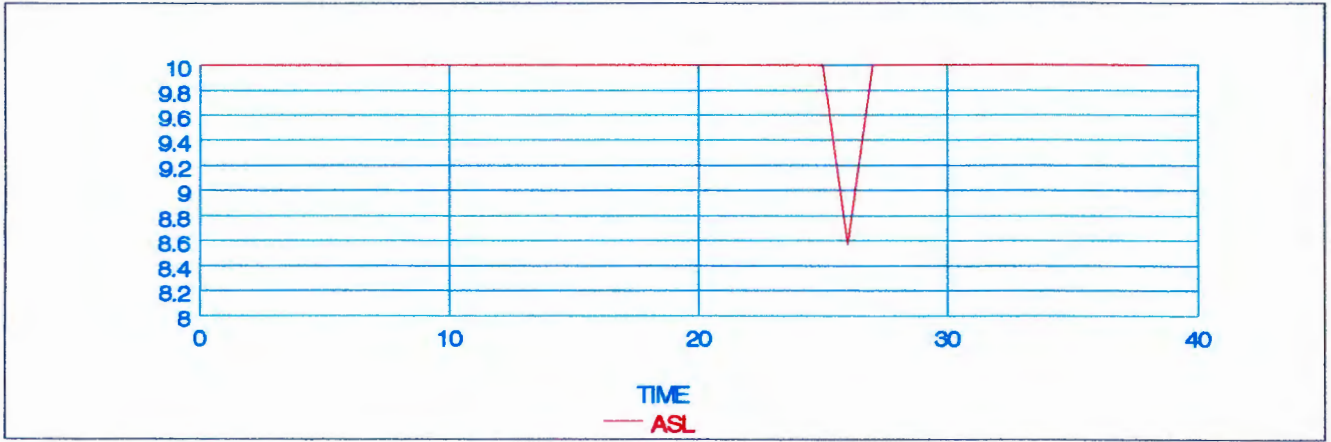
Once the simulation is started in equilibrium conditions, it is often useful to see how the system responds to exogenous (i.e. outside the system) disturbances. In this study a sudden shift of *Orders (ORD)* is considered. It is simulated by using a special DYNAMO function called the STEP function. Details about the STEP function and DYNAMO codes of the test model PRODUCTION PLANNING POLICY MODEL 6T1 are given in APPENDIX E.

The behaviour of the test model PRODUCTION PLANNING POLICY MODEL 6T1 (PPPM6T1) with initial CAP and SCP values is given in GRAPH SET 1.2. According to this :

- *Actual Service Level (ASL)* drops to 86 % at period 27, after the STEP increase of *Orders*.
- *Months Cover (MCV)* fluctuates between 2.7 and 0 months. The third time it drops to 0, ASL also goes down to 86 %.
- *Planned Production (PLPD)* has the same pattern as in the previous case until the STEP increase of *Orders*. After this point it reaches to higher values. This shows that the production planning system reacts to the sudden shift in *Orders* and tries to push the manufacturing system to produce higher quantities.
- Compared to GRAPH SET 1.1 a bigger gap is observed between *PLPD* and *TPD* after the increase of *ORD*. This can be interpreted as the disability the manufacturing system to meet the production plans.

The model behaviour which is observed in GRAPH SET 1.2 is representative of the real life behaviour of the manufacturing and production planning system, under fluctuating demand conditions. Therefore it is taken as a reference graph to be used in evaluating the effect of improvement alternatives on the performance of the system.

PPPM6T1/STEP TEST (CAP=5 SCP=1)



GRAPH SET 1.2

6.6 Policy Analysis and Model Use

For a given system structure, there are two constants that can be modified while trying to improve the systemic behaviour. These are *Capacity (CAP)* and *Stock Cover Parameter (SCP)*. If a satisfactory improvement cannot be brought by modifying them, then the system structure has to be changed. There is a limit to the amount of improvement that can be brought by modifying constants, after a point, the structure itself becomes the limiting factor.

The reasoning behind the decision taken by the management about the capacity increase can be explained by using GRAPH SET 1.2.

" Production planning system can react to the sudden increase of *Orders* by pushing *PLPD* values up, but the manufacturing system cannot follow these increased *PLPD* values. The gap between *PLPD* and *TPD* proves this fact. That is the reason of the drop in *Actual Service Level*. Manufacturing system cannot meet *PLPD* because of insufficient capacity. Therefore the capacity increase will be the solution of the problem. "

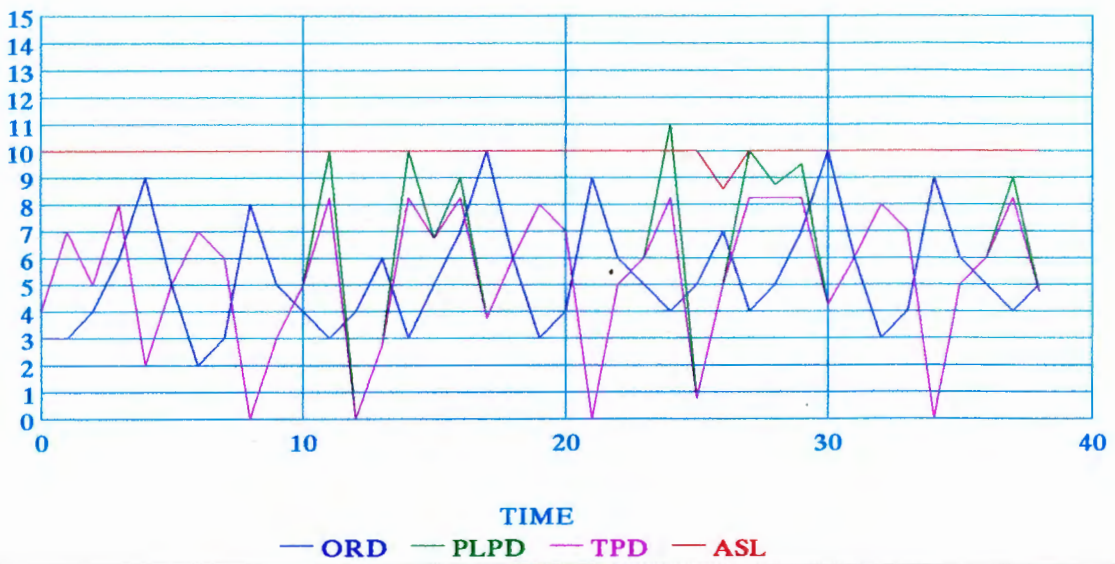
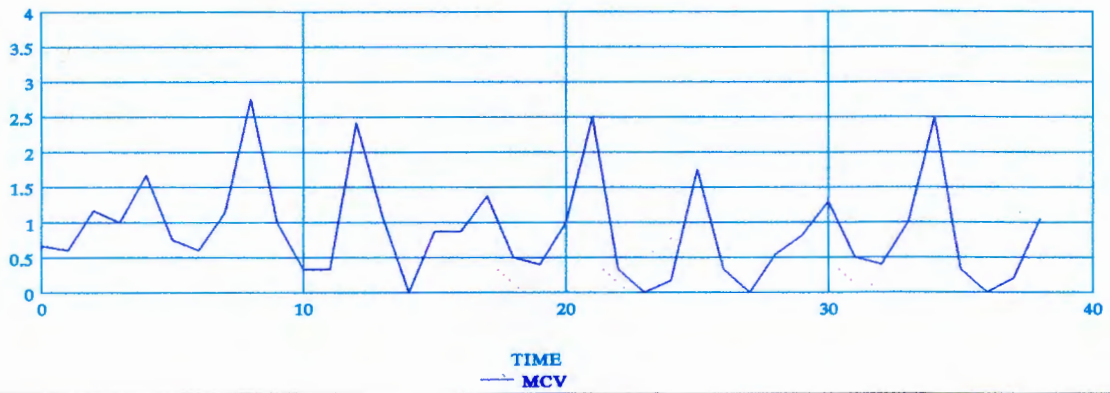
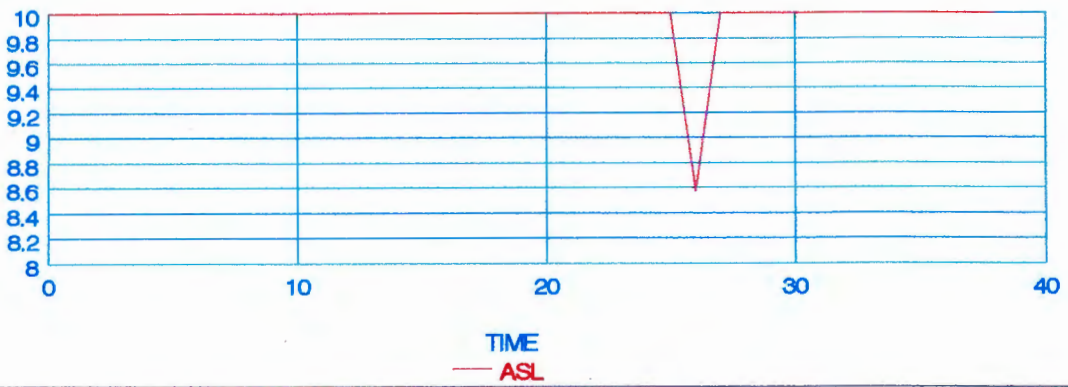
To evaluate the validity of this reasoning, the effect of capacity increase is simulated by using the test model PPPM6T1 and a *CAP* value of 5.5 (i.e 550 tons per month). Results of this simulation are given in GRAPH SET 1.3.

The consequences of capacity increase (from 5 to 5.5) can be summarized in the following way :

- *Actual Service Level (ASL)* still drops to 86 % at period 27, after the STEP increase of *Orders*.
- *Months Cover (MCV)* has more or less the same pattern as it has with $CAP=5$.
- *Planned Production (PLPD)* has a pattern which is very similar to the one of the previous simulation. In other words the capacity increase does not change the way the production planning system reacts to the increase of *Orders*.
- Compared to GRAPH SET 1.2 a smaller gap is observed between *PLPD* and *TPD*.

As it has been expected by the management, the capacity increase reduces the gap between *PLPD* and *TPD*. However, in contradiction with their expectations, it does not improve the *Actual Service Level* at all. *ASL* still goes down to 86 % after the STEP increase of *Orders*. Although some intermediate improvements can be achieved by increasing the capacity, the vulnerability of *ASL*, which is one of the major problematic behaviours, remains the same. This counter intuitive response of the system to the capacity increase is confusing and difficult to explain at this stage.

PPPM6T1/STEP TEST (CAP=5.5 SCP=1)



GRAPH SET 1.3

As the capacity increase fails to bring a noticeable improvement, the modification of the other constant, i.e. of *Stock Cover Parameter (SCP)*, is used as a mean of improving the systemic behaviour. *SCP* presents the number of months that the actual inventory should last if there is no further production. It is a contingency measure for keeping the *ASL* at a desired level in case of unexpected demand fluctuations. But high *SCP* values encourage undesired inventory build-ups. The initial value of *SCP* which is equal to one month, is not sufficient to keep *ASL* at 100 %. To increase this value slightly, may help to maintain a high *ASL*. The effect of this modification is tested on PPM6T1 by increasing *SCP* from 1 to 1.25 month. Results are given in GRAPH SET 1.4.

GRAPH SET 1.4 shows that, *SCP* increase is more effective than *Capacity* increase for improving *ASL*. But besides the positive effects, *SCP* increase has some negative effects as well. For example it pushes the *Months Cover (MCV)* up to 3.1 months.

High finished goods inventory is a problematic behaviour of the system. The original maximum *MCV* figure of 2.7 months is already too high when it is compared with the target of one month (set by the Factory Manager). A *Months Cover* which is equal to 3.1 months is beyond the acceptable limit, even with a target of 1.25 month (set by the increased $MCV=1.25$).

The following observations can be made in GRAPH SET 1.4 :

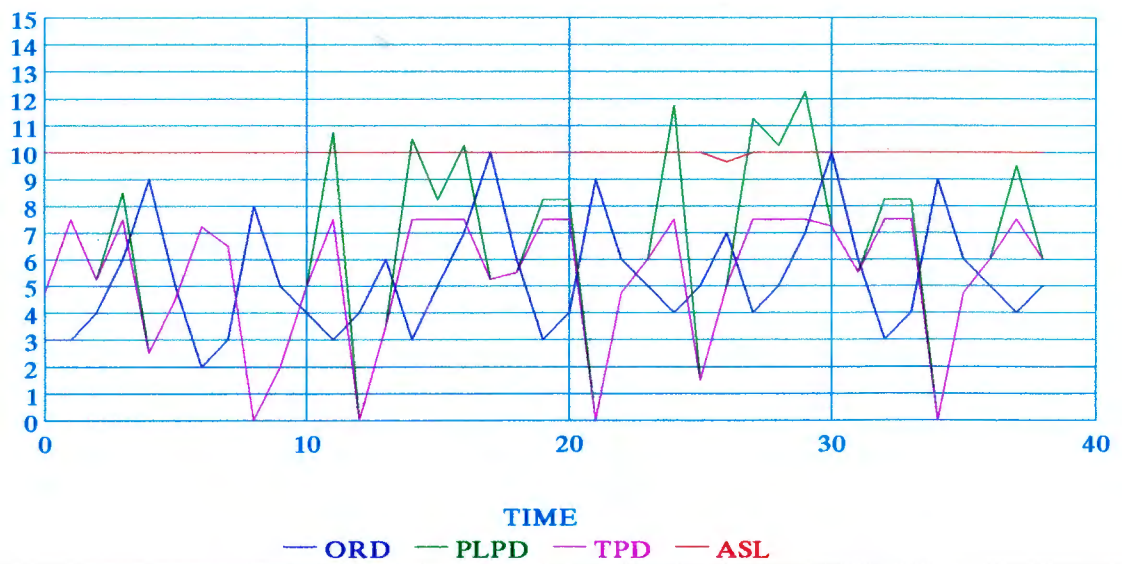
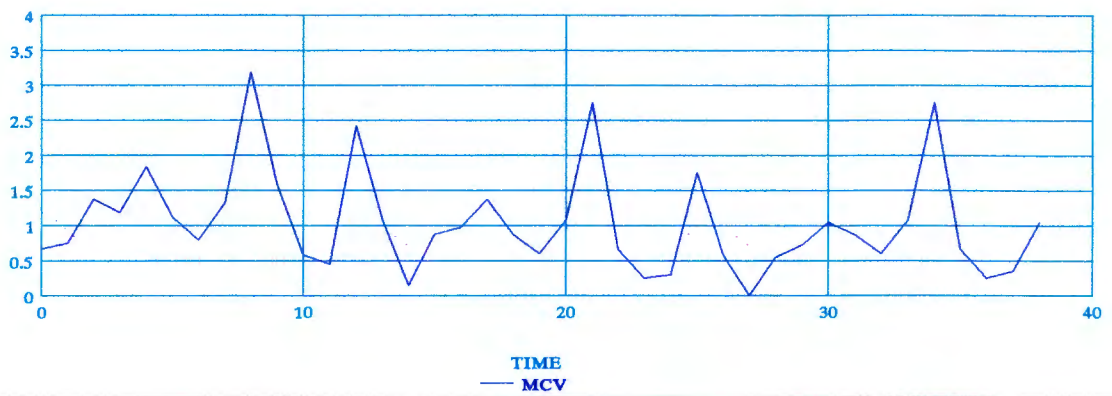
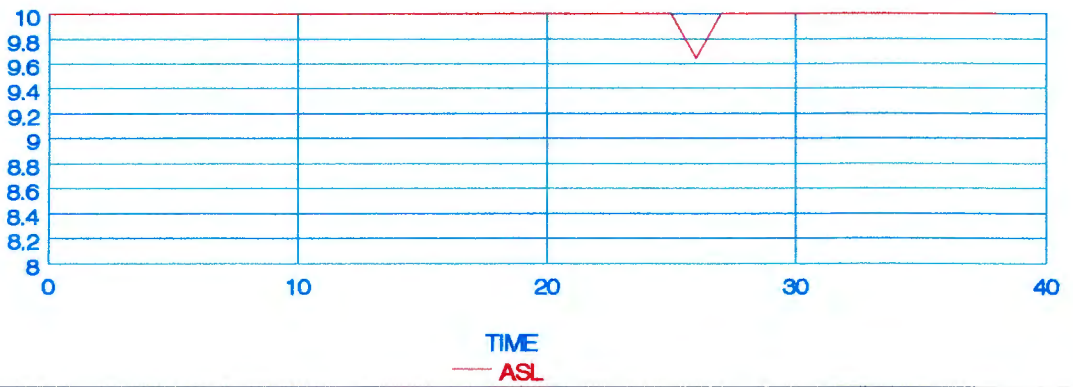
- *Actual Service Level (ASL)* drops only to 96 % at period 27. This is a considerable improvement in comparison with 86 % *ASL* of previous cases.
- *Months Cover (MCV)* drops to 0 only once. But at the same time, it reaches to higher values (3.1 at period 8) than previous cases.
- *Planned Production (PLPD)* figures are higher than previous simulations. The increase of *SCP* effects the behaviour of the production planning system.
- Compared to earlier simulations, there is a bigger gap between *PLPD* and *TPD*. This shows that production system cannot keep up with production plans.

96 % *ASL* and only one stock-out case ($MCV=0$) can be considered as improved behaviours. But on the other hand, the increase in average *MCV* and the bigger gap between *PLPD* and *TPD* are clearly undesired behaviours.

In the next simulation *SCP* is further increased to 1.5 to see whether it is possible to create more behavioural changes in the same direction. According to the results of this simulation which are given in GRAPH SET 1.5 :

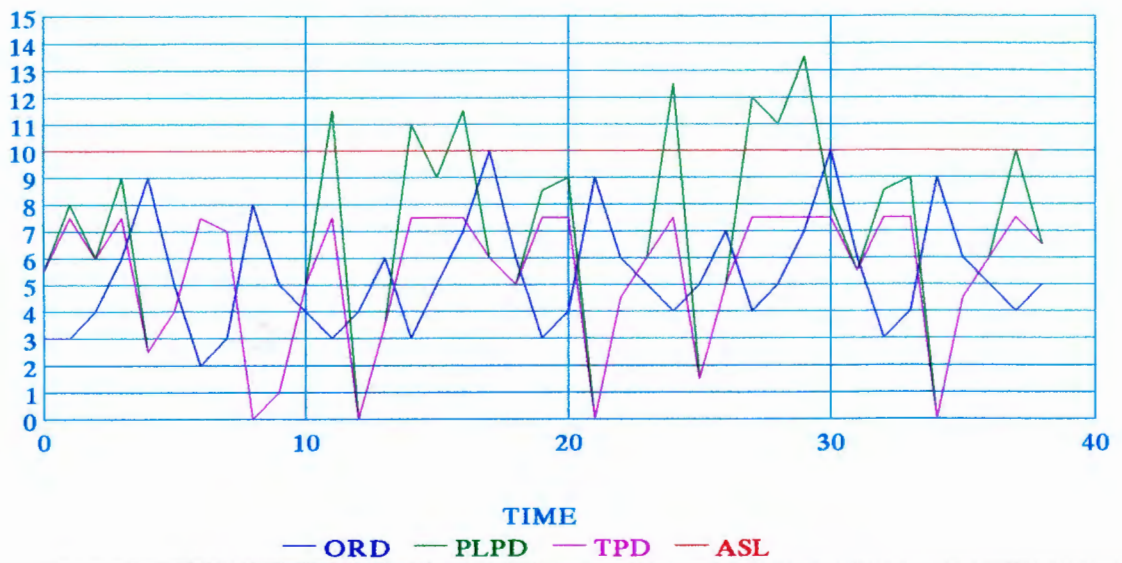
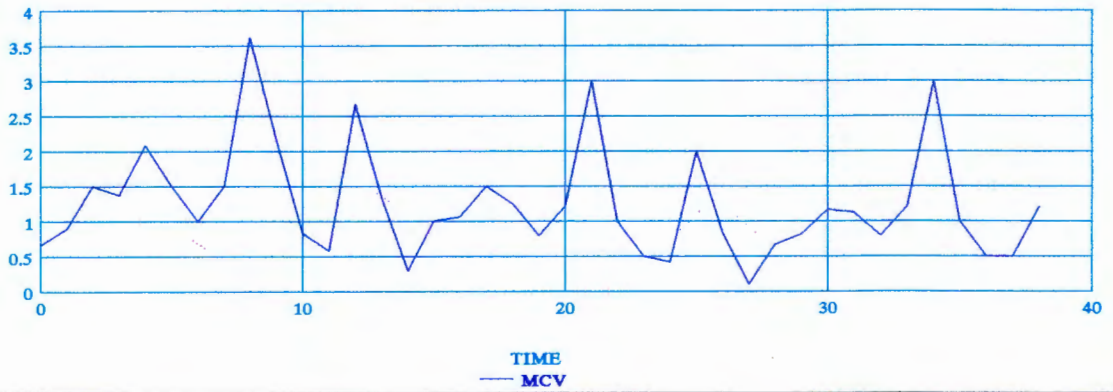
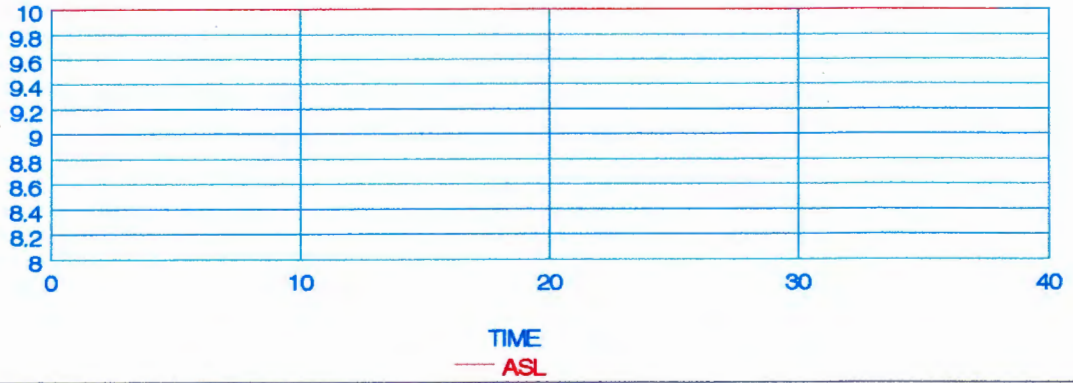
- It is possible to keep *Actual Service Level (ASL)* at 100 % throughout the simulation.
- *Months Cover (MCV)* does not drop to zero at all (no stock-outs). But at the same

PPPM6T1/STEP TEST (CAP=5 SCP=1.25)



GRAPH SET 1.4

PPPM6T1/STEP TEST (CAP=5 SCP=1.5)



GRAPH SET 1.5

time, it reaches to even higher figures (3.6 at period 8) than the previous case (with $SCP=1.25$).

- *Planned Production (PLPD)* figures are higher than the ones in GRAPH SET .
- The gap between *PLPD* and *TPD* gets even bigger than the previous simulation.

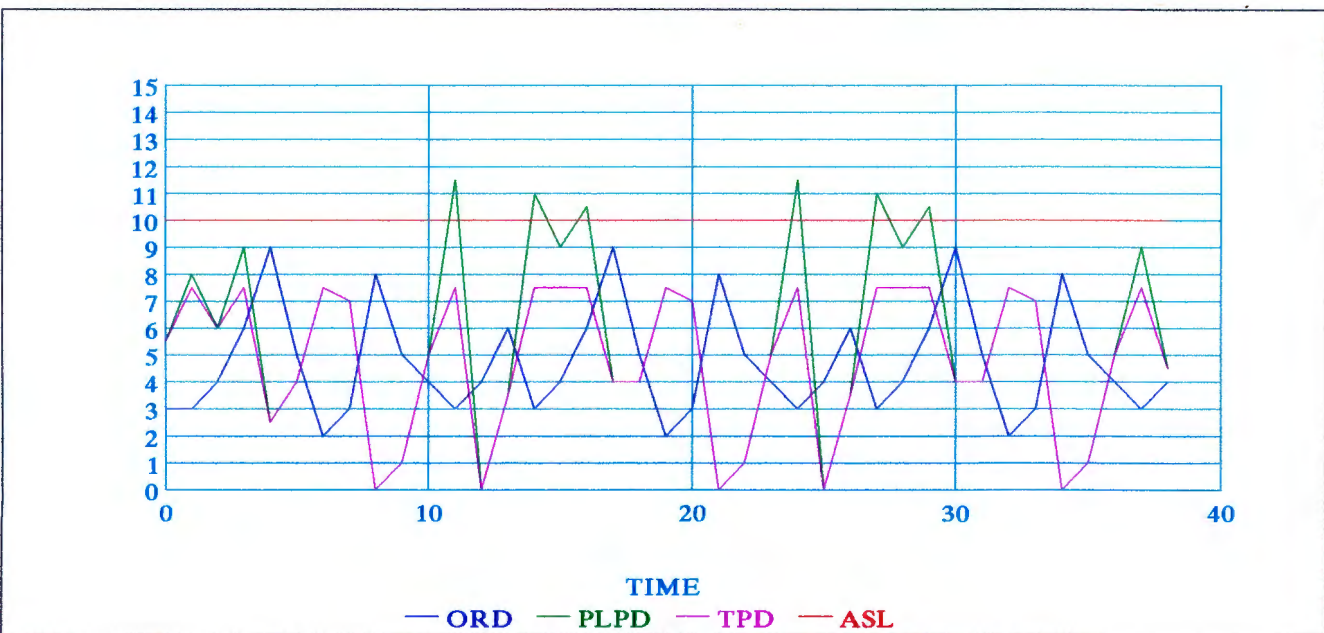
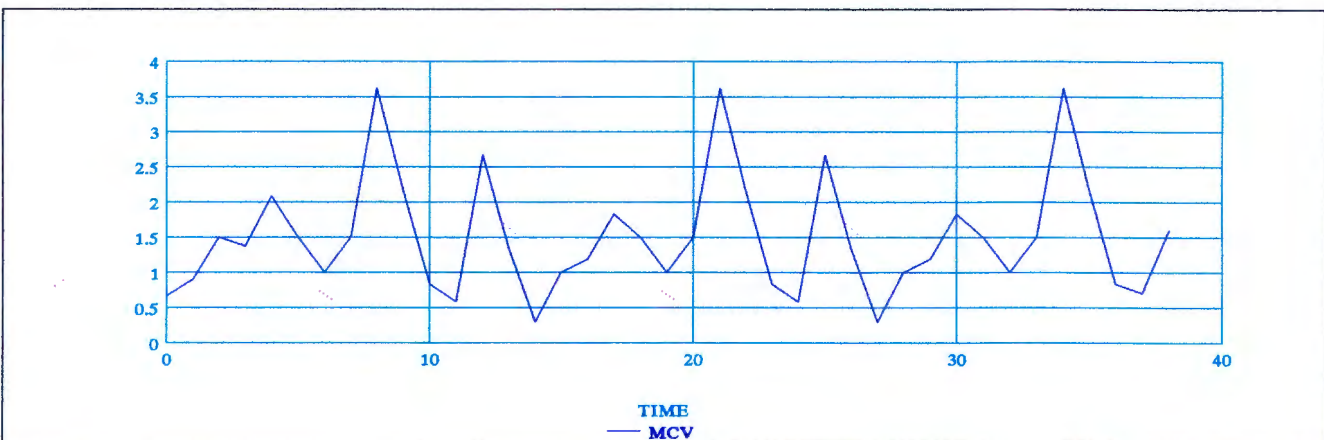
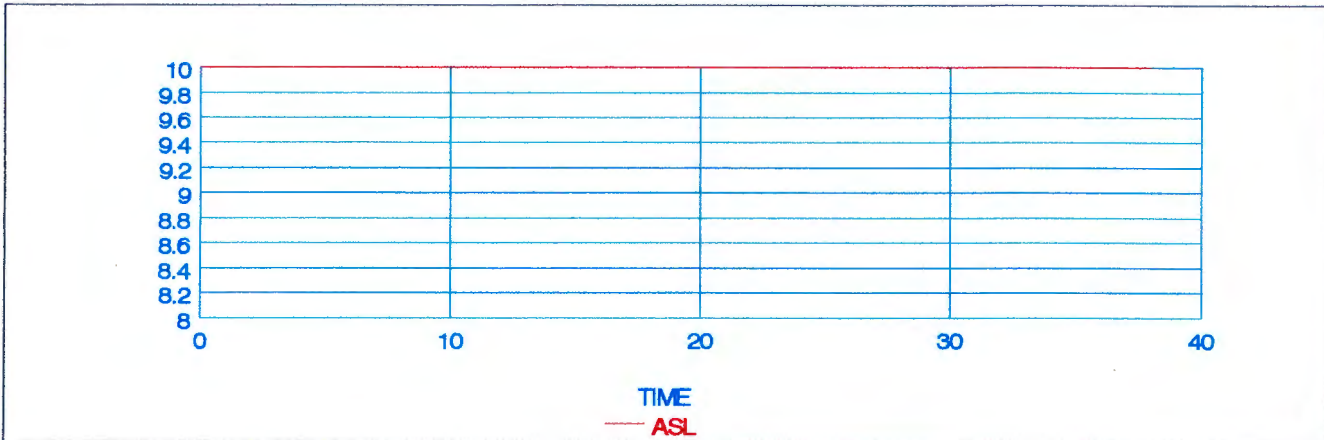
GRAPH SET 1.5 shows that behaviours of different key variables continue to change in the same way as SCP is increased more and more. For some variables this is a positive change whereas for some others it is a negative one. Especially from *ASL* aspect, a relatively better system behaviour is obtained in GRAPH SET 1.5.

PPPM6 is finally used, in its original form, without the STEP increase of *Orders* but with modified *Stock Cover Parameter* value ($SCP=1.5$). The purpose of this simulation is to see, under normal conditions (without any unexpected demand increase), the behaviour of the system that can maintain 100 % *ASL* during STEP test. Because, it is not sufficient to improve the model behaviour under test conditions only. Most of the time there will not be any unexpected environmental change, and the system will be subject to normal conditions. Therefore it should exhibit desirable behaviours under normal conditions as well. The results of this simulation are given in GRAPH SET 1.6.

When GRAPH SET 1.6 is compared with GRAPH SET 1.1, an increase in average *MCV* and a bigger gap between *PLPD* and *TPD* are observed.

It is quite clear that, there is a limit to the amount of improvement that can be brought to the general behaviour of the system by changing and by fine-tuning different constants like the *Capacity* and the *Stock Cover Parameter*. After a point, this type of changes do not have any more effect, because the structure itself becomes the limiting factor. Then the next step is to change the systemic structure and this is done in the following stage.

PPPM6 (CAP=5 SCP=1.5)



GRAPH SET 1.6

6.6.1 PRODUCTION PLANNING POLICY MODEL 7 (PPPM7)

FLOW DIAGRAM 4 which is presenting the structure of the actual operating system at Moir's, is modified at this stage of *Policy Analysis and Model Use*. Fluctuations of *TPD*, sometimes resulting in zero production, are considered as undesired systemic behaviours. A parameter called *Minimum Production (MPD)* is added to the structure in order to moderate the fluctuations of *TPD* and to maintain the production at a minimum level even when there is no direct demand. The new structure is presented in FLOW DIAGRAM 5 where *Minimum Production (MPD)*, is emphasized with a light blue colour. Modified DYNAMO codes of PRODUCTION PLANNING POLICY MODEL 7 and explanation about modifications are given in APPENDIX E.

Simulation results of PPPM7 can be observed in GRAPH SET 2.1. GRAPH SET 2.1 presents the behaviour of the modified system under normal conditions, i.e no STEP increase of demand increase, *Capacity* being equal to 500 tons/month and *Stock Cover Parameter* being equal to 1 month.

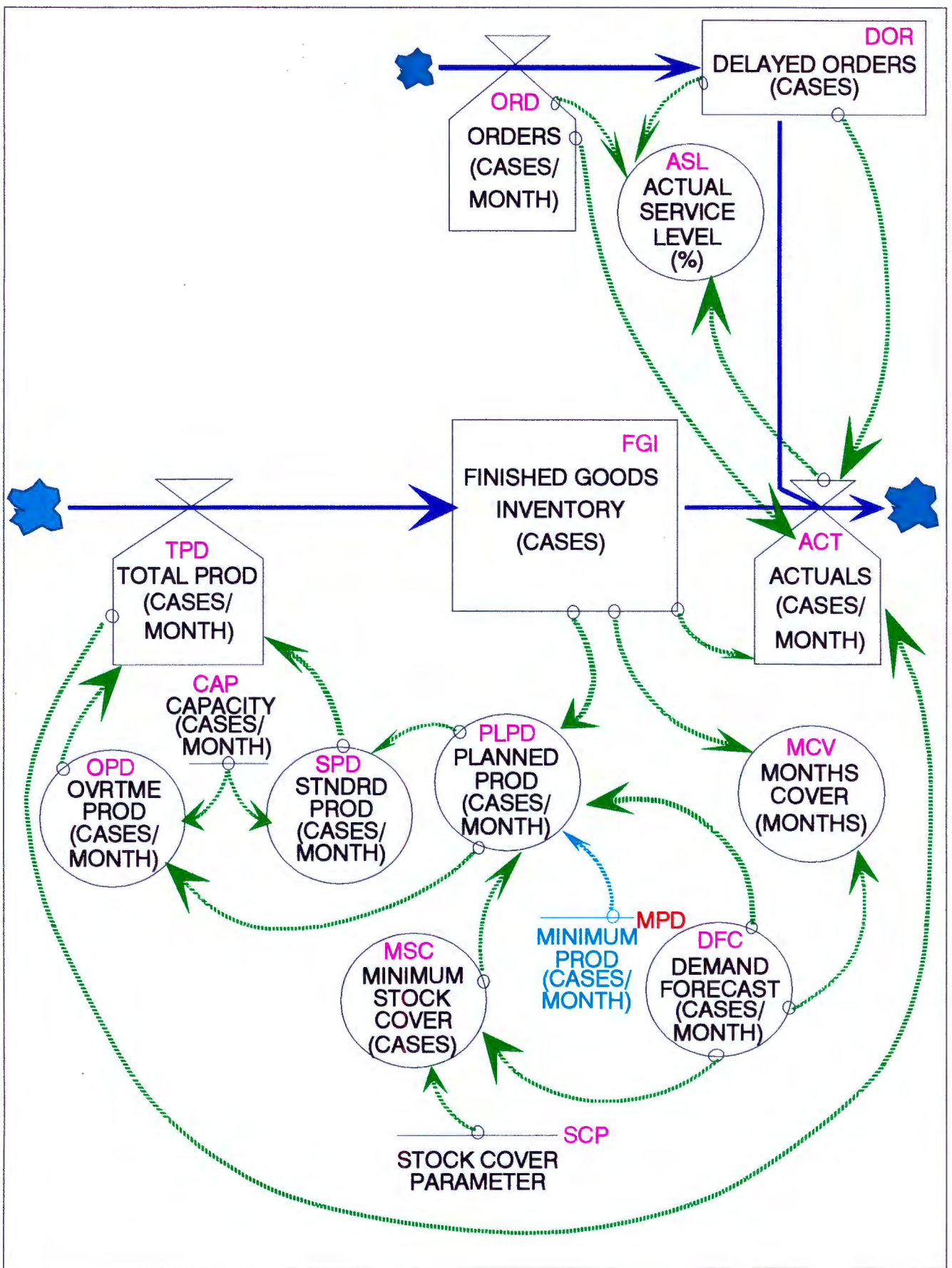
GRAPH SET 2.1 shows that :

- *Actual Service Level* is 100 % during the simulation (which is quite normal as there is no unexpected demand increase).
- *Months Cover (MCV)* does not drop to zero (no stock-outs) but it goes up to 2.7 months.
- *Planned Production (PLPD)* figures are generally lower than the ones in GRAPH SET 1.1.
- The gap between *PLPD* and *TPD* is smaller than the one in GRAPH SET 1.1.

The above observations can be interpreted, as a general improvement in systemic behaviours under normal conditions. However, before reaching a conclusion, it is also necessary to study the performance of the model under test conditions. The test model PPPM7T1 which is simulating the STEP increase of *Orders* is given in APPENDIX E.

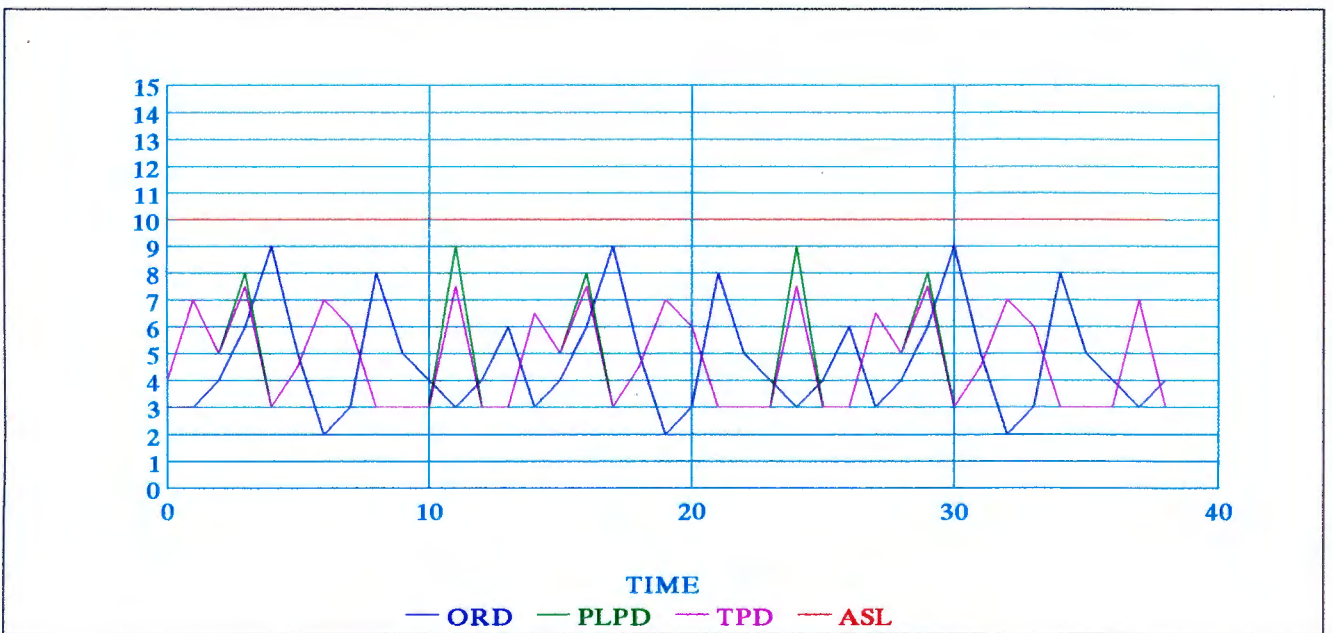
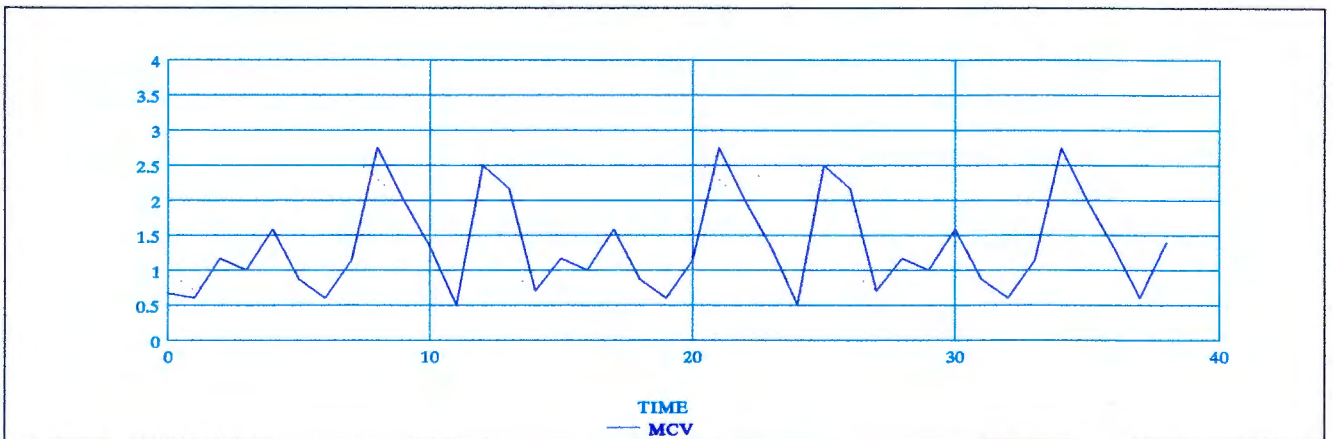
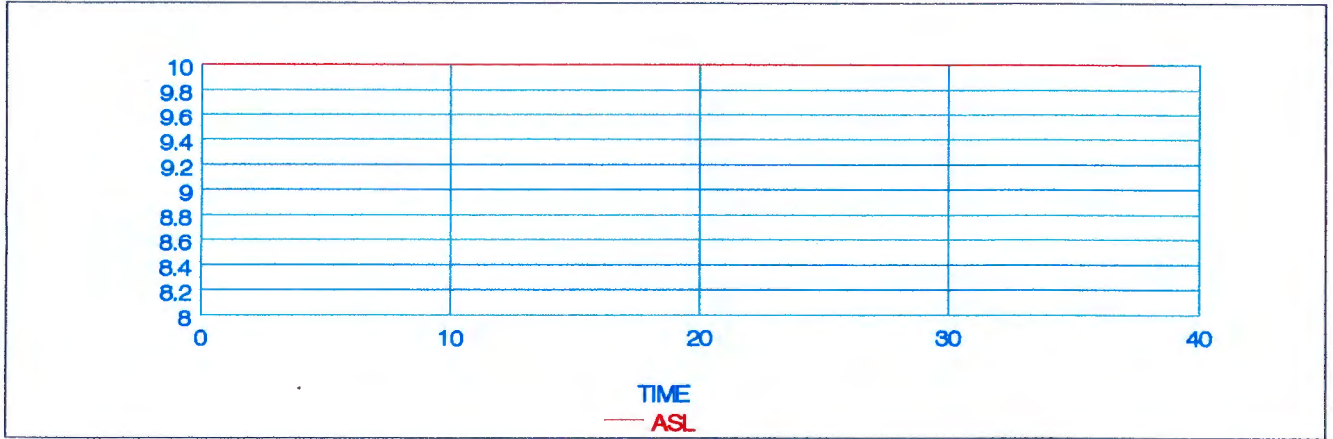
The following factors can be observed in the simulation results of PPPM7T1 (GRAPH SET 2.2) :

- *Actual Service Level* drops again to 86 % as in PPPM6T1.
- *Months Cover* becomes zero only at one point in time, but this single stock-out case is enough to cause *ASL* to drop to 86 %.
- *PLPD* has more or less the same pattern as in PPPM6T1.



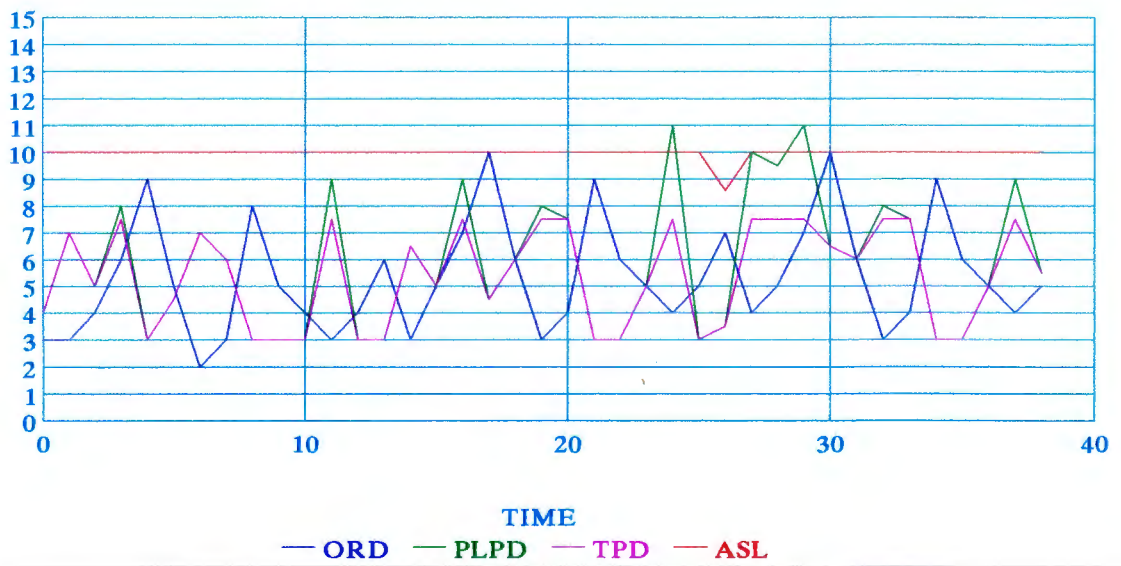
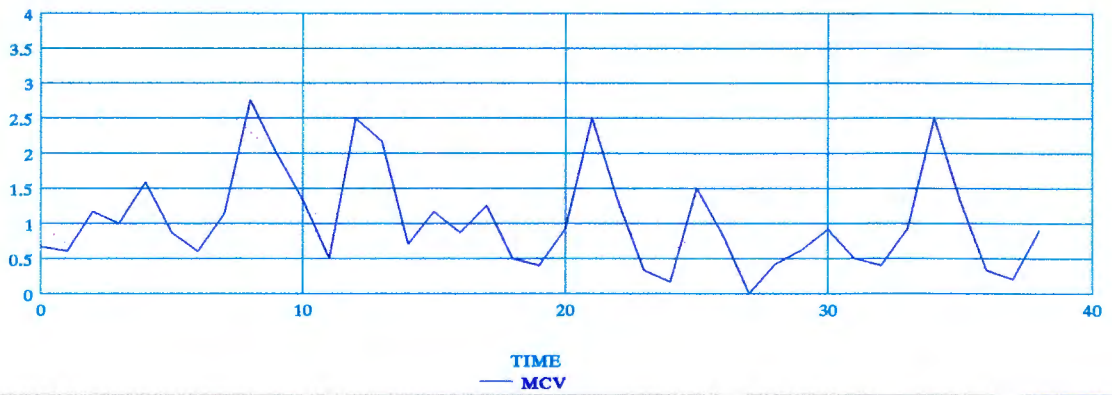
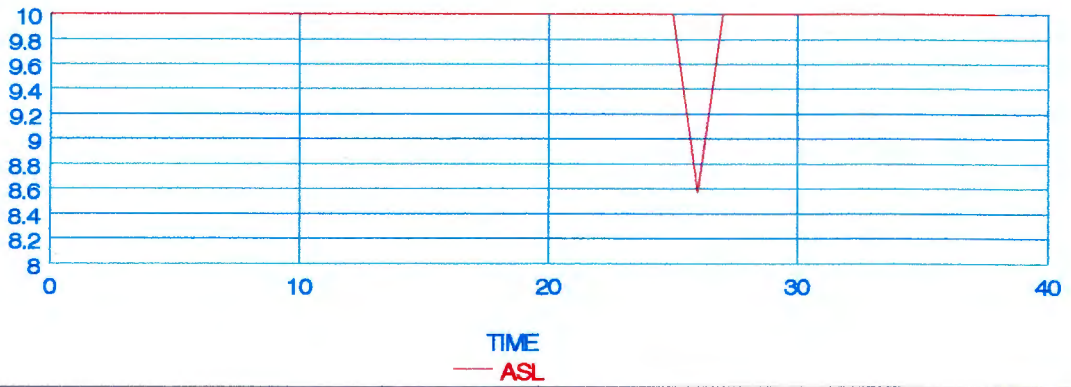
FLOW DIAGRAM 5

PPPM7 (CAP=5 SCP=1)



GRAPH SET 2.1

PPPM7T1/STEP TEST (CAP=5 SCP=1)



GRAPH SET 2.2

- The gap between *PLPD* and *TPD* is more or less equal to the one in PPPM6T1.

Under test conditions, the system does not behave as good as it does under normal conditions. In fact it exhibits more or less the same problematic behaviours as PPPM6T1.

Before doing any further structural change to the system presented in FLOW DIAGRAM 5, the effects of increasing the *Capacity* (*CAP*) and increasing the *Stock Cover Parameter* (*SCP*) are examined separately. The purpose of this attempt is to generate some outputs that are comparable with the ones of the previous case (PPPM6).

GRAPH SET 2.3 shows the effects of increasing the *Capacity* from 500 to 550 tons per month. GRAPH SET 2.3 is compared with GRAPH SET 1.3 which is presenting the same situation for the previous system structure. The outcome of the comparison is :

- Some improvements in *Actual Service Level* (from 86 % to 90 %) is obtained in PPPM7T1.
- Only one stock-out is observed in GRAPH SET 2.3 whereas the highest *MCV* values are more or less the same in both cases.
- *Planned Production* (*PLPD*) figures are very similar in both cases.
- The gap between *PLPD* and *TPD* is slightly smaller in GRAPH SET 2.3.

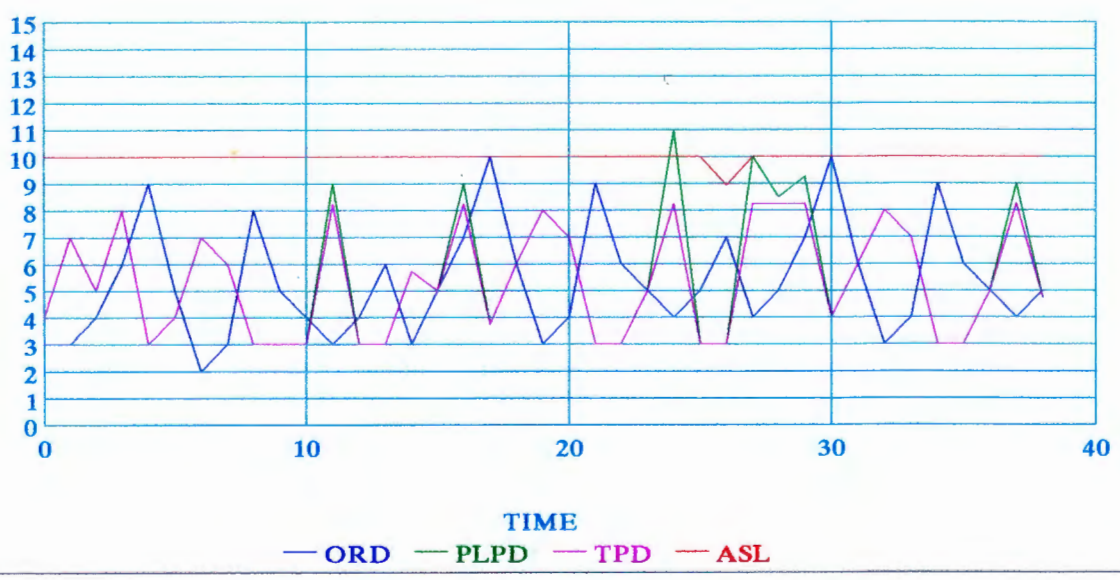
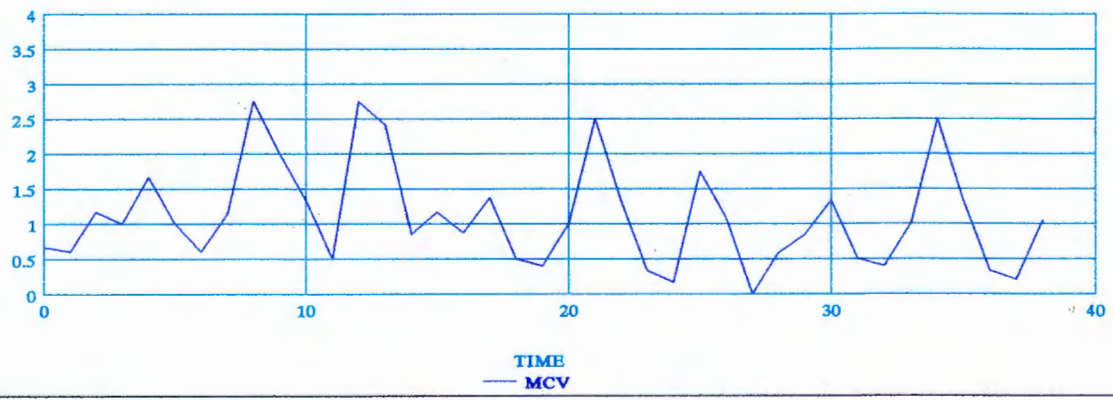
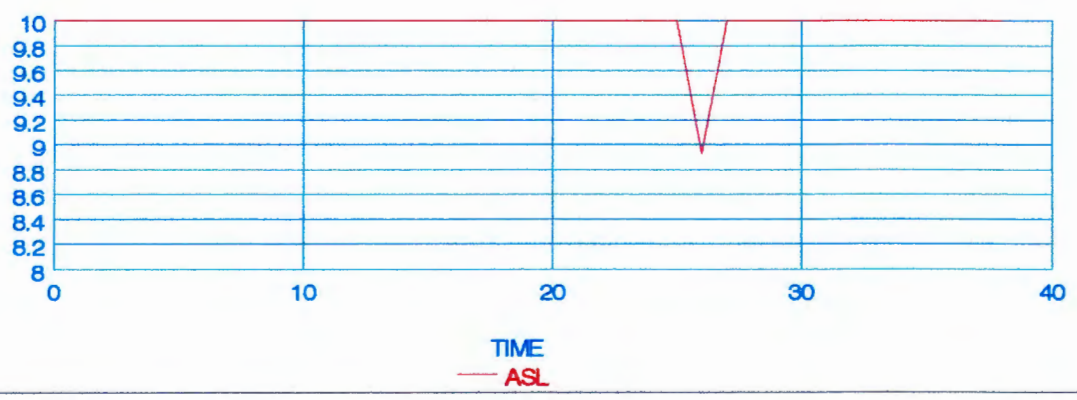
According to this comparison it can be said that, the capacity increase brings more improvements to the system presented in FLOW DIAGRAM 5 than it does to the system presented in FLOW DIAGRAM 4. With the new structure, it is possible to get a better result from a capacity increase.

The effect of increasing the *Stock Cover Parameter* (from 1 to 1.25 month) is examined in the same way and simulation results are given in GRAPH SET 2.4. When these are compared with GRAPH SET 1.4, it is observed that, in both models, *ASL*, *MCV*, *PLPD* and *TPD* respond in a similar way to the STEP increase of *Orders*.

As it is mentioned earlier, capacity increase does not improve much the behaviour of PPPM6T1. For this model, to use a higher *SCP*, is the only way of bringing some improvements to the systemic behaviour. Whereas for PPPM7T1, both the *Capacity* and *SCP* can contribute to improvements. In the next simulation, a combination of *CAP* and *SCP* increase is tested (*CAP*=5.5 and *SCP*=1.25). Results are given in GRAPH SET 2.5.

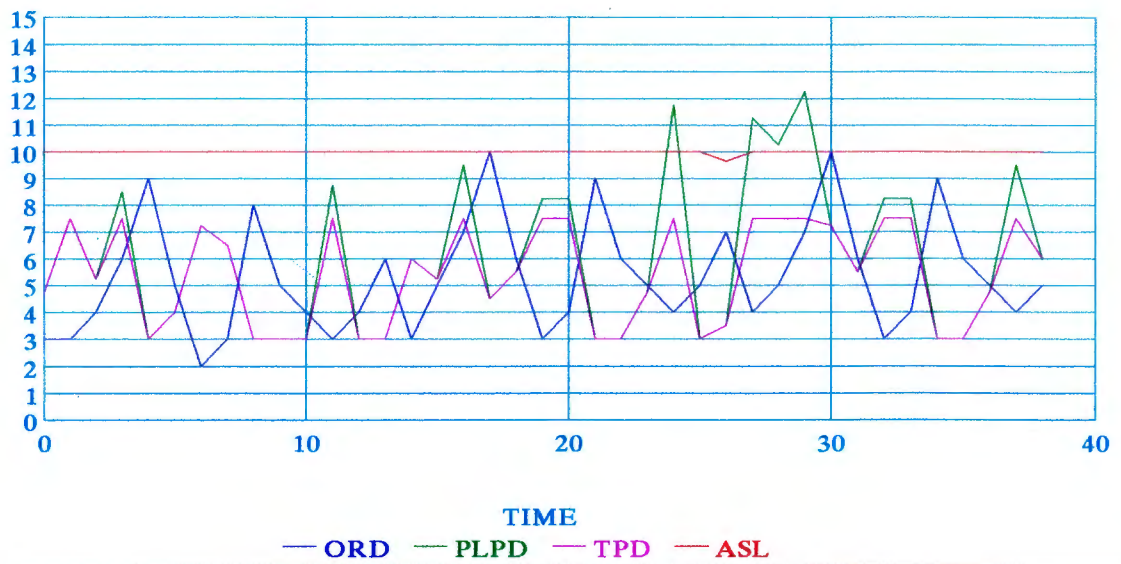
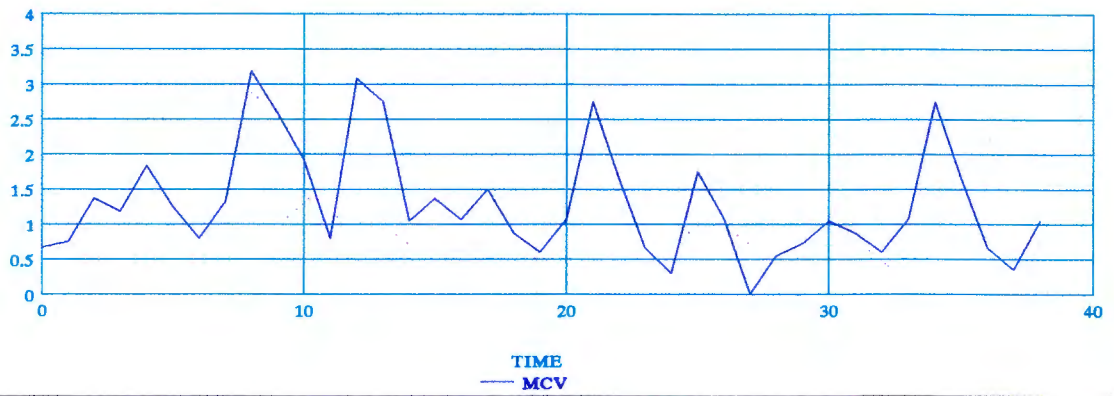
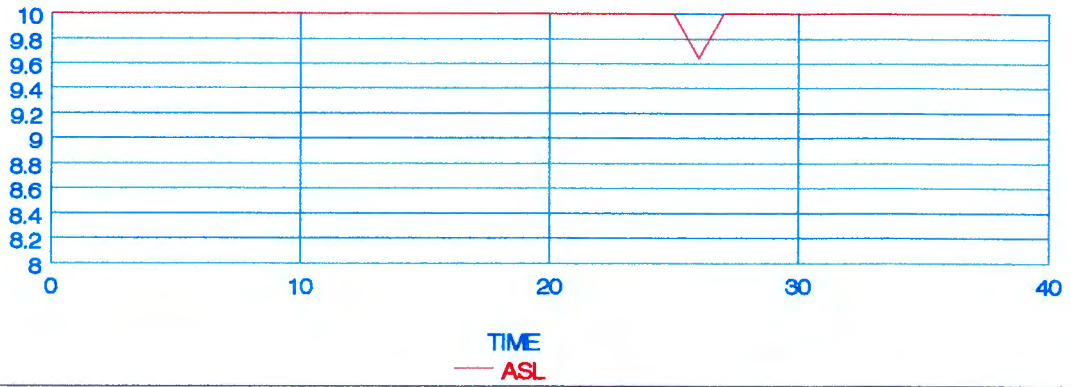
GRAPH SET 1.5 and GRAPH SET 2.5 are not totally comparable because of different *CAP* and *SCP* values that are used in simulations (in GRAPH SET 1.5, *CAP*=5 and *SCP*=1.5 whereas, in GRAPH SET 2.5, *CAP*=5.5 and *SCP*=1.25). But they have a common point that

PPPM7T1/STEP TEST (CAP=5.5 SCP=1)



GRAPH SET 2.3

PPPM7T1/STEP TEST (CAP=5 SCP=1.25)



GRAPH SET 2.4

makes such a comparison meaningful. They both represent the most improved behaviour of their models under test conditions. According to this comparison :

- They both have 100 % *Actual Service Level* throughout the simulation.
- One stock-out case is observed in both simulations and the maximum *MCV* value of GRAPH SET 1.5 is slightly higher than the one of GRAPH SET 2.5.
- *Planned Production (PLPD)* values of GRAPH SET 1.5 are generally higher than the ones of GRAPH SET 2.5.
- The gap between *PLPD* and *TPD* is much smaller in GRAPH SET 2.5.

The addition of *Minimum Production* parameter to the model structure, has helped to improve the production planning under unexpected demand conditions. Size of the gap between *PLPD* and *TPD* is a sign of this. It shows that the planning is done in a more realistic way and with less panic.

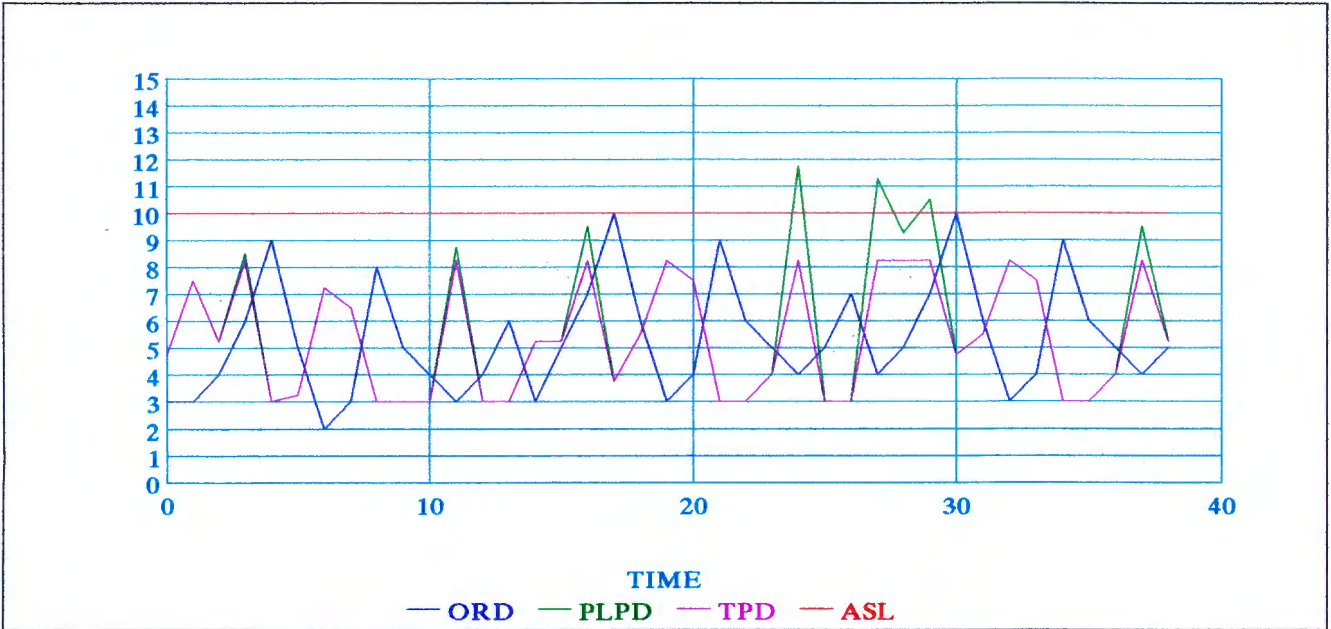
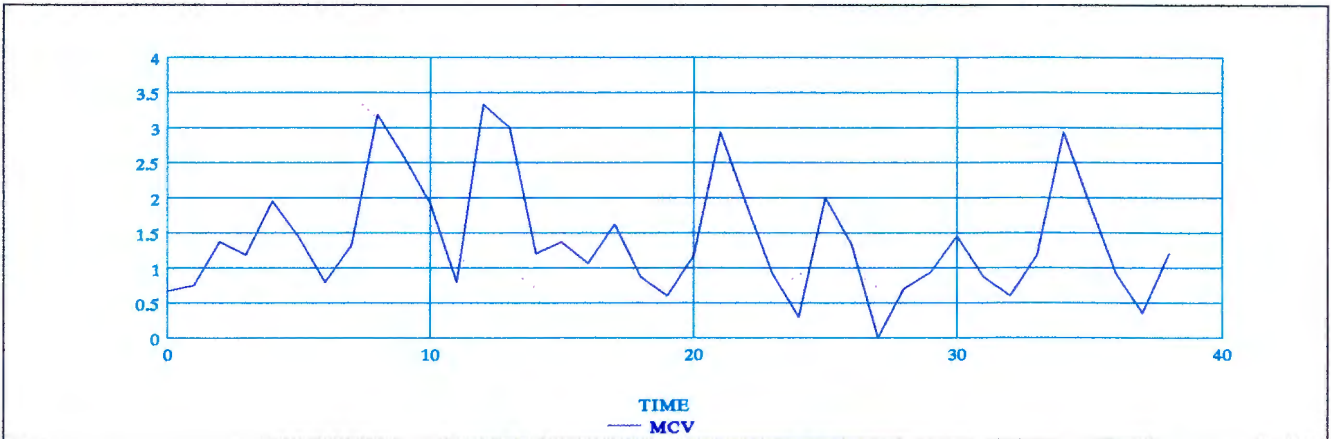
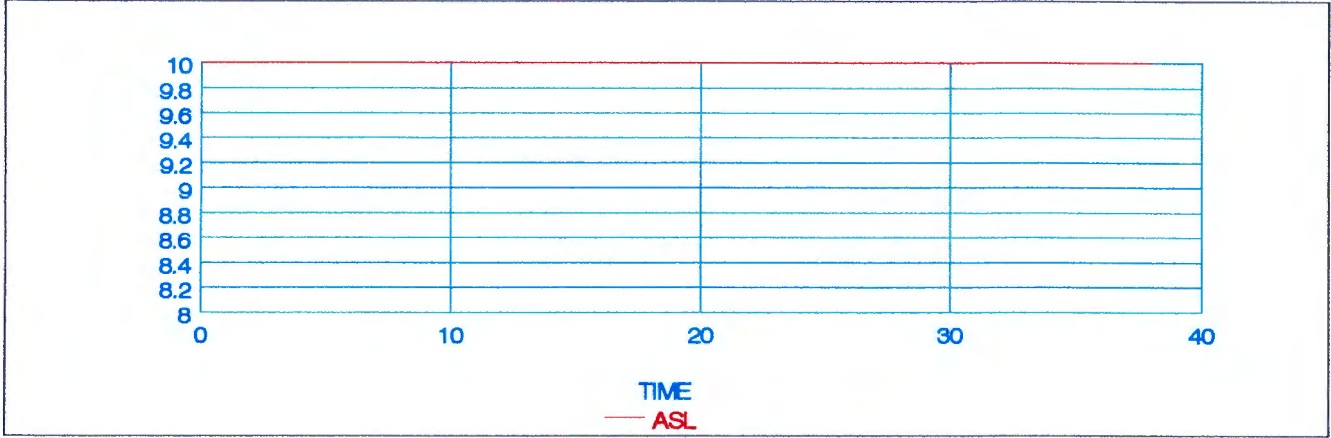
As it is done in the previous case, PPPM7 is finally used to simulate the behaviour of the modified model ($CAP=5.5$ and $SCP=1.25$) under normal conditions. Results are given in GRAPH SET 2.6. Although there is a considerable improvement in *PLPD* (there is almost no gap between *PLPD* and *TPD*), high *MCV* is still standing as an unsolved issue.

Graphs displayed in GRAPH SET 2.5 and in GRAPH SET 2.6 present the most improved behaviours that the model in FLOW DIAGRAM 5 can have under test (GRAPH SET 2.5) and under standard (GRAPH SET 2.6) conditions. During the study it is found that, no further modification and fine-tuning of *Capacity* and *Stock Cover Parameter* can improve the systemic behaviour any more, if the structure is kept as it is.

Up to this point, the performance of the system in terms of meeting the orders, did not have a direct effect on production planning. *Planned Production* is equal to *Demand Forecast - Finished Goods Inventory + Minimum Stock Cover*, or to *Minimum Production*, whichever is greater. On the other hand, the gap between *Orders* and *Actuals* has been monitored by the level called *Delayed Orders*. *Delayed Orders* effect *Actuals*, *Actuals* effect *Finished Goods Inventory* and *Finished Goods Inventory* effects *Planned Production*. There is a feed-back coming to *PLPD* about the performance of the system. But as the link is too indirect, *PLPD* can only respond after a considerable delay. This causes the production planning function to be *reactive* rather than *pro-active*.

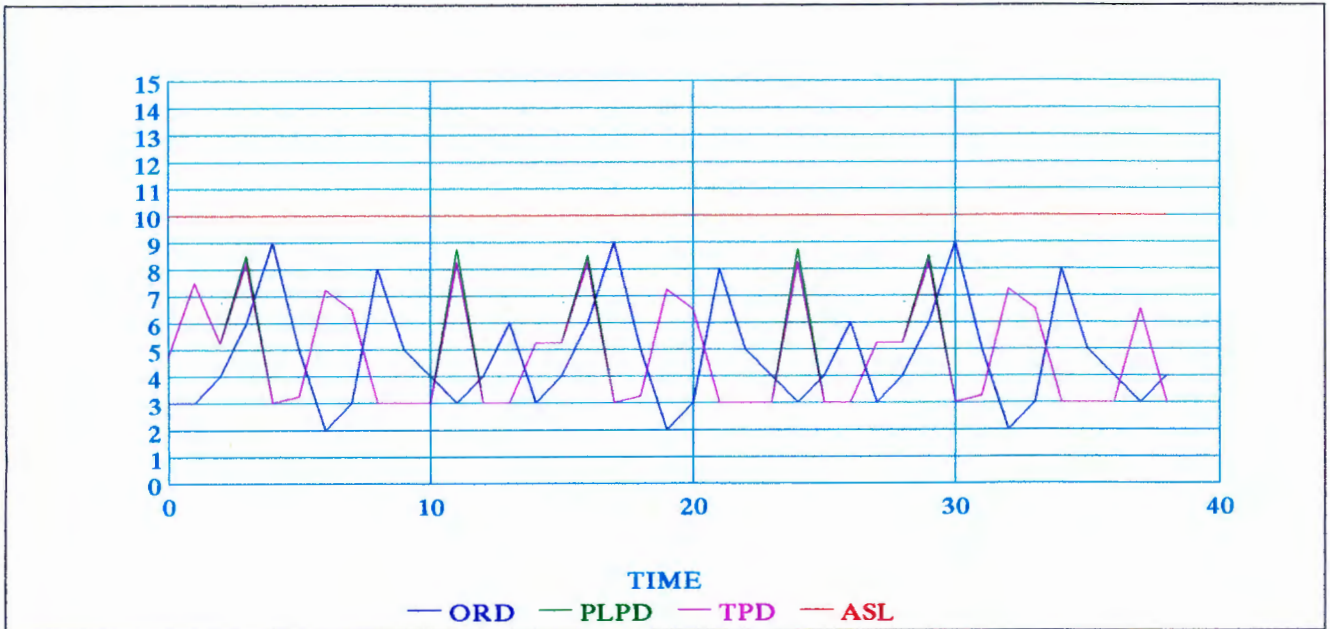
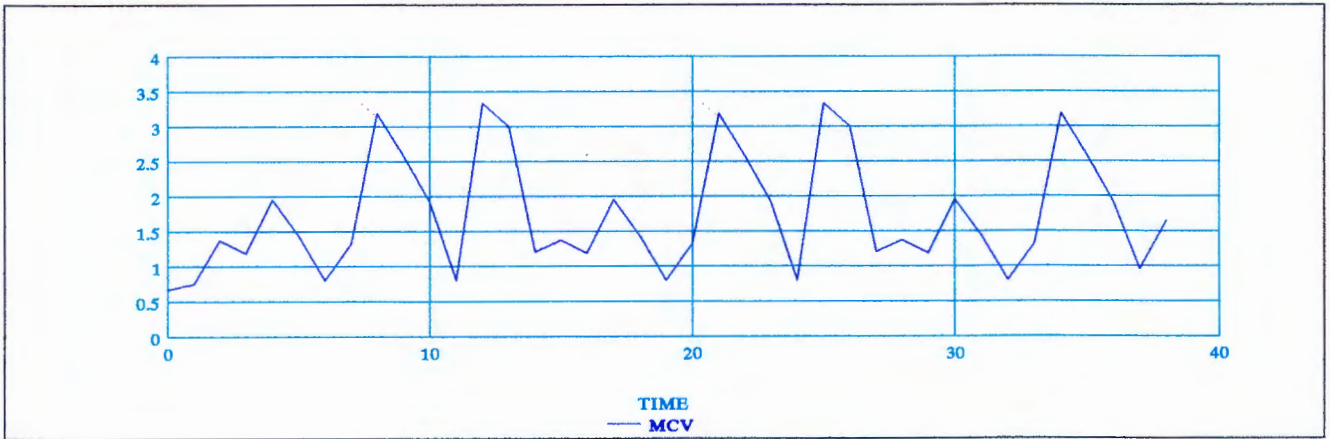
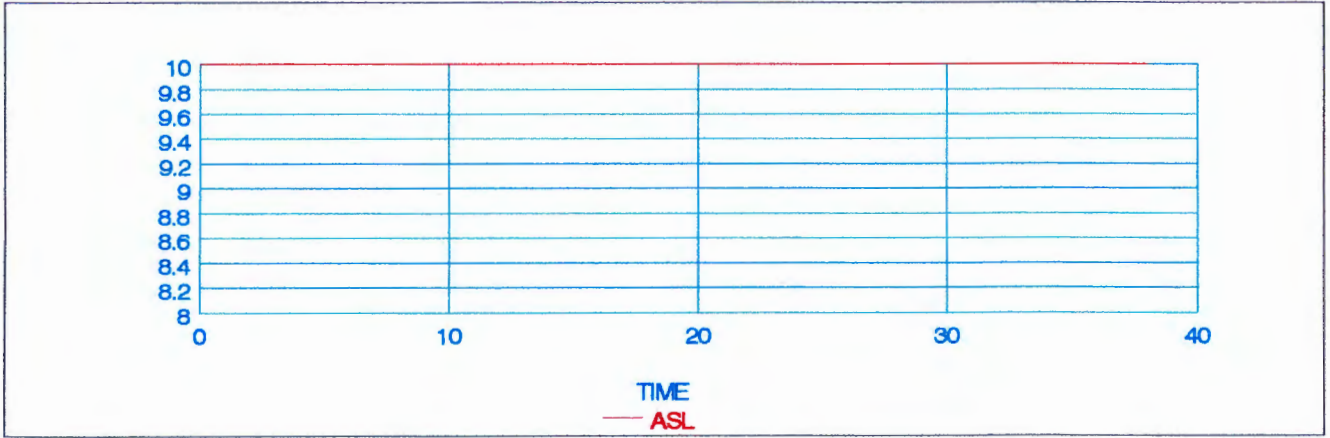
A better performance monitoring function which is directly connected to *PLPD* may improve the general behaviour of the system under study. In the next stage an attempt is made to build such a monitoring function and corresponding feed-back channel into the model.

PPPM7T1/STEP TEST (CAP=5.5 SCP=1.25)



GRAPH SET 2.5

PPPM7 (CAP=5.5 SCP=1.25)



GRAPH SET 2.6

6.6.2 PRODUCTION PLANNING POLICY MODEL 8 (PPPM8)

Although the level of *Delayed Orders* gives an idea about the overall performance of the system, it does not give the specific information about the performance of the production side itself. On the other hand, production planning function needs a feed-back about how well the production side is coping with the market demand. This is necessary for making relevant modifications to production plans. Therefore it is important to monitor whether right amounts are produced at the right time.

The gap between *Orders* and *Actuals* (i.e *Delayed Orders*) is not a good monitoring criteria for the specific performance of the production function. Instead of *Actuals*, *Total Production* has to be compared directly with *Orders*. The gap between *Orders* and *Total Production* can be used as a monitoring criteria that will provide the quick and accurate feed-back needed by *PLPD* to make necessary timeous corrections in production plans.

The existing model (shown in FLOW DIAGRAM 5) is modified to accommodate the new monitoring criteria. By this way the next model shown in FLOW DIAGRAM 6 is obtained. The new monitoring criteria is called *Cumulative Gap* (*CGP*). *Cumulative Gap* is a level showing the cumulative discrepancy between *Orders* and *Total Production*. *CGP* is used in the calculation of *Correction Parameter* (*CPR*). *Correction Parameter* is a coefficient that can modify the calculated *PLPD* values according to the feed-back coming from *CGP*. The influence level of *CPR* is adjusted by a constant called *Reduction Factor* (*RFC*). These three elements that are added to the structure are shown with a light blue colour in FLOW DIAGRAM 6.

DYNAMO codes corresponding to FLOW DIAGRAM 6 are given in APPENDIX E.

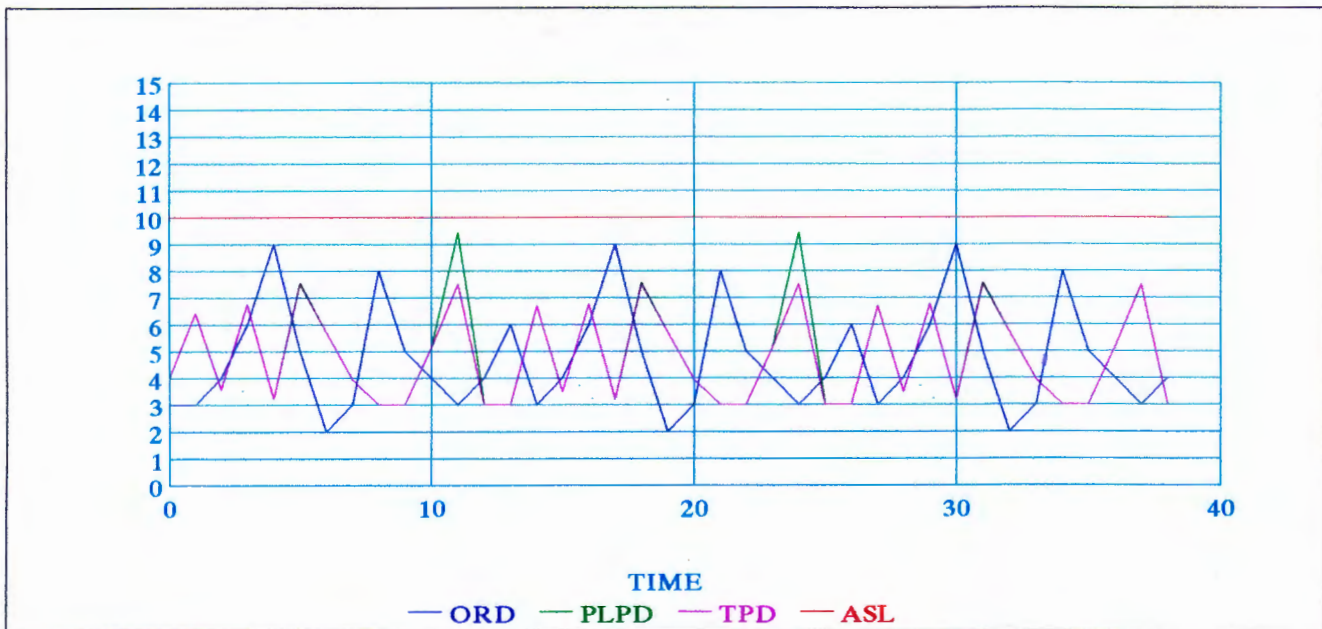
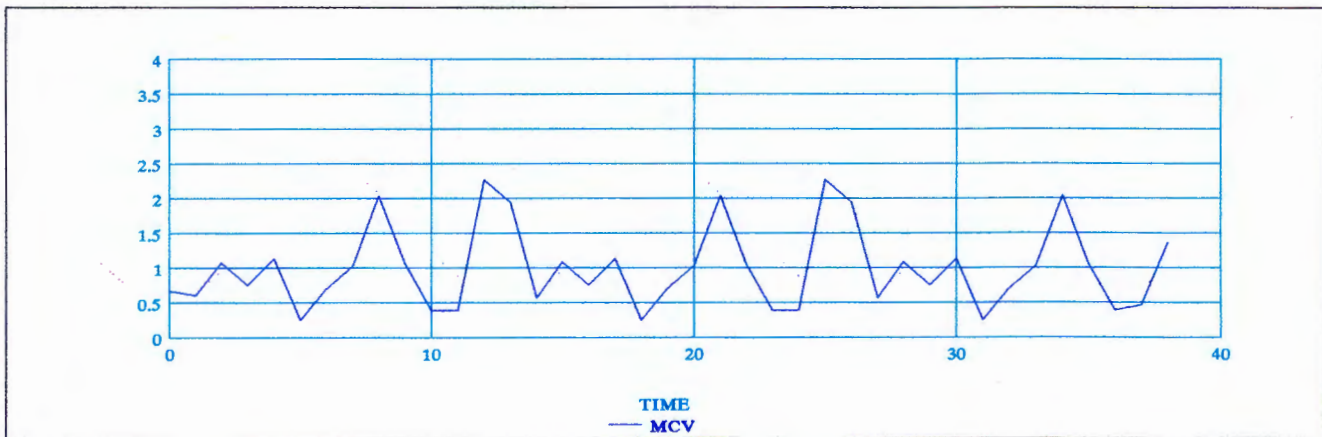
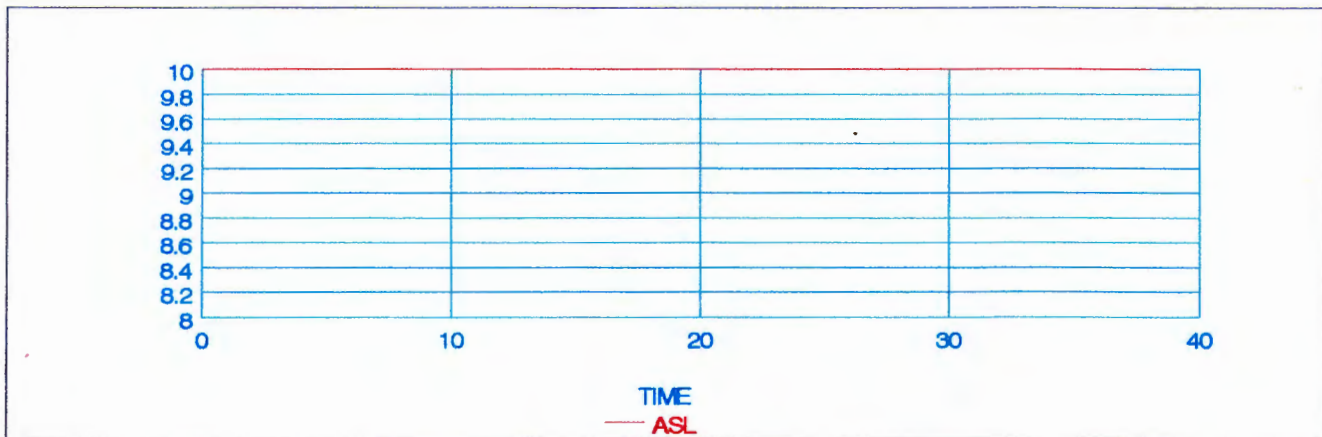
Same test procedures are followed for the new model as well. Graphs presenting its behaviour under normal conditions, with original *CAP* and *SCP* values are given in GRAPH SET 3.1.

GRAPH SET 3.1 shows that PPPM8 has not only the same improved characteristics of PPPM7 (no stock-outs, smaller gap between *PLPD* and *TPD*) but it also displays some further improvements like :

- smaller average *MCV* values fluctuating less than previous cases,
- a more regular behavioral pattern of *PLPD*, and consequently, of *TPD*.

In general, it can be said that, the new feed-back structure keeps the finished goods inventory down and it brings some consistency and regularity to the behaviour of critical system variables. In other words, it helps the system, to maintain its internal stability in a turbulent environment.

PPPM8 (CAP=5 SCP=1)



GRAPH SET 3.1

The ability of the model to cope with a non-forecasted demand increase is tested next. Results of this simulation are given in GRAPH SET 3.2.

According to GRAPH SET 3.2 :

- *ASL* drops to 90 %, which is better than 86 % of previous models.
- *MCV* has a less fluctuating pattern and its average value is less than previous models.
- The general pattern of *PLPD* and the gap between *PLPD* and *TPD* are quite similar to the ones in GRAPH SET 1.2 and in GRAPH SET 2.2.

These results show that, the structural change on its own (addition of new performance monitoring function and its feed-back link), without any *Capacity* or *Stock Cover* modification, can improve the response of the system to unexpected demand increase in the market.

With an increased *Capacity* of 550 tons per month, the system can keep the *Actual Service Level* at 100 % (GRAPH SET 3.3) under STEP test conditions. This shows that the *Capacity* increase can be much more effective if the necessary feed-back structure is at its place. As it is observed in previous simulations, *Capacity* increase can have no effect (GRAPH SET 1.3) or only a limited effect (GRAPH SET 2.3) if the structure is not suitable.

Another observation that can be done in GRAPH SET 3.3 is that, the new model builds relatively lower inventories (*MCV*) while keeping *ASL* at 100 %. The average *MCV* value in GRAPH SET 3.3 is less than the one in GRAPH SET 2.3. Generally, GRAPH SET 3.3 presents the most improved systemic behaviour obtained so far under test conditions.

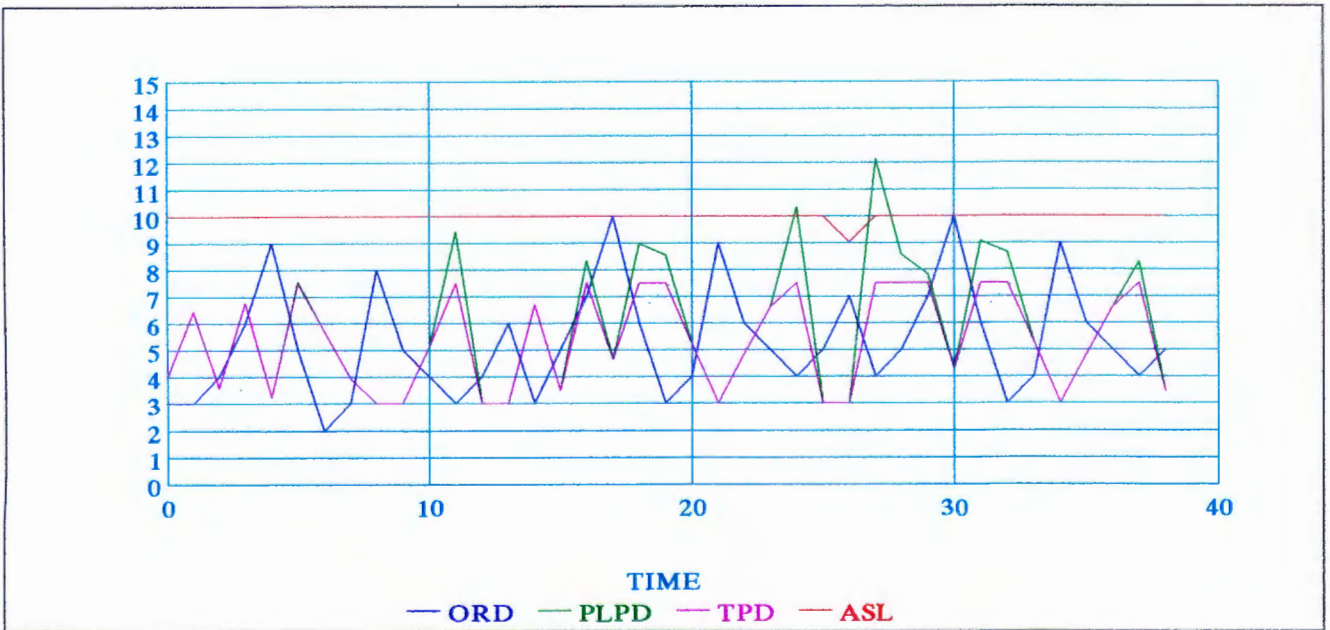
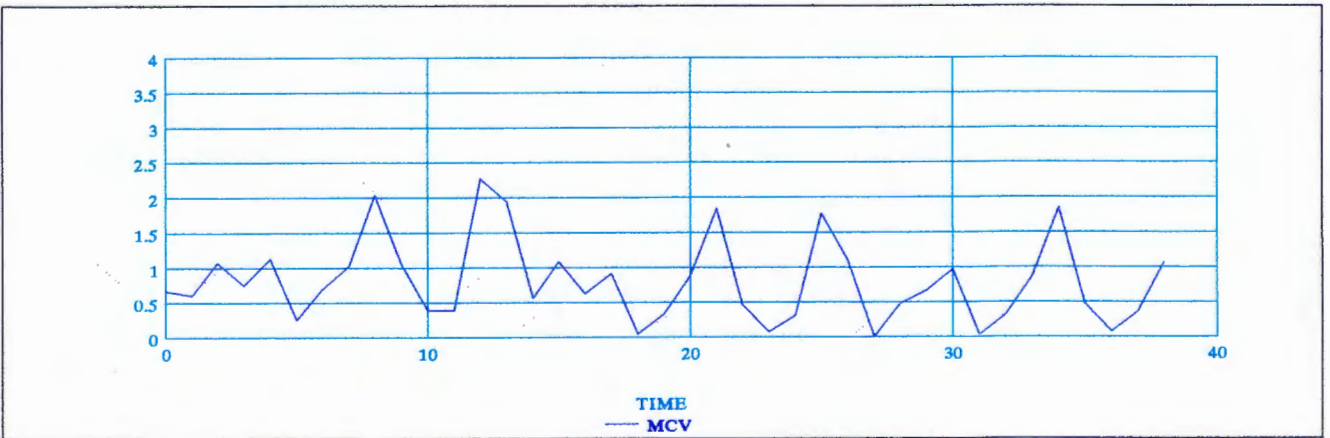
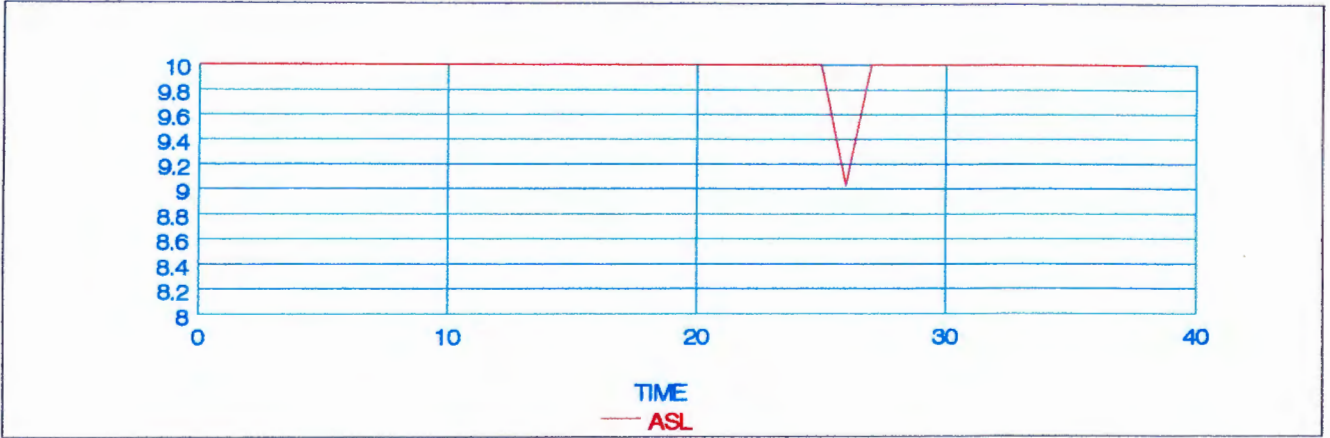
The objective of maintaining 100 % *ASL* and reducing *MCV* under STEP test condition has already been achieved by increasing the *Capacity* to 550 tons/month. Yet some further simulations are done with PPPM8 to test the effect of *SCP* increase and to see the behaviour of the system under different demand increase scenarios.

Graphs demonstrating the effect of a slight *SCP* increase (from 1 to 1.25 month) are given in GRAPH SET 3.4.

GRAPH SET 3.4 shows that :

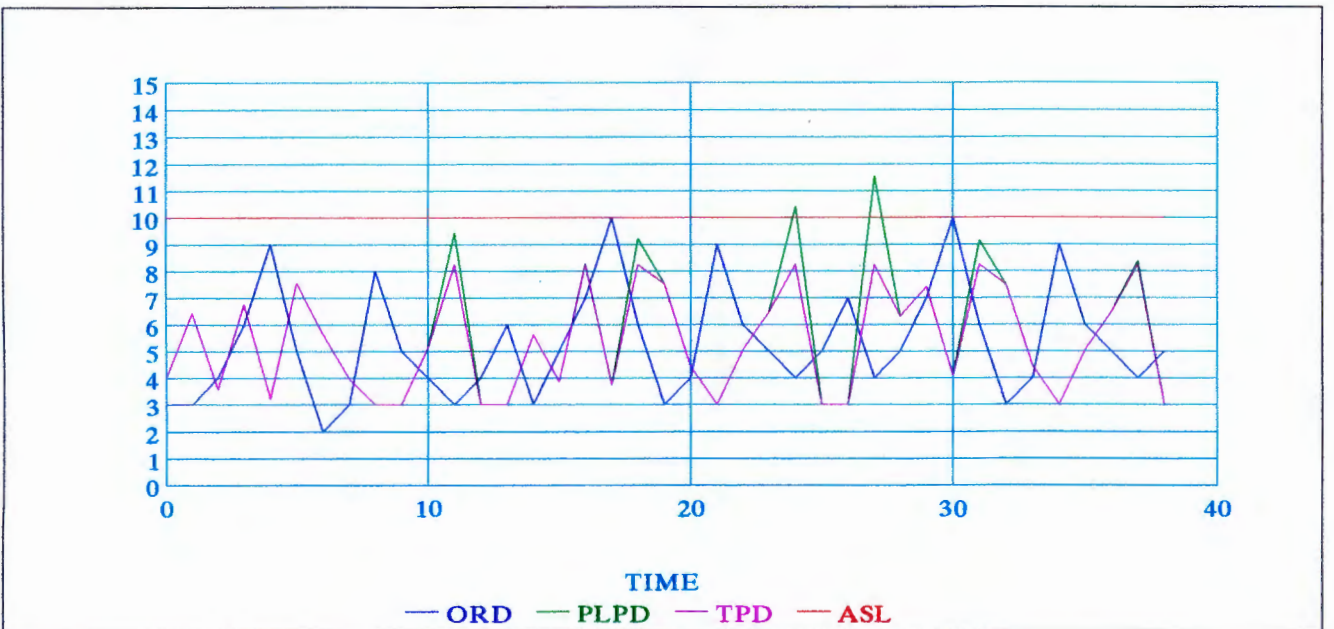
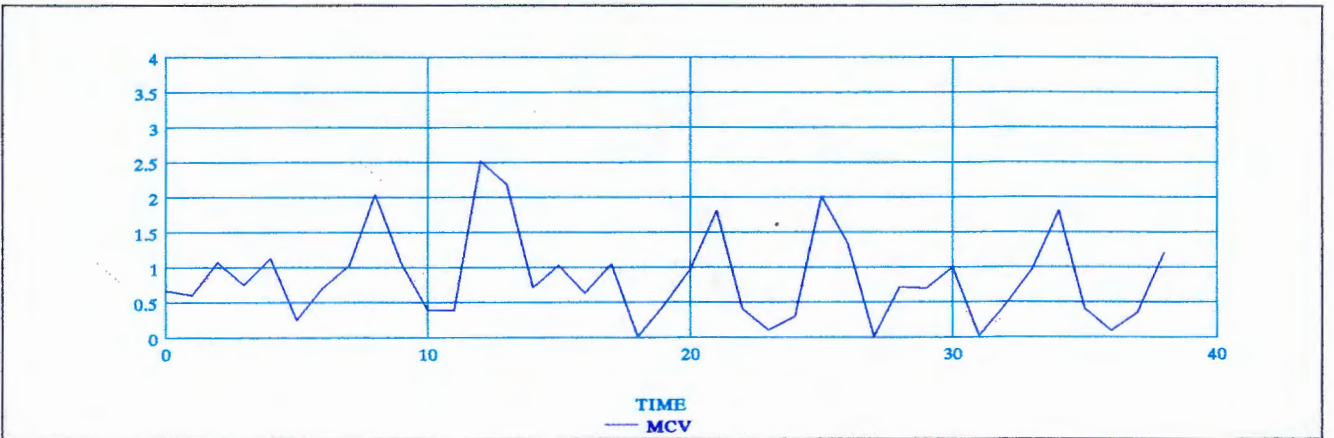
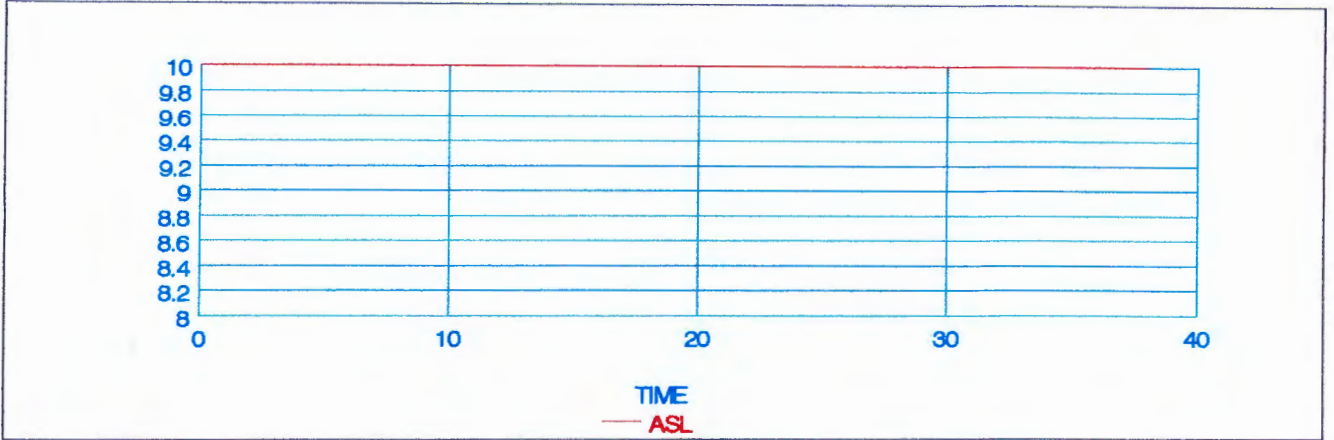
- There is only a small drop of 2 % in *ASL*. That is better than the 4 % of GRAPH SET and GRAPH SET 2.4.
- Average *MCV* is lower than the average *MCV* of GRAPH SET and GRAPH SET 2.4.

PPPM8T1/STEP TEST (CAP=5 SCP=1)



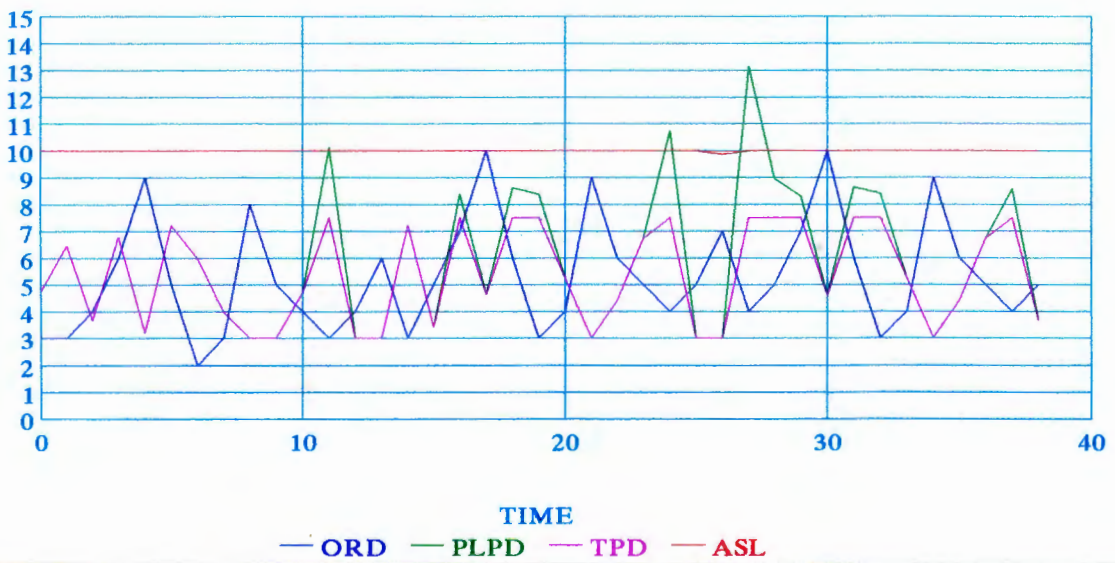
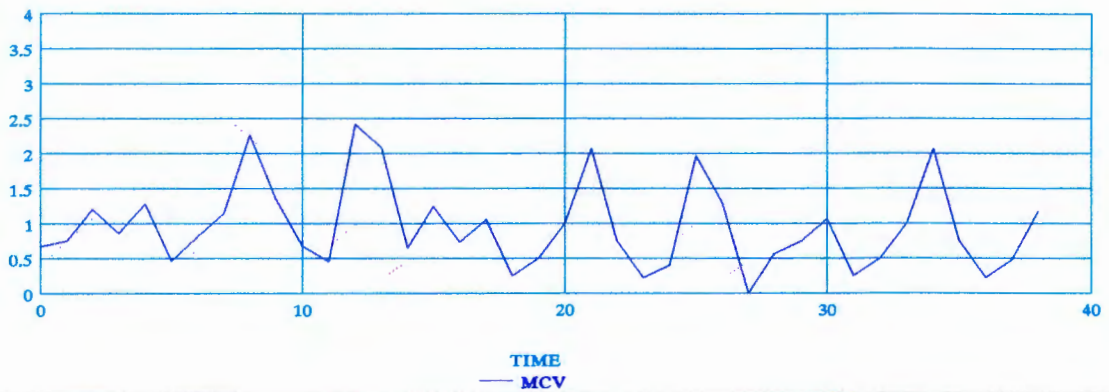
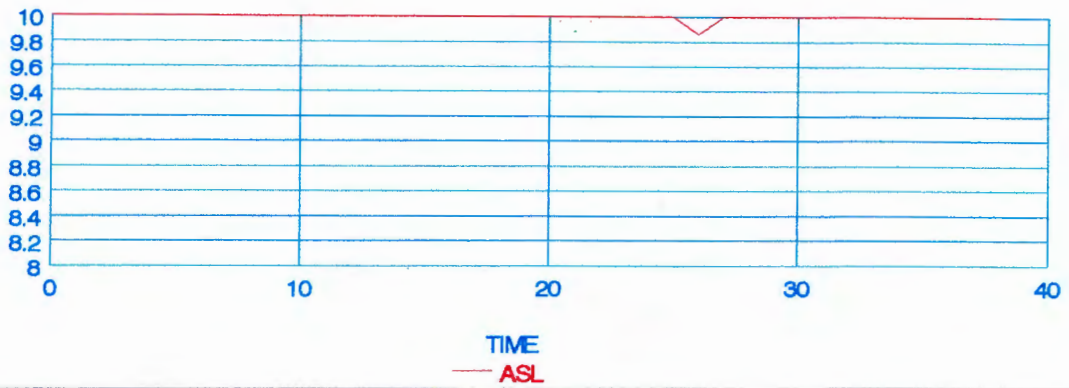
GRAPH SET 3.2

PPPM8T1/STEP TEST (CAP=5.5 SCP=1)



GRAPH SET 3.3

PPPM8T1/STEP TEST (CAP=5 SCP=1.25)



GRAPH SET 3.4

- The general pattern of *PLPD* is slightly more regular, the gap between *PLPD* and *TPD* is smaller and also the average *PLPD* is smaller than the two other figures.

Compared to GRAPH SET 3.4, GRAPH SET 3.3 presents more developed characteristics with 100 % *ASL*, with a smaller average *PLPD* and with a narrower gap between *PLPD* and *TPD* lines. *Capacity* increase seems to be a better alternative to improve the performance of the structure presented in FLOW DIAGRAM 6. In fact GRAPH SET 3.3 illustrates the most improved systemic behaviour obtained in this study, under test conditions.

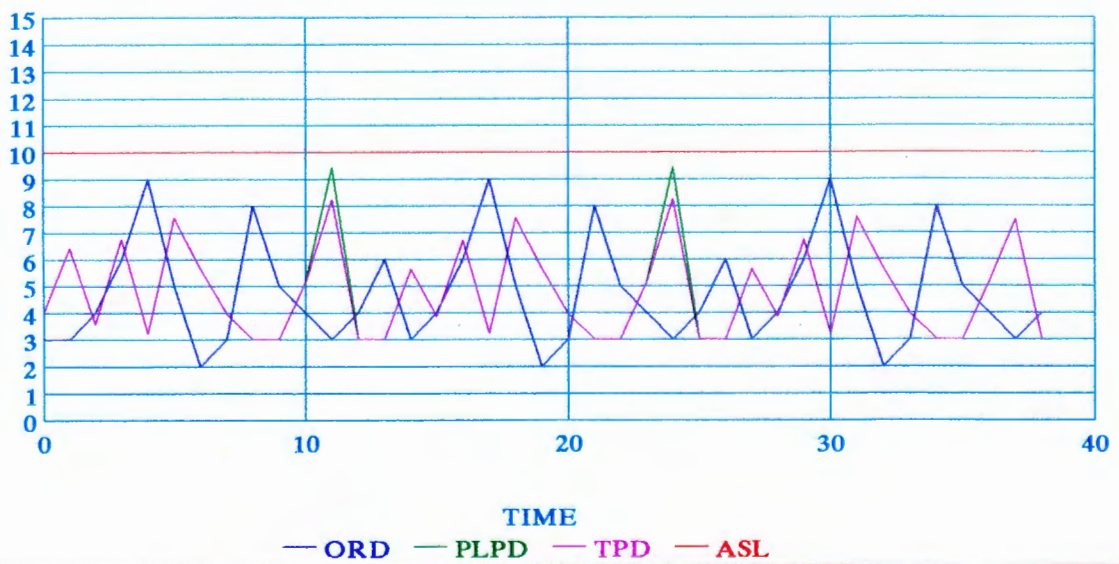
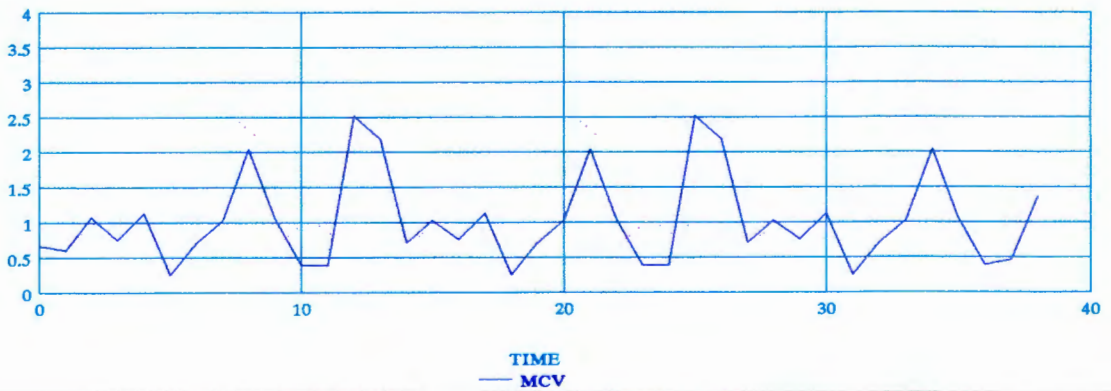
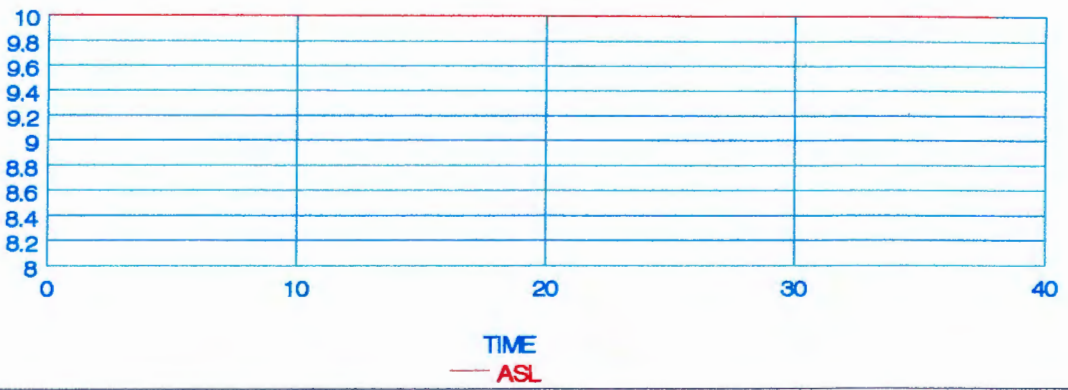
In the next simulation PPPM8 with an increased *Capacity* of 550 tons/month, is tested under normal circumstances (without any unexpected demand increase). PPPM8 with $CAP=1.25$ is the best performing model when there is a STEP increase of demand. Now its performance has to be checked under normal demand conditions. Results of this simulation are given in GRAPH SET 3.5. GRAPH SET 3.5 is comparable with GRAPH SET 2.6 and with GRAPH SET 1.6 which are presenting same kind of situations (behaviour of the best performing model of a given structure under normal conditions).

All three models have the same *ASL* graph. The difference comes with *MCV* graph. Average *MCV* in GRAPH SET 3.5 is the lowest one of all. Also it is possible to observe a more regular *PLPD* pattern in GRAPH SET 3.5. All these observations lead to the result that PPPM8 with a *Capacity* of 550 tons/month is the model conforming best to the criteria of *producing the right amount at the right time*.

Theoretically it is possible to do more modifications to the model to improve further its behaviour. But the level reached with PPPM8 is accepted to be sufficient for the purpose of this study.

PPPM8 with $CAP=550$ tons/month is the model that can cope best with the STEP increase of *Orders*. But in the real life demand fluctuations may not always be in the form of a STEP increase. DYNAMO has two more test functions that can simulate two other types of fluctuations. Details about these test functions and the behaviour of the model (PPPM8 with $CAP=550$ tons/month) under these test conditions are given in APPENDIX E.

PPPM8 (CAP=5.5 SCP=1)



GRAPH SET 3.5

6.6.3 Analysis of Standard Production and Overtime Production

As it is mentioned earlier, at the beginning of *Analysis of Model Behaviour and Model Evaluation* phase, *Overtime Production* (*OPD*) is one of the critical system variables. But up to this point, only *Total Production* (*TPD*), which is the sum of *Standard Production* (*SPD*) and *Overtime Production* (*OPD*), has been monitored. *TPD* is comparable with *Planned Production* and this comparison is necessary for drawing conclusions about the performance of the system. Although the simulation results of *OPD* and *SPD* are saved, they are not shown in any of the graphs. These results are grouped and given in GRAPH SET 4.1, GRAPH SET 4.2 and GRAPH SET 4.3.

GRAPH SET 4.1 shows *Standard Production* and *Overtime Production* of all three models (PPPM6, PPPM7 and PPPM8) with their original *CAP* and *SCP* values. *SPD* and *OPD* results are grouped in two graphs for comparison purposes. The same presentation is used for all three figures (4.1, 4.2 and 4.3).

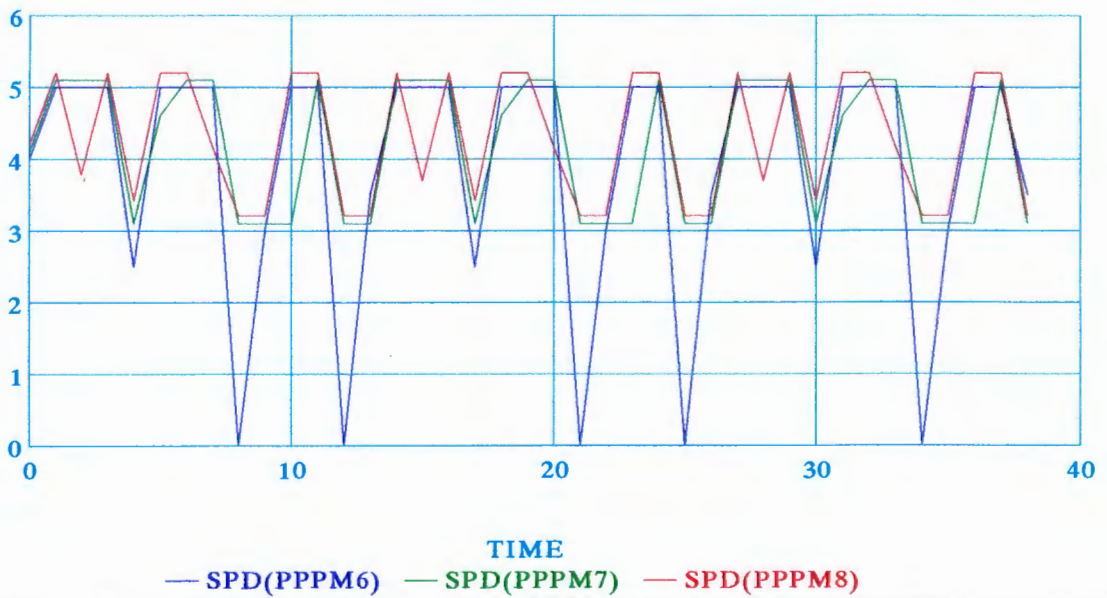
The general conclusion that can be drawn from *SPD* and *OPD* graphs of GRAPH SET 4.1 is that PPPM8 can respond faster to the change in the environment. Increases and decreases of PPPM8 usually happens before the similar fluctuations of PPPM6 and PPPM7. Also, PPPM8 cuts the production down if it is not necessary while PPPM7 and especially PPPM6 continue to produce. Probably that is the reason PPPM8 has lower *MCV* values. For example in *SPD* graph, in three occasions, PPPM6 and PPPM7 stays at 500 tons/month for three months whereas PPPM8 starts with 500 tons/month, goes down to 380 tons/month and comes back to 500 tons/month. This shows that PPPM8 is more sensitive to the requirements of the environment and it is more able to produce the right amount at the right time.

GRAPH SET 4.2 presents *SPD* and *OPD* graphs of all three models under STEP test conditions. Each model has *CAP* and *SCP* values enabling them to maintain 100 % *ASL* during the simulation. The general conclusion drawn about GRAPH SET 4.1 is also valid for GRAPH SET 4.2.

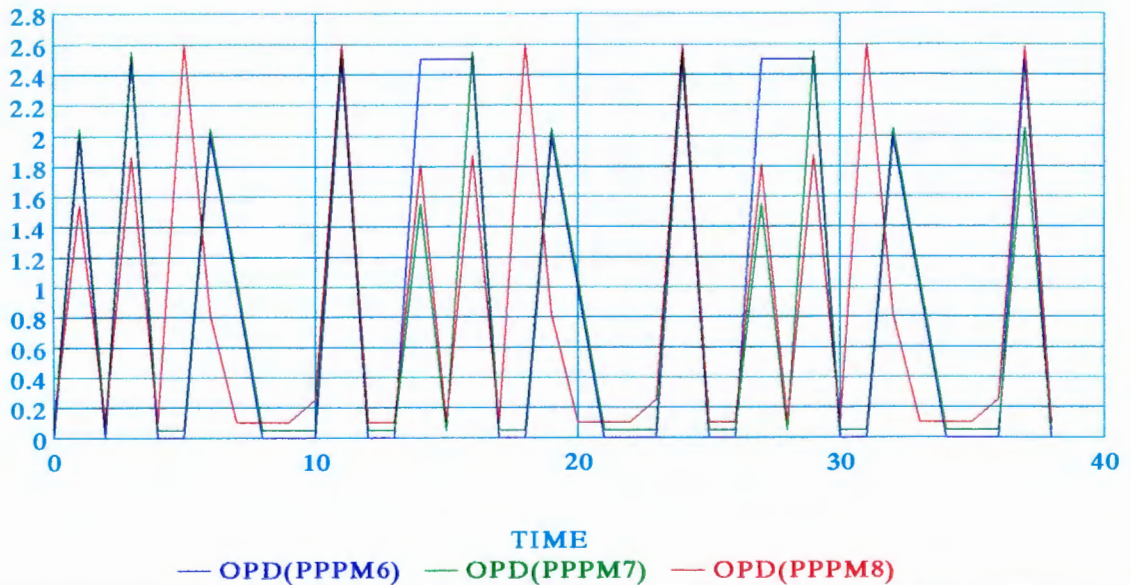
GRAPH SET 4.3 also presents the *Standard* and *Overtime Production* of the models with their optimum *CAP* and *SCP* values, but this time under normal conditions. In this figure it is clearer that PPPM8 minimizes the use of *Overtime Production* better than PPPM6 and PPPM7.

All the main steps of *Policy Analysis and Model Use* are summarized in FIGURE 16.

SPD FOR MODELS PPMP6 (CAP=5 SCP=1)
PPPM7 (CAP=5 SCP=1)
PPPM8 (CAP=5 SCP=1)

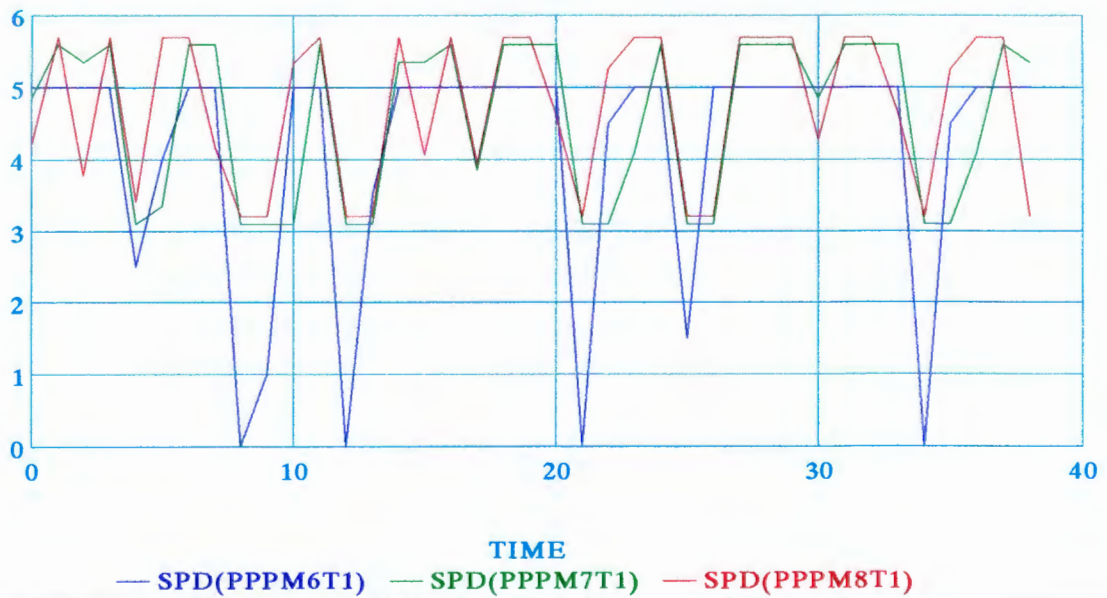


OPD FOR MODELS PPMP6 (CAP=5 SCP=1)
PPPM7 (CAP=5 SCP=1)
PPPM8 (CAP=5 SCP=1)

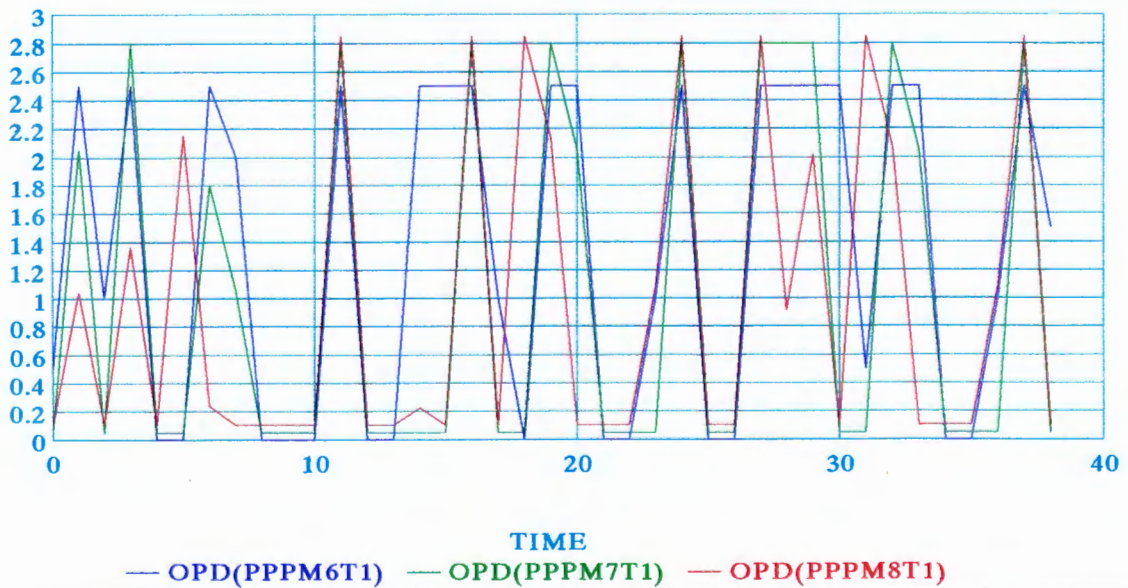


GRAPH SET 4.1

SPD FOR MODELS PPMP6T1 (CAP=5 SCP=1.5)
 PPPM7T1 (CAP=5.5 SCP=1.25)
 PPPM8T1 (CAP=5.5 SCP=1)

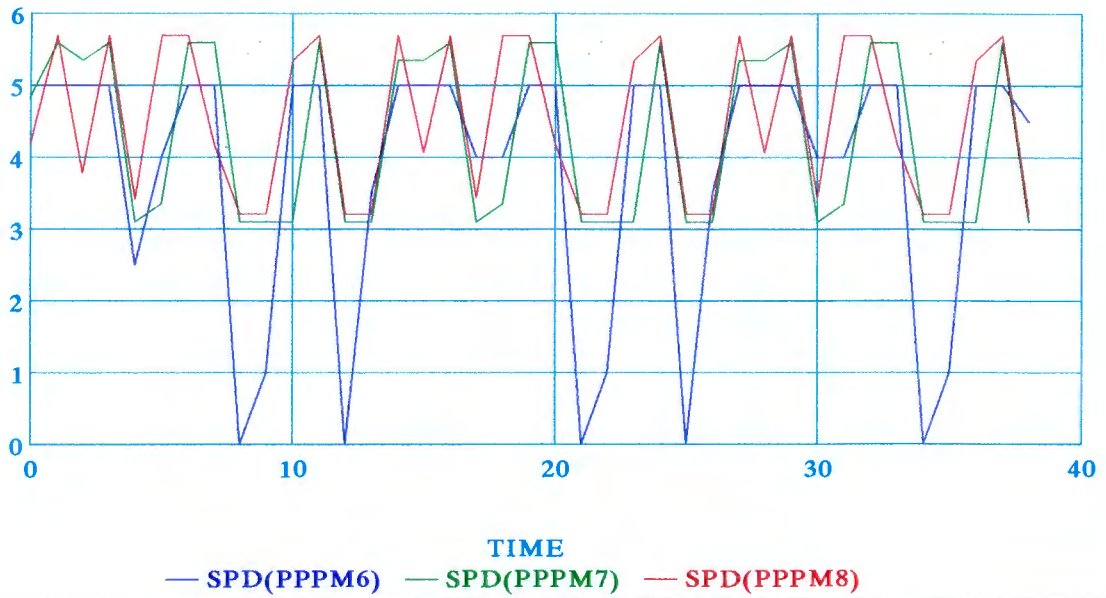


OPD FOR MODELS PPMP6T1 (CAP=5 SCP=1.5)
 PPPM7T1 (CAP=5.5 SCP=1.25)
 PPPM8T1 (CAP=5.5 SCP=1)

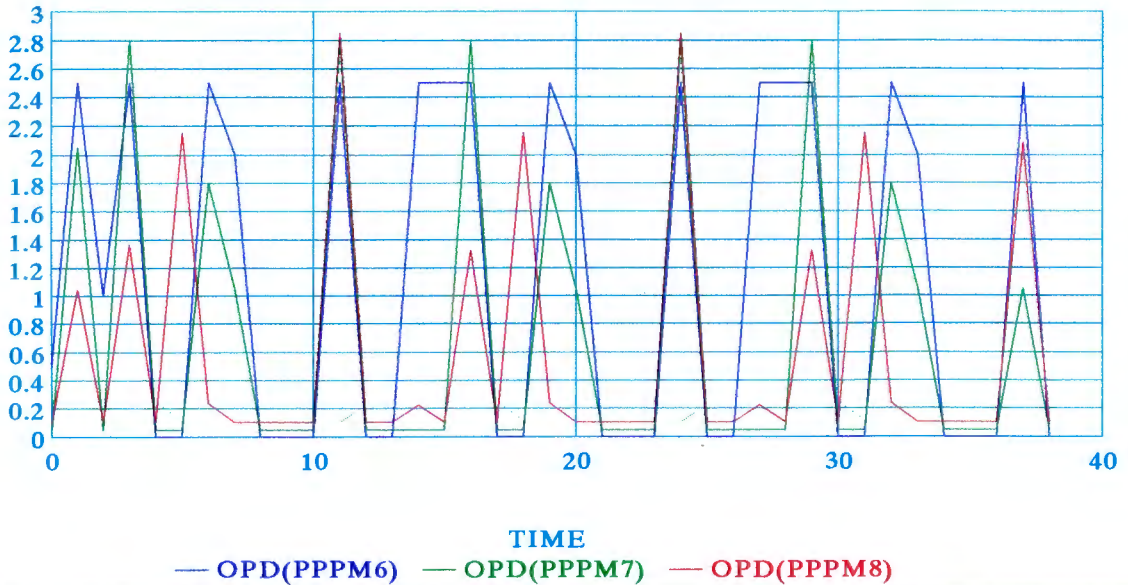


GRAPH SET 4.2

SPD FOR MODELS PPMP6 (CAP=5 SCP=1.5)
PPPM7 (CAP=5.5 SCP=1.25)
PPPM8 (CAP=5.5 SCP=1)



OPD FOR MODELS PPMP6 (CAP=5 SCP=1.5)
PPPM7 (CAP=5.5 SCP=1.25)
PPPM8 (CAP=5.5 SCP=1)



GRAPH SET 4.3

PRODUCTION PLANNING POLICY MODEL 6

- BEHAVIOUR UNDER NORMAL CONDITIONS WITH CAP=5 AND SCP=1
- BEHAVIOUR UNDER STEP TEST WITH CAP=5 AND SCP=1
- BEHAVIOUR UNDER STEP TEST WITH CAP=5.5 AND SCP=1
- BEHAVIOUR UNDER STEP TEST WITH CAP=5 AND SCP=1.25
- BEHAVIOUR UNDER STEP TEST WITH CAP=5 AND SCP=1.5
- BEHAVIOUR UNDER NORMAL CONDITIONS WITH CAP=5 AND SCP=1.5

STRUCTURAL MODIFICATION
(ADDITION OF MPD PARAMETER)

PRODUCTION PLANNING POLICY MODEL 7

- BEHAVIOUR UNDER NORMAL CONDITIONS WITH CAP=5 AND SCP=1
- BEHAVIOUR UNDER STEP TEST WITH CAP=5 AND SCP=1
- BEHAVIOUR UNDER STEP TEST WITH CAP=5.5 AND SCP=1
- BEHAVIOUR UNDER STEP TEST WITH CAP=5 AND SCP=1.25
- BEHAVIOUR UNDER STEP TEST WITH CAP=5.5 AND SCP=1.25
- BEHAVIOUR UNDER NORMAL CONDITIONS WITH CAP=5.5 AND SCP=1.25

STRUCTURAL MODIFICATION
(ADDITION OF PERFORMANCE MONITORING AND FEED-BACK FUNCTION)

PRODUCTION PLANNING POLICY MODEL 8

- BEHAVIOUR UNDER NORMAL CONDITIONS WITH CAP=5 AND SCP=1
- BEHAVIOUR UNDER STEP TEST WITH CAP=5 AND SCP=1
- BEHAVIOUR UNDER STEP TEST WITH CAP=5.5 AND SCP=1
- BEHAVIOUR UNDER STEP TEST WITH CAP=5 AND SCP=1.25
- BEHAVIOUR UNDER NORMAL CONDITIONS WITH CAP=5.5 AND SCP=1
- BEHAVIOUR UNDER PULSE TEST WITH CAP=5.5 AND SCP=1
- BEHAVIOUR UNDER RAMP TEST WITH CAP=5.5 AND SCP=1

CONCLUSION

Figure 16

6.7 Conclusion

At the end of the modelling activity, the knowledge that I have acquired and the understanding that I have developed about different parts, during previous phases, have been integrated into a larger, structured, holistic understanding of the operating system.

The process of building the model is as important as experimenting with the final model. During this process, one reconsiders problem behaviours, key variables and causality relations among them. The structure of causal relations provides a good framework for organising our thinking and understanding about key system variables. This structured understanding of elements leads to an overall understanding of the whole.

While formulating the model, *flow diagrams* are used to look at the same situation from a different angle. Here, the operating system is considered as a combination of *flows* and *rates*. This new consideration adds more perspective to our understanding of the operating system.

Finally, alternative ways of improving the actual situation (that have emerged from the overall systemic understanding), are tested on the model and their relevance are evaluated.

Experiments with the final model have shown that :

- Problematic behaviours that are experienced at Moir's are mainly related to the systemic structure and not to some parameters of the operating system like *Capacity* or *Stock Cover*.
- If the system structure is left as it is, only a limited improvement can be brought by modifying system parameters.
- To increase the production *Capacity* (which is a system parameter), as suggested by the management, will not improve the problem behaviours, if the system structure is left unchanged.
- As it is demonstrated by PRODUCTION PLANNING POLICY MODEL 8, a relevant structural change, on its own, can improve the systemic behaviour considerably.
- To increase the *Capacity* is only feasible if it is combined with a relevant structural change. In the case of Moir's, if the proper performance monitoring function and its feed-back channel are at their places, then the capacity increase can have a considerable impact on the overall performance of the production system.
- A relevant structural change does not only improve the actual performance of the system but it also increase the possible success of an intervention.

To summarise, it can be said that, the modelling activity has lead to an insightful structural

understanding of the operating system at Moir's. And from this understanding, an alternative structure that can improve the actual performance of the operating system that can increase the effect of relevant interventions, has emerged.

University of Cape Town

CHAPTER 7 : CONCLUSION AND RECOMMENDATIONS

In this thesis, the situation at Moir's is used to demonstrate the general considerations discussed in the INTRODUCTION. Moir's was a case illustrating the conventional management perspective which is assuming that the causes of problems are related in fairly straight forward ways to problem symptoms.

At Moir's, the management was considering to increase the capacity. The main reason of this consideration was the general belief about capacity shortage. And this belief was the result of the symptomatic thinking about causalities.

Traditionally experienced problem behaviours were :

- high finished goods inventory,
- excessive use of overtime work and
- fluctuating customer service level.

These problem behaviours were related to capacity shortage in the following way.

- As we do not have enough capacity, we have to play safe and keep high finished goods inventory.
- As we do not have enough capacity, we cannot produce what we need to produce during standard working hours. Therefore we have to work overtime.
- But all these measures are not enough. As we do not have enough capacity, we cannot respond to demand increases and therefore our customer service level goes down.

The simplistic idea behind this causality perspective is that cause and effect are closely related in time and space. When problem arise, it is assumed that the causes lie in the same part of the system as the problem itself. It is also assumed that, once the appropriate local remedy is applied, the problem will be solved relatively quickly. In the case of Moir's the proposed local remedy was the capacity increase. On the other hand, in the study it is found out that, even in very important issues like the correctness of bill of materials, the management can have some misleading assumptions.

From a systemic perspective, cause and effect generally are not closely related in time and space. Causes of a problem may lie in a completely different part of a system from the problem symptoms. Therefore we must look beyond the apparent causal relations.

Most of the times, the system structure itself is responsible of the systemic behaviour. Therefore it is necessary to understand the underlying structure in order to locate the real causes of problem behaviours and to be able to do relevant structural changes that will bring sustainable improvements. *System structure* is concerned with the interrelationships among key variables that influence the behaviour over time.

In the thesis, the structural understanding of the operating system, has been developed through system dynamics modelling. This understanding lead to an insightful interpretation of the situation.

According to systems perspective there are multiple levels of explanation in any complex situation depending on the depth of the approach used (FIGURE 17). To some extent, they all are equally *true* but their usefulness is quite different (Senge, 1990, p52).

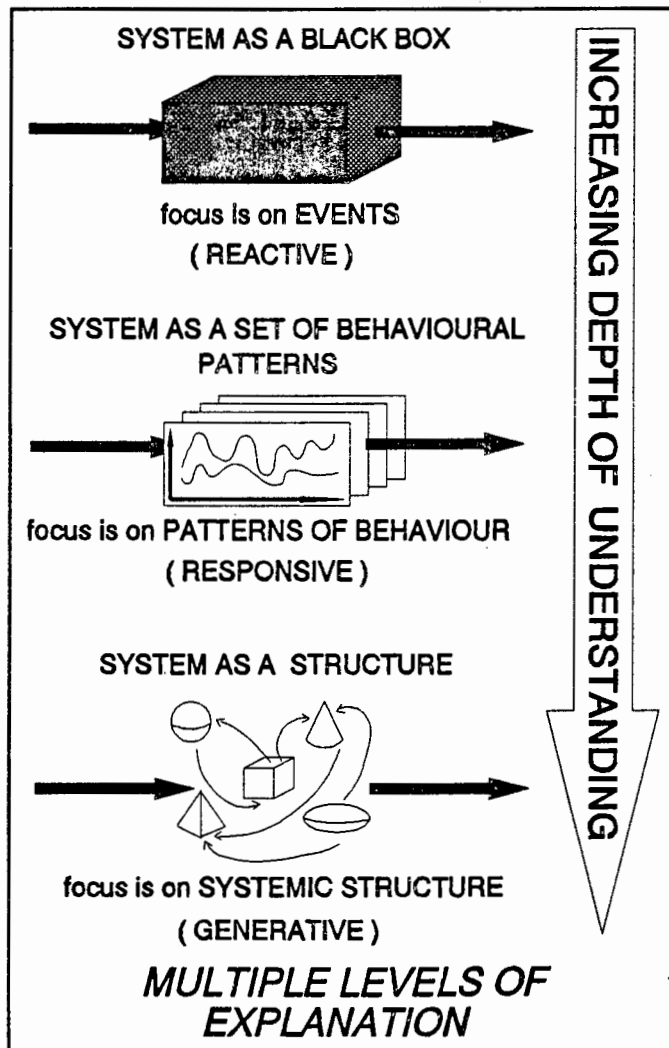


Figure 17

Event explanations condemn their holders to a reactive stance. These are the most common ones in contemporary culture and that is why reactive management prevails. The way how the management at Moir's have interpreted the actual situation and have decided to increase the production capacity, is an example of this case.

Patterns of behaviour explanations focus on seeing longer term trends and assessing their implications. They begin to break the grip of short term reactivity. At least they suggest how, over a longer term, we can respond to shifting trends. During modelling exercise, fluctuations of the *Total Production* are considered, as an undesirable pattern of behaviour. A *Minimum Production* requirement is then introduced to reduce these fluctuations. Consequently, this change has improved the overall performance of the system.

The third level of explanation, the *structural explanation*, is the least common and the most powerful one. It focuses on answering the question, *What causes the patterns of behaviour?* In the case of Moir's the answer to this question was *the lack of a subsystem monitoring the performance of the production system and feeding the results back to production planning function*. Once the *structural explanation* of undesired systemic behaviour is found then the only thing to do is to correct this structural deficiency to improve the behaviour. This is what exactly done in the final model (PRODUCTION PLANNING POLICY MODEL 8) . By the addition of a performance monitoring function and its feed-back channel, the most improved systemic behaviours of the modelling exercise are obtained. Structural explanations, when they are clear and widely understood, have a considerable impact on the system.

The case of Moir's demonstrates that, it is necessary, first to develop an overall structural understanding of the operating system in order to locate the problem and then to bring a sustainable improvement. Most of the time the problem is in the structure itself and to correct the structure will improve the situation.

Symptomatic interventions based on simplistic causal explanations, like increasing the production capacity, will not have the desired effect unless the systemic structure is right.

Continuous and accelerating change and its impact on the nature of today's business problems will make the traditional management approach to problem solving, less and less effective. This symptomatic approach which is stuck in event explanations will only see a chaos in the multi-facial, and multi-dimensional complex problems of today's world. In this world of complex systems, systemic approaches that can see an order in today's chaotic problems, through their structural explanations, will generate solutions that can bring improvements sustainable in the long term.

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APPENDIX A

E-CODES AND P-CODES.....1

M-CODES AND F-CODES.....4

ITEM CODE	CLASS	ITEM DESCRIPTION	ITEM CODE	CLASS	ITEM DESCRIPTION	
E313850	01	COCOA POWDER BOURNVILLE	P345002	99	MJP CHERRY	345.600KG
E314118	01	LECITHINATED COCOA POWDER B	P345011	99	MJP GREENGAGE	345.600KG
E314419	01	BUTTABELLE	P345020	99	MJP LEMON	345.600KG
E314428	01	CHERRY F1451	P345039	99	MJP LIME	345.600KG
E314437	01	TRUSIL GREENGAGE F1459	P345048	99	MJP ORANGE	345.600KG
E314473	01	STRAWBERRY 85574/3 ESROLKO	P345057	99	MJP PEACH	345.600KG
E314491	01	APRICOT 28970	P345066	99	MJP PINEAPPLE	345.600KG
E314534	01	BUTTERSCOTCH SO 33616	P345075	99	MJP RASPBERRY	345.600KG
E314543	01	CARAMEL NO 1044	P345084	99	MJP STRAWBERRY	345.600KG
E314598	01	LEMON NO 2513	P345109	99	T/JELLY B/CURRANT	288.000KG
E314604	01	LIME NO 1505	P345118	99	T/JELLY P/WINE	288.000KG
E314622	01	PEACH 53 2812	P345127	99	T/JELLY G/GAGE	288.000KG
E314640	01	RASPBERRY NO 4028	P345136	99	T/JELLY STRAWBERRY	288.000KG
E314686	01	VANILLA MD 2501	P345145	99	T/JELLY LEMON	288.000KG
E314695	01	VANILLA OLEO RESIN 02494	P345154	99	T/JELLY ORANGE	288.000KG
E314747	01	BBA DDX BLACKCURNT F1442	P345172	99	C/PACK JELLY RASPBERRY	288.000KG
E314756	01	H+R PORTWINE LR15785	P345233	99	IP BUTTERSCOTCH	388.800KG
E314792	01	PINEAPPLE N6 4278	P345242	99	IP CARAMEL	388.800KG
E314808	01	STRAWBERRY BBA J1183	P345279	99	IP STRAWBERRY	388.800KG
E314835	01	CHOCOLATE DXO 5667	P345288	99	IP CHOCOLATE	388.800KG
E314844	01	ORANGE N6 4361	P345312	99	IP VANILLA	388.800KG
E314880	01	CHOCOLATE 9/029052(DRAGOCO)	P346740	99	IP BER O/T FORREST	388.800KG
E314899	01	VANIFF 403779	P346759	99	IP TROP FRUIT	388.800KG
E314905	01	TRUSIL CNDSD MILK J1620	P345464	99	HSP SPONGE CHOCOLATE	544.800KG
E314923	01	GIV CARAMEL 77614-71	P345473	99	HSP SPONGE CARAMEL	544.800KG
E314932	01	BBA TRUSIL APPLE BRM J2143	P345482	99	HSP SPONGE MIXED FRUIT	544.800KG
E314969	01	FIRMENICH B/SCOTCH 50126 AP	P345491	99	HSP SPONGE APRICOT	544.800KG
E314978	01	CADBURY CHOC CRUMB	P345525	99	HSP SPONGE LEMON	544.800KG
E314987	01	GUNTHER FUDGE R12223	P346616	99	HSP SPONGE APPL&CRML	544.800KG
E314996	01	RUM FIRMENICH 53305	P346634	99	HSP SPONGE PEACH	544.800KG
E315005	01	APRI/PEACH TS8826	P345543	99	HSP SAUCE CHOCOLATE	136.800KG
E315014	01	BERRIES O/T FORREST N7-4674	P345552	99	HSP SAUCE CARAMEL	136.800KG
E315023	01	TROPICAL FRUIT 75322.31	P345561	99	HSP SAUCE MIXED FRUIT	136.800KG
E315032	01	BANANA 85509.31	P345570	99	HSP SAUCE APRICOT	136.800KG
E315041	01	ORANGE 7546751 GIV	P345604	99	HSP SAUCE LEMON	136.800KG
E315050	01	LEMON J2424 BBA	P346625	99	HSP SAUCE APL & CARAM	136.800KG
E313203	02	LAKE BLUE WG648	P346643	99	HSP SAUCE PEACH	136.800KG
E313212	02	CARAMEL POWDER	P345668	99	CREME CARAMEL PUDD	540.000KG
E313221	02	LAKE TARTRAZINE WG644	P345677	99	CREME CARAMEL SAUCE	180.000KG
E313230	02	LAKE SUNSET YELLOW WG641	P345853	99	SOFT & MOIST VANILLA	768.000KG
E313249	02	LAKE GERANINE WG642	P345880	99	SOFT & MOIST CHOCOLATE	768.000KG
E313267	02	CHOCOLATE BROWN F1619	P346449	99	SUPER MOIST CHOCOLATE	780.000KG
E313276	02	QUINOLINE YELLOW	P346458	99	SUPER MOIST VANILLA	780.000KG
E900087	02	CARMOISINE	P346713	99	C/MX FUNFET/FUNCAKES	696.000KG
E900142	02	ERYTHROSINE	P345969	99	CUST FINAL MIX	540.000KG
E900207	02	GERANINE	P345978	99	ESS ALMOND	190.200 L
E900223	02	CP GREEN "S"	P346005	99	ESS VANILLA	176.400 L
E900333	02	PONCEAU 4R	P346014	99	ESS RUM	180.000 L
E900443	02	SUNSET YELLOW	P346023	99	ESS STRAWBERRY	180.000 L
E900456	02	TARTRAZINE	P346032	99	ESS ROSE	180.000 L
E900498	02	BLUE COL POWDER FCF	P346041	99	ESS RASPBERRY	180.000 L
E313805	03	HI-LITE FAT	P346050	99	ESS PINEAPPLE	182.400 L
E314002	03	EMULSIFIER EC 25	P346069	99	ESS PEPPERMINT	180.000 L
E900485	03	VEGETABLE COOKING OIL	P346078	99	ESS ORANGE	180.000 L
E312501	04	CORNSTARCH (NORMAL)	P346087	99	ESS LEMON	181.200 L
E312510	04	CORNFLOUR LOW MOISTURE	P346102	99	ESS CARAMEL	180.000 L

E312608	04	MAIZE FLOUR	P346111	99	COLOURING SKY BLUE	186.000 L
E316585	04	H 50	P346157	99	COLOURING EGG YELL	453.000 L
E319618	04	HI-FLAKE FLOUR	P346166	99	COLOURING CRIM RED	180.000 L
E319627	04	SNOWFLAKE FLOUR	P346184	99	COLOURING APPLE GREEN	186.000 L
E319636	04	POLLARD	P346193	99	BAKING POWDER	672.000KG
E319645	04	OAT BRAN	P346476	99	LOWCAL GREENGAGE	158.400KG
E319654	04	OAT FLOUR	P346485	99	LOWCAL LEMON	158.400KG
E510299	04	MEALIE MEAL YELLOW	P346494	99	LOWCAL ORANGE	158.400KG
E315403	05	APPLES DICED DRIED	P346500	99	LOWCAL RASPBERRY	158.400KG
E315412	05	APRICOTS DICED DRIED	P346519	99	GROUND WHITE PEPPER	100.000KG
E315458	05	PEEL CUT MIXED VALOR	P346528	99	GROUND BLACK PEPPER	100.000KG
E315485	05	RAISINS SEEDLESS SMALL	P346555	99	CAYENNE PEPPER	100.000KG
E315494	05	DBLE DCED YEL CLING PEACHES	P346564	99	L/CAL IP CARAMEL	158.400KG
E317409	07	MIXED SPICE GROUND	P346573	99	L/CAL IP CHOCOLATE	158.400KG
E317418	07	CINNAMON GROUND	P346582	99	L/CAL IP VANILLA	158.400KG
E317463	07	MEAT MAGIC BARBECUE	P346591	99	EC25/DRIDEX 10	157.500KG
E317472	07	MEAT MAGIC ORIENTAL	P346670	99	ICING MIX CHOC FUDGE	468.000KG
E317481	07	MEAT MAGIC MEXICAN	P346689	99	ICING MIX CARAMEL	468.000KG
E317524	07	MEAT MAGIC SOSATIE	P346704	99	ICING MIX FUN CAKES	231.840KG
E317490	07	WHOLE FENNEL	P346722	99	ICING MIX FUNFETTI	295.800KG
E318031	07	CASSIA STICKS	P346980	99	MUFFIN MIX RAISIN	768.000KG
E318138	07	CARAWAY SEEDS	P346999	99	MUFFIN MIX APPLE	768.000KG
E318147	07	CUMMIN SEED	P347008	99	WHOLESOME APPLE SACHET	50.000 G
E318314	07	WHOLE BLACK PEPPER	P347017	99	WHOLESOME RAISIN SACHET	75.000 G
E318332	07	WHOLE WHITE PEPPER	P360014	99	COL SOL BROWN	NO1 11.080 L
E318387	07	WHOLE TURMERIC	P360041	99	COL SOL GREEN	NO1 11.000 L
E318396	07	GINGER WHOLE SLICED	P360069	99	COL SOL GREEN	NO4 10.240 L
E515061	07	CHILLI WHOLE GRADE 1A	P360078	99	COL SOL ORANGE	NO1 10.570 L
E515074	07	CRUSHED CHILLIES	P360087	99	COL SOL PINEAPPLE	NO1 10.506 L
E515142	07	WHOLE CORIANDER	P360102	99	COL SOL B/CURRANT	NO1 11.160 L
E515223	07	FENUGREEK SEEDS	P360111	99	COL SOL CARMOSINE	NO2 10.750 L
E900100	07	GROUND CLOVES	P360120	99	COL SOL GERANINE	NO1 11.320 L
E316576	08	ASPARTAME	P360139	99	COL SOL PONCEAU	NO1 10.500 L
E312529	09	CARRAGEENAN GENUL CP100	P360148	99	COL SOL PORT WINE	NO1 11.628 L
E312574	09	FLANOGEN 3	P360157	99	COL SOL RASPBERRY	NO1 11.126 L
E313708	09	CMC DAICEL N330	P360166	99	COL SOL STRAWBERRY	NO1 11.020 L
E313799	09	DEXTRROSE MONOHYDRATE	P360175	99	COL SOL LEM YELLOW	NO1 11.000 L
E315908	09	GELATINE	P360184	99	COL SOL YELLOW	NO1 10.745 L
E316220	09	SODIUM BICARBONATE (FINE)	P360193	99	COL SOL YELLOW DH	10.937 L
E316239	09	BICARBONATE (USP)	P364876	99	COL SOL PEPPERMINT	12.000 L
E316293	09	CALCIUM LACTATE	P360227	99	COL LCJ GREENGAGE	26.880 L
E316309	09	CREAM OF TARTAR	P360236	99	COL LCJ LEMON	26.448 L
E316318	09	DISODIUM ORTHO PHOSPHATE	P360245	99	COL LCJ ORANGE	26.448 L
E316327	09	EPSOM SALTS	P360254	99	COL LCJ RASPBERRY	26.448 L
E316336	09	MALIC ACID	P360263	99	COL LC IP CHOCOLATE	25.264KG
E316390	09	TETRON K	P360272	99	COL LC IP CARAMEL	25.488KG
E316451	09	SUPERFINE SALT	P346731	99	COL IP FUNFETTI YELLOW	26.200KG
E316488	09	EMJEL PAS	P346768	99	COL IP SUNSET YELLOW	26.520KG
E316497	09	ADMUL MG 6203	P362029	99	COL IP BROWN	29.130KG
E316521	09	PAN-O-LITE	P362038	99	COL IP LEMON YELLOW	26.250KG
E316530	09	PYRAN	P362047	99	COL IP RED	26.215KG
E316558	09	DRIDEX 10/20	P362056	99	COL IP STRAWBERRY RED	28.280KG
E316600	09	COFFEE CREAMER	P362065	99	COL IP YELLOW	26.215KG
E510435	09	SIPERNAT 22 S	P362144	99	COL IP BLACK	30.845KG
E900003	09	ACID ASCORBIC	P362171	99	COL IP BLUE	28.280KG
E900016	09	ACID CITRIC ANHYDROUS	P364007	99	VITAMIN C MASTER	175.000KG
E900045	09	ACID SODIUM PYROPHOSPHAT	P364358	99	DI-ACETYL NO 2 SOL	1.000 L
E900058	09	ACID TARTARIC	P364539	99	ROSE OIL MIX	1.450 L

E900249	09	NIPIGAN M	P364557	99	CREAM MIX NO1	13.000 L
E900375	09	RECTIFIED SPIRITS	P364566	99	ALMOND ESS ART	191.800 L
E900388	09	SODIUM BENZOATE	P364575	99	CITRAL SOLUTION	191.800 L
E900401	09	SODIUM CITRATE	P364584	99	ETHYL ACETATE SOL	191.800 L
E900469	09	SOFT WATER	P364593	99	FLAVOURED SPIRITS NO1	189.000 L
E310037	17	AMYL ACETATE	P364609	99	FLAVOURED SPIRITS NO3	191.800 L
E310046	17	AMYL BUTYRATE	P364618	99	ORANGE OIL SOL	191.800 L
E310107	17	ALDEHYDE C10	P364627	99	ROSE ESS ART NO2	193.000 L
E310125	17	ALDEHYDE C19	P364645	99	BUCHU OIL 10% SOL	300.000ML
E310189	17	AMYL VALERIANATE	P364672	99	PINEAPPLE ADDITIVE	9.500 L
E310213	17	BUTYL BUTYRATE	P364724	99	RUM CONCENTRATE	5.380 L
E310231	17	CINNAMIC ALDEHYDE	P364742	99	VANILLIN SOLUTION	191.500 L
E310259	17	CITRAL	P364821	99	MALIC ACID SOL 50%	1.000 L
E310268	17	COUMARIN	P364830	99	NIPAGIN SOLUTION 30%	1.000 L
E310277	17	DI-ACETYL	P364849	99	SODIUM BENZOATE SOL	1.000 L
E310286	17	ETHYL ACETATE	P364867	99	ALDEHYDE C10 10% SOL	500.000ML
E310295	17	ETHYL BUTYRATE	P366003	99	CUST COLOUR BATCH	29.720KG
E310301	17	ETHYL CAPRYLATE	P745022	99	INDUSTRIAL B/POWDER	765.250KG
E310310	17	ETHYL FORMATE	P745064	99	MOIRS CURRY MED	200.000KG
E310329	17	ETHYL OENANTHATE	P745080	99	MOIRS CURRY HOT	100.000KG
E310338	17	ETHYL PROPIONATE	P745103	99	BORRIE COMPOUND	100.000KG
E310347	17	ETHYL SALICYLATE	P745129	99	WHITE PEPPER COMPOUND	100.000KG
E310365	17	ETHYL VALERIANATE	P745145	99	MOIRS MASALA PRE MIX	194.170KG
E310374	17	GERANYL ACETATE	P745161	99	MOIRS MASALA FIN MIX	200.000KG
E310383	17	GERANIOL	P745187	99	BLACK PEPPER COMPOUND	100.000KG
E310408	17	IONONE-ALPHA	P745242	99	CRUSHED TURMERIC	100.000KG
E310462	17	OIL BERGAMOT		140		
E310471	17	OIL BUCHU				
E310505	17	OIL CLOVE				
E310523	17	OIL GERANIUM				
E310541	17	OIL LEMON				
E310550	17	OIL LIME RECON				
E310587	17	OIL PEPPERMINT				
E900265	17	OIL ORANGE				
E310602	17	PHENYL ETHYL ALCOHOL				
E310611	17	RHODINOL				
E310639	17	VANILLIN				
E900061	17	BENZALDEHYDE				
E315449	19	COCONUT DESICCATED FINE				
E315573	19	COCONUT DESICCATED MEDIUM				
E319210	25	SUPERFINE SUGAR H11				
E319229	25	CASTOR SUGAR H6				
E319238	25	ICING SUGAR				
E900430	25	SUGAR ILLOVO WHITE				
E312006	26	CHOC CHIPS				
E312015	26	SILVER BALLS				
E312024	26	HUNDREDS & THOUSANDS				
E312079	26	CHOCOLATE VERMICELLI				
E312088	26	WAFERETTES				
E312097	26	FUNFETTI SUGAR STRANDS				

ITEM CODE	CLASS	ITEM DESCRIPTION	ITEM CODE	CLASS	ITEM DESCRIPTION	
M332138	10	DISPLAY BORRIE	F013900	M1	MJP CHERRY	48X80G
M332147	10	DISPLAY CURRY	F013919	M1	MJP LEMON	48X80G
M332156	10	DISPLAY CAYENNE PEPPER	F013927	M1	MJP ORANGE	48X80G
M332165	10	DISPLAY WHITE PEPPER	F013935	M1	MJP RASPBERRY	48X80G
M332174	10	DISPLAY COMPOUND PEPPER	F013943	M1	MJP GREENGAGE	48X80G
M332271	10	DISPLAY BAKING POWDER 50G	F013951	M1	MJP LIME	48X80G
M335933	10	INNER DISPLAY PEPPERCONE 50G	F013978	M1	MJP PEACH	48X80G
M335207	10	CORR MOIRS JELLY 4 DOZ	F013986	M1	MJP PINEAPPLE	48X80G
M335252	10	CORR INSTANT PUDDING 4 DOZ	F013994	M1	MJP STRAWBERRY	48X80G
M335289	10	CORR SPONGE PUDDING 2 DOZ	F014001	M1	TWR ASSORTED JELLY	144X80G
M335298	10	CORR CAKE MIX 2 DOZ	F014028	M1	TWR ASSORTED JELLY	72 X80G
M335359	10	CORR CUSTARD 125G 6 DOZ	F014079	M1	IP CARAMEL	48X90G
M335386	10	CORR ESSENCE 30ML 2X10	F014087	M1	IP BUTTERSCOTCH	48X90G
M335395	10	CORR ESSENCE 500ML 1 DOZ	F014095	M1	IP CHOCOLATE	48X90G
M335401	10	CORR COL 30ML 2X10	F014117	M1	IP VANILLA	48X90G
M335410	10	CORR COCONUT 100G 2 DOZ	F014125	M1	IP STRAWBERRY	48X90G
M335474	10	CORR BICARB 500G	F015482	M1	IP TROPICAL FRUIT	48X90G
M335483	10	CORR MOIRS EPSOM	F015490	M1	IP FOREST BERRIES	48X90G
M335492	10	CORR MOIRS BICARB	F014184	M1	HSP CARAMEL	24X284G
M335508	10	CORR MOIRS CREAM TARTAR	F014192	M1	HSP LEMON	24X284G
M335517	10	CORR MOIRS TARTARIC ACID	F014214	M1	HSP APRICOT	24X284G
M335544	10	CORR TABLE PACK 50G	F014222	M1	HSP CHOCOLATE	24X284G
M335599	10	CORR CREME CARAMEL 4 DOZ	F014230	M1	HSP MIX FRUIT	24X284G
M335605	10	CORR BAKING POWDER 200G	F015369	M1	HSP APPLE & CARAMEL	24X284G
M335614	10	CORR BAKING POWDER 500G	F015407	M1	HSP PEACH	24X284G
M335687	10	CORR BAKING POWDER 100G	F014249	M1	CREME CARAMEL	24X125G
M335702	10	CORR CAKE MIX 1 DOZ	F014257	M1	L/CAL JELLY RASPBERRY	36X40G
M335720	10	CORR ESSENCE 100ML 2 DOZ	F014265	M1	L/CAL JELLY ORANGE	36X40G
M335748	10	CORR SPICE TINS 50G	F014273	M1	L/CAL JELLY GREENGAGE	36X40G
M335784	10	CORR TOWER JELLY 1/2GR	F014281	M1	L/CAL JELLY LEMON	36X40G
M335793	10	CORR TOWER JELLY GROSS	F014303	M1	MIP L/CAL CHOCOLATE	36X20G
M335818	10	CORR SPICE TINS 100G	F014311	M1	MIP L/CAL VANILLA	36X20G
M335872	10	CORR MEAT MAGIC	F015318	M1	MIP L/CAL CARAMEL	36X20G
M335924	10	CORR TOWER C/NUT 200G	F014346	M1	CUSTARD VANILLA	72X125G
M335951	10	CORR PEPPERCONE 40X50G	F015261	M1	CUSTARD VANILLA	36X250G
M335650	10	CORR CAKE DECORATIONS 125ML	F014354	M1	CUSTARD VANILLA (JAR)36X500G	
M335988	10	CORR CAKE DECORATIONS 100ML	F018880	M1	CUSTARD VANILLA (PKT)36X500G	
M336112	10	CORR CUSTARD 500G	F014419	M1	CAKE MIX CHOCOLATE	24X400G
M336185	10	CORR FINE COCONUT 200G	F014427	M1	CAKE MIX VANILLA	12X400G
M336194	10	CORR FINE COCONUT 500G	F015458	M1	FUNCAKES	12X240G
M336486	10	CORR MEDIUM COCONUT 200G	F015474	M1	FUNFETTI	12X240G
M336501	10	CORR MEDIUM COCONUT 500G	F015512	M1	RAISIN MUFFIN	12X475G
M336237	10	CORR LOWCAL JELLY	F015520	M1	APPLE MUFFINS	12X450G
M336274	10	CORR LOWCAL INST PUDDING	F015415	M1	C/MX S/MST VAN/CARAM	12X800G
M336307	10	CORR CUSTARD 250G	F015423	M1	C/MX S/MST CHOC/FUDG	12X800G
M336334	10	CORR FUN CAKE	F014494	M1	ESS VANILLA	20X 30ML
M336343	10	CORR CUSTARD (PKTS) 500G	F014508	M1	ESS STRAWBERRY	20X 30ML
M336352	10	CORR FUNFETTI	F014516	M1	ESS LEMON	20X 30ML
M336361	10	CORR GENERAL SUPER MOIST	F014524	M1	ESS CARAMEL	20X 30ML
M336370	10	CORR MUFFINS APPLE	F014532	M1	ESS ALMOND	20X 30ML
M336389	10	CORR MUFFINS RAISIN	F014540	M1	ESS ORANGE	20X 30ML
M735016	10	CORR BAKING POWDER 2KG	F014559	M1	ESS RUM	20X 30ML
M735029	10	CORR CP 3KG	F015431	M1	ESS PEPPERMINT	20X 30ML
M735032	10	CORR CP 1KG	F020532	M1	ESS RASPBERRY	20X 30ML
M735058	10	CORR ESSENCE 1LT	F021032	M1	ESS ROSE	20X 30ML
M735061	10	CORR JELLY/INST PUDDING 12KG	F014567	M1	ESS VANILLA	24X100ML

M335711	12	TRAY ESS	30ML	2X10	F014583	M1	ESS VANILLA	12X500ML
M336006	10	TRAY SILVER BALLS			F020923	M1	ESS ORANGE	12X500ML
M336015	10	TRAY CHOC CHIPS			F020931	M1	ESS RASPBERRY	12X500ML
M336024	10	TRAY CHOC VERMICELLI			F020958	M1	ESS PINEAPPLE	12X500ML
M336042	10	TRAY 100'S & 1000'S			F020966	M1	ESS ALMOND	12X500ML
M336051	12	TRAY COLS	30ML	2X10	F021040	M1	ESS ROSE	12X500ML
M336060	10	TRAY CUSTARD		500G	F021172	M1	ESS STRAWBERRY	12X500ML
M336291	10	TRAY CUSTARD		6X250G	F014591	M1	COL APPLE GREEN	20X30ML
M336097	10	SLEEVE FINE COCONUT		200G	F014605	M1	COL SKY BLUE	20X30ML
M336103	10	SLEEVE FINE COCONUT		500G	F014613	M1	COL CRIMSON RED	20X30ML
M336477	10	SLEEVE MEDIUM COCONUT		200G	F014621	M1	COL EGG YELLOW	20X30ML
M336495	10	SLEEVE MEDIUM COCONUT		500G	F014656	M1	BAKING POWDER	100X50G
M335863	10	DIVISIONS ESSENCE		100ML	F014664	M1	BAKING POWDER	48X100G
M336398	10	DIVISIONS ESSENCE		1000ML	F014672	M1	BAKING POWDER	24X200G
M342438	10	DIVISIONS ESSENCE		500ML	F014680	M1	BAKING POWDER	24X500G
M342447	10	DIVISIONS SPICE DISPLAY			F014699	M1	COCONUT (FINE)	24X100G
M342474	10	DIVISIONS CAKE DEC SHORT			F014702	M1	COCONUT (FINE)	48X200G
M342483	10	DIVISIONS CAKE DEC LONG			F014710	M1	COCONUT (FINE)	24X500G
M330071	11	LINERS CUSTARD WAXED		125G	F014729	M1	TOWER COCONUT	40X200G
M330080	11	LINERS CUSTARD		500G	F015563	M1	COCONUT (MEDIUM)	48X200G
M330099	11	SPICE BAGS PLAIN		25KG	F015571	M1	COCONUT (MEDIUM)	24X500G
M330105	11	SPICE BAG LINERS		25KG	F014745	M1	100'S & 1000'S	24X100G
M330150	11	ENV MOIRS EPSOM SALTS			F014753	M1	CHOC. VERMICELLI	24X 75G
M330169	11	ENV MOIRS BICARBONATE			F015342	M1	CHOC CHIPS	24X 70G
M330178	11	ENV MOIRS CREAM/TARTAR			F015350	M1	SILVER BALLS	24X 50G
M330187	11	ENV MOIRS TARTARIC ACID			F014907	M1	MEAT MAGIC BARBEQUE	24X100G
M330284	11	SACHETS WHITE PEPPER			F014915	M1	MEAT MAGIC SOSATIE	24X100G
M330293	11	SACHETS COMPOUND PEP			F014923	M1	MEAT MAGIC ORIENTAL	24X100G
M341620	11	REELS POLYCOTE		250MM	F014931	M1	MEAT MAGIC MEXICAN	24X100G
M341639	11	REELS POLYCOTE		270MM	F014966	M1	WHITE PEPPER ENV	384X9G
M341657	11	REELS POLYCOTE		300MM	F014974	M1	CURRY ENV	384X9G
M741259	11	REELS POLYCOTE		350MM	F014982	M1	BORRIE ENV	384X9G
M227526	11	REELS S/FILM	525MM	65MIC	F014990	M1	CAYENNE PEPPER ENV	384X9G
M341666	11	REELS S/FILM	280MM	40MIC	F015008	M1	COMPOUND PEPPER ENV	384X9G
M341842	11	REELS S/FILM	250MM		F015040	M1	BLACK PEPPER TIN	72X 50G
M341727	11	REELS CAYENNE PEPPER			F015059	M1	WHITE PEPPER TIN	72X 50G
M341736	11	REELS CURRY			F015067	M1	WHITE PEPPER TIN	48X100G
M341745	11	REELS BORRIE			F015075	M1	PEPPERCONE	72X 50G
M341912	11	REELS TOWER B/CURRANT			F015083	M1	PEPPERCONE	40X 50G
M341921	11	REELS TOWER G/GAGE		80G	F015091	M1	EPSOM SALTS	36X500G
M341930	11	REELS TOWER LEMON		80G	F015105	M1	BICARB OF SODA	36X500G
M341949	11	REELS TOWER ORANGE		80G	F015113	M1	EPSOM SALTS	100X15G
M341967	11	REELS TOWER S/BERRY		80G	F015121	M1	BICARB OF SODA	100X15G
M341985	11	REELS TOWER P/WINE		80G	F015148	M1	TARTARIC ACID	100X15G
M342049	11	REELS POLYCOTE B/POWDER		50G	F015156	M1	CREAM OF TARTAR	100X15G
M342058	11	REELS PLN P/CELL		30MIC	F017914	K1	MJP GREENGAGE	24X500G
M330275	11	REELS TOWER COCONUT		200G	F017922	K1	MJP ORANGE	24X500G
M341675	11	REELS COCONUT		100G	F017930	K1	MJP RASPBERRY	24X500G
M342100	11	REELS FINE COCONUT		200G	F017949	K1	MJP LEMON	24X500G
M342146	11	REELS MEDIUM COCONUT		200G	F017965	K1	IP CARAMEL	24X500G
M342155	11	REELS MEDIUM COCONUT		500G	F017973	K1	IP CHOCOLATE	24X500G
M342182	11	REELS FINE COCONUT		500G	F017981	K1	IP STRAWBERRY	24X500G
M341781	11	REELS METALLIZED POLYEST		250MM	F018007	K1	IP VANILLA	24X500G
M342137	11	REELS METALLIZED POLYEST		300MM	F018015	K1	MOIRS CURRY MEDIUM	4X3KG
M341587	11	FOIL CUPS			F018074	K1	MOIRS CURRY MEDIUM	25KG
M342085	11	FOIL LID REEL B/P		80MM	F018082	K1	MOIRS CURRY HOT	25KG
M342119	11	FOIL LID REEL B/P		60MM	F018090	K1	MOIRS TURMERIC	25KG
M342128	11	FOIL LID PLN B/P		80MM	F018104	K1	MOIRS BORRIE COMPOUND	25KG

M330309	15	PLASTIC BAG TOWER COCONUT		F018112	K1	MOIRS CAYENNE PEPPER	25KG
M341879	11	PLASTIC BAG COCONUT	100G	F018120	K1	MOIRS GRD BLK PEPPER	25KG
M331001	12	CTN MJP ORANGE		F018139	K1	MOIRS GRD WHT PEPPER	25KG
M331010	12	CTN MJP GREENGAGE		F018198	K1	MOIRS GRD CORNDR	25KG
M331029	12	CTN MJP CHERRY		F018201	K1	MOIRS GRD GINGER	25KG
M331038	12	CTN MJP LEMON		F018228	K1	MOIRS MIX MASALA	25KG
M331047	12	CTN MJP RASPBERRY		F018317	K1	GROUND CUMMIN	25KG
M331056	12	CTN MJP PINEAPPLE		F018325	K1	WHOLE FENNEL	25KG
M331065	12	CTN MJP LIME		F018333	K1	GROUND FENNEL	25KG
M331074	12	CTN MJP PEACH		F018384	K1	CUSTARD POWDER	25KG
M331083	12	CTN MJP STRAWBERRY		F018554	K1	IND BAKING POWDER	20KG
M331348	12	CTN IP STRAWBERRY		F018376	K1	CUSTARD POWDER	4X2KG
M331357	12	CTN IP CHOCOLATE		F018546	K1	BAKING POWDER	6X2KG
M331366	12	CTN IP CARAMEL		F018856	K1	ESS VANILLA	12X1L
M331375	12	CTN IP VANILLA		F017957	K1	MJP GULL STRAWBERRY	24X500G
M331384	12	CTN IP BUTTERSCOTCH		F018023	K1	MOIRS CURRY HOT	4X3KG
M332536	12	CTN IP BERRIES O/T FORREST		F018031	K1	MOIRS CAYENNE PEPPER	4X3KG
M332545	12	CTN IP TROPICAL FRUIT		F018066	K1	MOIRS GRND WHT PEPPER	6X1KG
M331481	12	CTN HSP LEMON		F018147	K1	MOIRS WHT PEPPER COMP	25KG
M331490	12	CTN HSP APRICOT		F018155	K1	MOIRS BLK PEPPER COMP	25KG
M331506	12	CTN HSP CHOCOLATE		F018511	K1	ESS CARAMEL	5LT
M331515	12	CTN HSP CARAMEL					
M331524	12	CTN HSP MIXED FRUIT					
M332420	12	CTN HSP APPLE & CARAMEL					
M332439	12	CTN HSP PEACH					
M331542	12	CTN CAKE CHOCOLATE					
M331588	12	CTN CAKE VANILLA					
M332448	12	CTN S/MOIST CHOCOLATE					
M332457	12	CTN S/MOIST VANILLA					
M332466	12	CTN FUN CAKES					
M332475	12	CTN FUNFETTI					
M331667	12	CTN CUSTARD	125G				
M331676	12	CTN CUSTARD	500G				
M331746	12	CTN ESSENCE	100ML				
M331782	12	CTN EPSOM SALTS	500G				
M331791	12	CTN BICARB	500G				
M331904	12	CTN CREME CARAMEL					
M332095	12	CTN MEAT MAGIC BBQ					
M332101	12	CTN MEAT MAGIC MEXICAN					
M332110	12	CTN MEAT MAGIC ORIENTAL					
M332217	12	CTN M/MAGIC SOSATIE					
M332305	12	CTN L/CAL ORANGE					
M332314	12	CTN L/CAL LEMON					
M332323	12	CTN L/CAL R/BERRY					
M332332	12	CTN L/CAL G/GAGE					
M332350	12	CTN L/CAL IP CHOC					
M332369	12	CTN L/CAL IP VANILLA					
M332378	12	CTN L/CAL IP CARAMEL					
M332554	12	CTN APPLE MUFFIN					
M332563	12	CTN RAISIN MUFFIN					
M334028	13	CAP ESSENCE	30ML				
M334046	13	CAP ESSENCE	100ML				
M334064	13	CAP ESSENCE	500ML				
M334073	13	CAP COLOUR	30ML				
M741291	13	CAP ESSENCE	1000ML				
M334082	13	PEPPERCONES	50G				
M334091	13	YELLOW PEPPER SPOUTS T/P					
M334198	13	JAR B/POWDER	200G				

M334213	13	JAR B/POWDER	500G
M334329	13	JAR B/POWDER	100G
M334347	13	JAR CUSTARD	500G
M334383	13	JAR CUSTARD	250G
M741217	13	JAR B/POWDER	2KG
M334204	13	LID B/POWDER	200G & 500G
M334338	13	LID B/POWDER	100G
M334310	13	LID CAKE DECORATION	
M334356	13	LID CUSTARD	250G & 500G
M741220	13	LID B/POWDER	2KG
M334125	14	TINS WHITE PEPPER	50G
M334134	14	TINS BLACK PEPPER	50G
M334152	14	TINS WHITE PEPPER	100G
M334143	14	TWIN TOPS FOR TINS	50G
M334161	14	TWIN TOPS FOR TINS	100G
M334374	15	CAP BUNNYCAN	5LT
M334408	15	TUB CAKE DECS	50G 273/10
M334417	15	TUB CAKE DECS	100G 152/10
M341268	15	SPOONS BAKING POWDER	
M341277	15	SELLOTAPE ROLLS	1/2"
M227580	15	GLUE SYNTA A1733	
M341310	15	GLUE GLOBE HOTMELT 43	
M341338	15	GLUE PRIMO C49	
M341596	15	GLUE GLOBE NO 24	
M342508	15	GLUE TAC 1258 C/6	
M341356	15	CLEAR TAPE	48X100MM
M341383	15	BAG BROWN VIKING NO 1	
M341392	15	BAG BROWN VIKING NO 2	
M341408	15	BAG BROWN VIKING NO 4	
M341417	15	BAG BROWN VIKING NO 6	
M341426	15	BAG BROWN VIKING NO 10	
M341435	15	BAG BROWN VIKING NO 12	
M341444	15	BAG BROWN VIKING NO 16	
M341453	15	BAG BROWN VIKING NO 25	
M341499	15	CANS BUNNY	5LT
M341550	15	CARRIERS H/DUTY FACT/SHOP	
M741204	15	POLY BAG CP	3KG
M741246	15	BROWN PAPER SACK	20KG
M231527	16	STCKR B/CODE S/W	4X4.5CM
M231536	16	STCKR B/CODE OUTER	4.8X10CM
M231882	16	STCKR B/CODE INN	40X29MM
M341480	16	STCKR BEST BEFORE S/C	
M337203	16	LAB ESS ORANGE	30ML
M337212	16	LAB ESS LEMON	30ML
M337221	16	LAB ESS RASPBERRY	30ML
M337267	16	LAB ESS STRAWBERRY	30ML
M337285	16	LAB ESS ROSE	30ML
M337294	16	LAB ESS ALMOND	30ML
M337300	16	LAB ESS CARAMEL	30ML
M337319	16	LAB ESS VANILLA	30ML
M337328	16	LAB ESS RUM	30ML
M337878	16	LAB ESS PEPPERMINT	30ML
M737302	16	LAB ESS R/BERRY	30ML
M737315	16	LAB ESS ROSE	30ML
M337355	16	LAB ESS VANILLA	100ML
M337452	16	LAB ESS VANILLA	500ML
M737247	16	LAB ESS ALMOND	500ML
M737250	16	LAB ESS S/BERRY	500ML

M737263	16	LAB ESS P/APPLE	500ML
M737276	16	LAB ESS ORANGE	500ML
M737289	16	LAB ESS R/BERRY	500ML
M737292	16	LAB ESS ROSE	500ML
M737331	16	LAB ESS VANILLA	1LT
M337504	16	LAB COL CRIMSON RED	30ML
M337513	16	LAB COL EGG YELLOW	30ML
M337522	16	LAB COL APPLE GREEN	30ML
M337559	16	LAB COL SKY BLUE	30ML
M337780	16	LAB BAKING POWDER	200G
M337799	16	LAB BAKING POWDER	500G
M337805	16	LAB BAKING POWDER	100G
M337832	16	LAB CUSTARD	500G
M337869	16	LAB CUSTARD	250G
M737027	16	LAB CUSTARD	2KG
M737030	16	LAB B/POWDER	2KG
M737124	16	LAB GRD WHT PEP	1KG
M737153	16	LAB CAYENNE PEP	3KG
M737195	16	LAB CURRY MED	3KG
M737360	16	LAB INST PUDDING	500G
M737373	16	LAB JELLY	500G
M337975	16	S/ADH LBL 100'S&1000'S	100G
M337984	16	S/ADH LBL CHOC VERM	75G
M337993	16	S/ADH LBL SILVER BALLS	50G
M338002	16	S/ADH LBL CHOC CHIPS	70G
M339209	16	NAMESTRIPS ORANGE	
M339218	16	NAMESTRIPS GREENGAGE	
M339227	16	NAMESTRIPS CHERRY	
M339236	16	NAMESTRIPS LEMON	
M339245	16	NAMESTRIPS RASPBERRY	
M339254	16	NAMESTRIPS PINEAPPLE	
M339263	16	NAMESTRIPS LIME	
M339281	16	NAMESTRIPS APRICOT	
M339290	16	NAMESTRIPS PEACH	
M339315	16	NAMESTRIPS STRAWBERRY	
M339351	16	NAMESTRIPS CHOCOLATE	
M339360	16	NAMESTRIPS CARAMEL	
M339379	16	NAMESTRIPS VANILLA	
M339388	16	NAMESTRIPS BUTTERSCOTCH	
M339582	16	NAMESTRIPS 100'S/1000'S	
M339591	16	NAMESTRIPS CHOC VERMICEL	
M339616	16	NAMESTRIPS EPSOM SALTS	
M339625	16	NAMESTRIPS BICARB SODA	
M339722	16	NAMESTRIPS WHITE PEPPER	
M339926	16	NAMESTRIPS ORIENTAL	
M339935	16	NAMESTRIPS MEXICAN	
M339944	16	NAMESTRIPS SOSATIE	
M340034	16	NAMESTRIPS APPLE & CARAMEL	
M340061	16	NAMESTRIPS B.O/T FOREST	
M340070	16	NAMESTRIPS TROP.FRUIT	
M340089	16	NAMESTRIPS COCONUT MED SHRED	
M341523	16	NAMESTRIPS CHOC CHIPS	
M341541	16	NAMESTRIPS	4X10X200G
M334019	21	BOTTLES ESSENCE	30ML
M334037	21	BOTTLES ESSENCE	100ML
M334055	21	BOTTLES ESSENCE	500ML
M741301	21	BOTTLES ESSENCE	1000ML

APPENDIX B

E-GROUPS AND P-GROUPS.....1

M-GROUPS AND F-GROUPS.....5

 USAGE BASED GROUPING OF E-CODES
 (29 GROUPS)

1 >COCOA FLAVOURS

E313850 01 COCOA POWDER BOURNVILLE
 E314118 01 LECITHINATED COCOA POWDER B

2 >FLAVOURS

E310639 17 VANILLIN
 E314419 01 BUTTABELLE
 E314428 01 CHERRY F1451
 E314437 01 TRUSIL GREENGAGE F1459
 E314473 01 STRAWBERRY 85574/3 ESROLKO
 E314491 01 APRICOT 28970
 E314534 01 BUTTERSCOTCH S0 33616
 E314543 01 CARAMEL NO 1044
 E314598 01 LEMON NO 2513
 E314604 01 LIME NO 1505
 E314622 01 PEACH 53 2812
 E314640 01 RASPBERRY NO 4028
 E314686 01 VANILLA MD 2501
 E314695 01 VANILLA OLEO RESIN 02494
 E314747 01 BBA DDX BLACKCURNT F1442
 E314756 01 H+R PORTWINE LR15785
 E314792 01 PINEAPPLE N6 4278
 E314808 01 STRAWBERRY BBA J1183
 E314835 01 CHOCOLATE DXO 5667
 E314844 01 ORANGE N6 4361
 E314880 01 CHOCOLATE 9/029052(DRAGOCO)
 E314899 01 VANIFF 403779
 E314905 01 TRUSIL CNDS MILK J1620
 E314923 01 GIV CARAMEL 77614-71
 E314932 01 BBA TRUSIL APPLE BRM J2143
 E314969 01 FIRMENICH B/SCOTCH 50126 AP
 E314978 01 CADBURY CHOC CRUMB
 E314987 01 GUNTHER FUDGE R12223
 E314996 01 RUM FIRMENICH 53305
 E315005 01 APRI/PEACH TS8826
 E315014 01 BERRIES O/T FORREST N7-4674
 E315023 01 TROPICAL FRUIT 75322.31
 E315032 01 BANANA 85509.31
 E315041 01 ORANGE 7546751 GIV
 E315050 01 LEMON J2424 BBA

3 >PRIMARY COLOURS

E313203 02 LAKE BLUE WG648
 E313221 02 LAKE TARTRAZINE WG644
 E313230 02 LAKE SUNSET YELLOW WG641
 E313249 02 LAKE GERANINE WG642
 E313276 02 QUINOLINE YELLOW
 E900087 02 CARMOISINE
 E900142 02 ERYTHROSINE
 E900207 02 GERANINE
 E900223 02 CP GREEN "S"
 E900333 02 PONCEAU 4R
 E900443 02 SUNSET YELLOW

 USAGE BASED GROUPING OF P-CODES
 (60 GROUPS)

1 >MJP BTCH

P345011 99 MJP GREENGAGE 345.600KG
 P345020 99 MJP LEMON 345.600KG
 P345039 99 MJP LIME 345.600KG
 P345048 99 MJP ORANGE 345.600KG
 P345057 99 MJP PEACH 345.600KG
 P345066 99 MJP PINEAPPLE 345.600KG
 P345075 99 MJP RASPBERRY 345.600KG
 P345084 99 MJP STRAWBERRY 345.600KG

2 >ANHYDROUS MJP BTCH

P345002 99 MJP CHERRY 345.600KG

3 >TOWER JELLY BTCH

P345127 99 T/JELLY G/GAGE 288.000KG
 P345136 99 T/JELLY STRAWBERRY 288.000KG
 P345145 99 T/JELLY LEMON 288.000KG
 P345154 99 T/JELLY ORANGE 288.000KG
 P345172 99 C/PACK JELLY RASPBERRY 288.000KG

4 >ANHYDROUS TOWER JELLY BTCH

P345109 99 T/JELLY B/CURRANT 288.000KG
 P345118 99 T/JELLY P/WINE 288.000KG

5 >IP BTCH

P345242 99 IP CARAMEL 388.800KG
 P345279 99 IP STRAWBERRY 388.800KG
 P346740 99 IP BER O/T FORREST 388.800KG
 P346759 99 IP TROP FRUIT 388.800KG

6 >IP BTCH WITH LIQUID AROMATICS

P345233 99 IP BUTTERSCOTCH 388.800KG
 P345312 99 IP VANILLA 388.800KG

7 >IP BTCH WITH COCOA

P345288 99 IP CHOCOLATE 388.800KG

8 >HSP SPONGE BTCH

P345525 99 HSP SPONGE LEMON 544.800KG

9 >HSP SPONGE BTCH WITH COCOA

P345464 99 HSP SPONGE CHOCOLATE 544.800KG

10 >HSP SPONGE BTCH WITH CARAMEL

P345473 99 HSP SPONGE CARAMEL 544.800KG

11 >HSP SPONGE BTCH WITH FRUIT & SPICES

P345482 99 HSP SPONGE MIXED FRUIT 544.800KG

12 >HSP SPONGE BTCH WITH FRUITS

P345491 99 HSP SPONGE APRICOT 544.800KG
 P346616 99 HSP SPONGE APPL&CRML 544.800KG
 P346634 99 HSP SPONGE PEACH 544.800KG

E900456 02 TARTRAZINE			
E900498 02 BLUE COL POWDER FCF			
4 >SECONDARY COLOURS			
E313212 02 CARAMEL POWDER			
E313267 02 CHOCOLATE BROWN F1619			
5 >HI-LITE FAT			
E313805 03 HI-LITE FAT			
6 >EMULSIFIER FAT			
E314002 03 EMULSIFIER EC 25			
7 >VEG COOK OIL			
E900485 03 VEGETABLE COOKING OIL			
8 >THICKENERS			
E312501 04 CORNSTARCH (NORMAL)			
E316585 04 H 50			
E316488 04 EMJEL PA5			
9 >CARRIERS			
E312510 04 CORNFLOUR LOW MOISTURE			
E312608 04 MAIZE FLOUR			
10 >FLOURS			
E319618 04 HI-FLAKE FLOUR			
E319627 04 SNOWFLAKE FLOUR			
E319654 04 OAT FLOUR			
11 >BULKING AGENTS			
E319636 04 POLLARD			
E510299 04 MEALIE MEAL YELLOW			
E316558 08 DRIDEX 10/20			
12 >BRAN			
E319645 04 OAT BRAN			
13 >DRIED FRUITS			
E315403 05 APPLES DICED DRIED			
E315412 05 APRICOTS DICED DRIED			
E315458 05 PEEL CUT MIXED VALOR			
E315485 05 RAISINS SEEDLESS SMALL			
E315494 05 DBLE DCED YEL CLING PEACHES			
14 >READY SPICY SAUCE MIX			
E317463 07 MEAT MAGIC BARBECUE			
E317472 07 MEAT MAGIC ORIENTAL			
E317481 07 MEAT MAGIC MEXICAN			
E317524 07 MEAT MAGIC SOSATIE			
15 >GROUND SPICES			
E317409 07 GROUND MIXED SPICE			
E317418 07 GROUND CINNAMON			
E318101 07 GROUND CLOVES			
16 >WHOLE SPICES			
E317490 07 WHOLE FENNEL			
13 >HSP SAUCES BTCH			
P345561 99 HSP SAUCE MIXED FRUIT	136.800KG		
P345570 99 HSP SAUCE APRICOT	136.800KG		
P345604 99 HSP SAUCE LEMON	136.800KG		
P346643 99 HSP SAUCE PEACH	136.800KG		
14 >HSP SAUCE BTCH WITH COCOA			
P345543 99 HSP SAUCE CHOCOLATE	136.800KG		
15 >HSP SAUCE BTCH WITH CARAMEL			
P345552 99 HSP SAUCE CARAMEL	136.800KG		
P346625 99 HSP SAUCE APL & CARAM	136.800KG		
16 >CREME CARAMEL PUDD BTCH			
P345668 99 CREME CARAMEL PUDD	540.000KG		
17 >CREME CARAMEL SAUCE BTCH			
P345677 99 CREME CARAMEL SAUCE	180.000KG		
18 >SOFT & MOIST BTCH			
P345853 99 SOFT & MOIST VANILLA	768.000KG		
19 >SOFT & MOIST BTCH WITH COCOA & CARAMEL			
P345880 99 SOFT & MOIST CHOCOLATE	768.000KG		
20 >SUPER MOIST BTCH			
P346458 99 SUPER MOIST VANILLA	780.000KG		
21 >SUPER MOIST BTCH WITH COCOA & CRMEL			
P346449 99 SUPER MOIST CHOCOLATE	780.000KG		
22 >FUNFETTI/FUNCAKES CAKE MIX BTCH			
P346713 99 C/MX FUNFET/FUNCAKES	696.000KG		
23 >CUSTARD FINAL MIX BTCH			
P345969 99 CUST FINAL MIX	540.000KG		
24 >ESSENCE BTCH			
P346014 99 ESS RUM	180.000 L		
P346023 99 ESS STRAWBERRY	180.000 L		
P346032 99 ESS ROSE	180.000 L		
P346069 99 ESS PEPPERMINT	180.000 L		
P346087 99 ESS LEMON	181.200 L		
25 >ESSENCE BTCH WITHOUT COLOUR			
P345978 99 ESS ALMOND	190.200 L		
26 >ESSENCE BTCH WITH FLAVOURS			
P346005 99 ESS VANILLA	176.400 L		
P346041 99 ESS RASPBERRY	180.000 L		
P346050 99 ESS PINEAPPLE	182.400 L		
P346102 99 ESS CARAMEL	180.000 L		
27 >ORANGE ESSENCE BTCH			
P346078 99 ESS ORANGE	180.000 L		
28 >COLOURING BTCH			

E318031	07	CASSIA STICKS	P346111	99	COLOURING SKY BLUE	186.000 L
E318138	07	CARAWAY SEEDS	P346166	99	COLOURING CRIM RED	180.000 L
E318147	07	CUMMIN SEED	P346184	99	COLOURING APPLE GREEN	186.000 L
E318314	07	WHOLE BLACK PEPPER				
E318332	07	WHOLE WHITE PEPPER	29	>	COLOURING BTCH WITH MALIC ACID	
E318387	07	WHOLE TURMERIC	P346157	99	COLOURING EGG YELL	453.000 L
E318396	07	WHOLE SLICED GINGER				
E515061	07	WHOLE GRADE 1A CHILLI	30	>	BAKING POWDER BTCH	
E515074	07	CRUSHED CHILLIES	P346193	99	BAKING POWDER	672.000KG
E515142	07	WHOLE CORIANDER	P745022	99	INDUSTRIAL B/POWDER	765.250KG
E515223	07	FENUGREEK SEEDS				
17	>	CAKE DECORATIONS	31	>	LOWCAL JELLY BTCH	
E312006	08	CHOC CHIPS	P346476	99	LOWCAL GREENGAGE	158.400KG
E312015	08	SILVER BALLS	P346485	99	LOWCAL LEMON	158.400KG
E312024	08	HUNDREDS & THOUSANDS	P346494	99	LOWCAL ORANGE	158.400KG
E312079	08	CHOCOLATE VERMICELLI	P346500	99	LOWCAL RASPBERRY	158.400KG
18	>	WAFERETTES	32	>	LOWCAL IP BTCH	
E312088	08	WAFERETTES	P346564	99	L/CAL IP CARAMEL	158.400KG
			P346582	99	L/CAL IP VANILLA	158.400KG
19	>	FUNFETTI SUGAR STRANDS	33	>	LOWCAL IP BTCH WITH COCOA & SIPERNATE	
E312097	08	FUNFETTI SUGAR STRANDS	P346573	99	L/CAL IP CHOCOLATE	158.400KG
20	>	ARTIFICIAL SWEETENERS	34	>	DRIDEX PRE-MIX BTCH	
E316576	08	ASPARTAME	P346591	99	EC25/DRIDEX 10	157.500KG
21	>	CHEMICAL AGENTS	35	>	ICING MIX BTCH	
E312529	09	CARRAGEENAN GENUL CP100	P346689	99	ICING MIX CARAMEL	468.000KG
E312574	09	FLANOGEN 3	P346722	99	ICING MIX FUNFETTI	295.800KG
E313708	09	CMC DAICEL N330				
E313799	09	DEXTROSE MONOHYDRATE	36	>	ICING MIX BTCH WITH COCOA	
E315908	09	GELATINE	P346670	99	ICING MIX CHOC FUDGE	468.000KG
E316220	09	SODIUM BICARBONATE (FINE)				
E316293	09	CALCIUM LACTATE	37	>	ICING MIX BTCH WITHOUT CORN FLOUR	
E316318	09	DISODIUM ORTHO PHOSPHATE	P346704	99	ICING MIX FUN CAKES	231.840KG
E316336	09	MALIC ACID				
E316390	09	TETRON K	38	>	RAISIN MUFFIN MIX BTCH	
E316451	09	SUPERFINE SALT	P346980	99	MUFFIN MIX RAISIN	768.000KG
E316497	09	ADMUL MG 6203				
E316521	09	PAN-O-LITE	39	>	APPLE MUFFIN MIX BTCH WITH FLAVOURING	
E316530	09	PYRAN	P346999	99	MUFFIN MIX APPLE	768.000KG
E316600	09	COFFEE CREAMER				
E510435	09	SIPERNAT 22 S	40	>	APPLE SACHET BTCH MIXED WITH DEXTROSE	
E900003	09	ACID ASCORBIC	P347008	99	WHOLESOME APPLE SACHET	50.000 G
E900016	09	ACID CITRIC ANHYDROUS				
E900045	09	ACID SODIUM PYROPHOSPHAT	41	>	RAISIN SACHET BTCH	
E900401	09	SODIUM CITRATE	P347017	99	WHOLESOME RAISIN SACHET	75.000 G
22	>	CHEMICAL AGENTS (REPACKED/USED IN FACT)	42	>	PRIMARY COLOUR & WATER SOLUTIONS BTCH	
E316239	09	BICARBONATE (USP)	P360014	99	COL SOL BROWN	NO1 11.080 L
E316309	09	CREAM OF TARTAR	P360041	99	COL SOL GREEN	NO1 11.000 L
			P360069	99	COL SOL GREEN	NO4 10.240 L
23	>	CHEMICAL AGENTS (REPACKED ONLY)	P360078	99	COL SOL ORANGE	NO1 10.570 L
E316327	09	EPSOM SALTS	P360087	99	COL SOL PINEAPPLE	NO1 10.506 L
E900058	09	ACID TARTARIC	P360102	99	COL SOL B/CURRANT	NO1 11.160 L
			P360111	99	COL SOL CARMOSINE	NO2 10.750 L
24	>	PRESERVATIVES	P360120	99	COL SOL GERANINE	NO1 11.320 L

E900249	09	NIPIGAN M	P360139	99	COL SOL PONCEAU	NO1	10.500	L
E900388	09	SODIUM BENZOATE	P360148	99	COL SOL PORT WINE	NO1	11.628	L
>SOLVENTS			P360157	99	COL SOL RASPBERRY	NO1	11.126	L
E900375	09	RECTIFIED SPIRITS	P360166	99	COL SOL STRAWBERRY	NO1	11.020	L
>WATER			P360175	99	COL SOL LEM YELLOW	NO1	11.000	L
E900469	09	SOFT WATER	P360184	99	COL SOL YELLOW	NO1	10.745	L
>AROMATICS			P360193	99	COL SOL YELLOW DH		10.937	L
E310037	17	AMYL ACETATE	P364876	99	COL SOL PEPPERMINT		12.000	L
E310046	17	AMYL BUTYRATE	>PRM COL SLT BTCH WITH DRIDEX(MNLIGHT BLNDR)					
E310107	17	ALDEHYDE C10	P360227	99	COL LCJ GREENGAGE		26.880	L
E310125	17	ALDEHYDE C19	P360236	99	COL LCJ LEMON		26.448	L
E310189	17	AMYL VALERIANATE	P360245	99	COL LCJ ORANGE		26.448	L
E310213	17	BUTYL BUTYRATE	P360254	99	COL LCJ RASPBERRY		26.448	L
E310231	17	CINNAMIC ALDEHYDE	>PRM COL SLT BTCH WTH DRIDEX(SRCH LGHT BLDR)					
E310259	17	CITRAL	P346731	99	COL IP FUNFETTI YELLOW		26.200KG	
E310268	17	COUMARIN	P346768	99	COL IP SUNSET YELLOW		26.520KG	
E310277	17	DI-ACETYL	P362029	99	COL IP BROWN		29.130KG	
E310286	17	ETHYL ACETATE	P362038	99	COL IP LEMON YELLOW		26.250KG	
E310295	17	ETHYL BUTYRATE	P362047	99	COL IP RED		26.215KG	
E310301	17	ETHYL CAPRYLATE	P362056	99	COL IP STRAWBERRY RED		28.280KG	
E310310	17	ETHYL FORMATE	P362065	99	COL IP YELLOW		26.215KG	
E310329	17	ETHYL OENANTHATE	P362144	99	COL IP BLACK		30.845KG	
E310338	17	ETHYL PROPIONATE	P362171	99	COL IP BLUE		28.280KG	
E310347	17	ETHYL SALICYLATE	>PRM COL SLT BTCH WITH CRNSTARCH(WT PROCESS)					
E310365	17	ETHYL VALERIANATE	P360263	99	COL LC IP CHOCOLATE		25.264KG	
E310374	17	GERANYL ACETATE	P360272	99	COL LC IP CAMEL		25.488KG	
E310383	17	GERANIOL	>VITAMIN C PRE-MIX BTCH					
E310408	17	IONONE-ALPHA	P364007	99	VITAMIN C MASTER		175.000KG	
E310462	17	OIL BERGAMOT	>AROMATICS BTCH WITH WATER					
E310471	17	OIL BUCHU	P364358	99	DI-ACETYL NO 2 SOL		1.000	L
E310505	17	OIL CLOVE	>AROMATICS BTCH WITH WATER & RECTIF SPIRITS					
E310523	17	OIL GERANIUM	P364539	99	ROSE OIL MIX		1.450	L
E310541	17	OIL LEMON	P364566	99	ALMOND ESS ART		191.800	L
E310550	17	OIL LIME RECON	P364575	99	CITRAL SOLUTION		191.800	L
E310587	17	OIL PEPPERMINT	P364584	99	ETHYL ACETATE SOL		191.800	L
E900265	17	OIL ORANGE	P364593	99	FLAVOURED SPIRITS NO1		189.000	L
E310602	17	PHENYL ETHYL ALCOHOL	P364609	99	FLAVOURED SPIRITS NO3		191.800	L
E310611	17	RHODINOL	P364618	99	ORANGE OIL SOL		191.800	L
E900061	17	BENZALDEHYDE	P364627	99	ROSE ESS ART NO2		193.000	L
>COCONUTS			P364645	99	BUCHU OIL 10% SOL		300.000ML	
E315449	19	COCONUT DESICCATED FINE	P364867	99	ALDEHYDE C10 10% SOL		500.000ML	
E315573	19	COCONUT DESICCATED MEDIUM	>ARMTICS BTCH WITH FLVRNG WATER & RECT SPRTS					
>SUGARS			P364557	99	CREAM MIX NO1		13.000	L
E319210	25	SUPERFINE SUGAR H11	P364672	99	PINEAPPLE ADDITIVE		9.500	L
E319229	25	CASTOR SUGAR H6	>AROMATIC ONLY BTCH					
E319238	25	ICING SUGAR	P364724	99	RUM CONCENTRATE		5.380	L
E900430	25	SUGAR ILLOVO WHITE	>FLAVOURING BTCH WITH WATER & RECTIF SPIRITS					
			P364742	99	VANILLIN SOLUTION		191.500	L

52	>MALIC ACID SOLUTION BTCH			
	P364821	99	MALIC ACID SOL 50%	1.000 L
53	>NIPAGIN SOLUTION BTCH			
	P364830	99	NIPAGIN SOLUTION 30%	1.000 L
54	>SODIUM BENZOATE SOLUTION BTCH			
	P364849	99	SODIUM BENZOATE SOL	1.000 L
55	>CUSTARD COLOUR BTCH			
	P366003	99	CUST COLOUR BATCH	29.720KG
56	>PURE GROUND SPICE BTCH			
	P346519	99	GROUND WHITE PEPPER	100.000KG
	P346528	99	GROUND BLACK PEPPER	100.000KG
	P346555	99	CAYENNE PEPPER	100.000KG
57	>SPICE BTCH WITH BULKING AGENT			
	P745064	99	MOIRS CURRY MED	100.000KG
	P745103	99	BORRIE COMPOUND	100.000KG
	P745129	99	WHITE PEPPER COMPOUND	100.000KG
	P745145	99	MOIRS MASALA PRE MIX	98.000KG
	P745187	99	BLACK PEPPER COMPOUND	100.000KG
58	>SPICE BTCH WITH BULKING AGENT, SUGAR & SALT			
	P745080	99	MOIRS CURRY HOT	100.000KG
59	>SPICE BTCH WITH BULKING AGENT & OIL			
	P745161	99	MOIRS MASALA FIN MIX	150.000KG
60	>CRUSHED TURMERIC BTCH			
	P745242	99	CRUSHED TURMERIC	100.000KG

USAGE BASED GROUPING OF M-CODES
(3 4 G R O U P S)

1	>DISPLAYS			
	M331746	12	CTN ESSENCE	100ML
	M332138	10	DISPLAY BORRIE	
	M332147	10	DISPLAY CURRY	
	M332156	10	DISPLAY CAYENNE PEPPER	
	M332165	10	DISPLAY WHITE PEPPER	
	M332174	10	DISPLAY COMPOUND PEPPER	
	M332271	10	DISPLAY BAKING POWDER	50G
	M335933	10	INNER DISPLAY PEPPERCONE	50G
2	>CORRUGATES			
	M335207	10	CORR MOIRS JELLY	4 DOZ
	M335252	10	CORR INSTANT PUDDING	4 DOZ
	M335289	10	CORR SPONGE PUDDING	2 DOZ
	M335395	10	CORR ESSENCE	500ML 1 DOZ
	M335410	10	CORR COCONUT	100G 2 DOZ
	M335474	10	CORR BICARB	500G
	M335650	10	CORR CAKE DECORATIONS	125ML

PROCESS BASED GROUPING OF F-CODES
(7 1 G R O U P S)

1	>MJP			
	F013919	M1	MJP LEMON	48X80G
	F013927	M1	MJP ORANGE	48X80G
	F013935	M1	MJP RASPBERRY	48X80G
	F013943	M1	MJP GREENGAGE	48X80G
	F013951	M1	MJP LIME	48X80G
	F013978	M1	MJP PEACH	48X80G
	F013986	M1	MJP PINEAPPLE	48X80G
	F013994	M1	MJP STRAWBERRY	48X80G
2	>ANHYDROUS MJP			
	F013900	M1	MJP CHERRY	48X80G
3	>TOWER JELLIES			
	F014001	M1	TWR ASSORTED JELLY	144X80G
	F014028	M1	TWR ASSORTED JELLY	72 X80G
4	>CATERPACK JELLIES			

M335748	10	CORR SPICE TINS	50G	F017914	K1	MJP GREENGAGE	24X500G
M335872	10	CORR MEAT MAGIC		F017922	K1	MJP ORANGE	24X500G
M336185	10	CORR FINE COCONUT	200G	F017930	K1	MJP RASPBERRY	24X500G
M336194	10	CORR FINE COCONUT	500G	F017949	K1	MJP LEMON	24X500G
M335298	10	CORR CAKE MIX	2 DOZ	F017957	K1	MJP GULL STRAWBERRY	24X500G
M335359	10	CORR CUSTARD	125G 6 DOZ				
M335483	10	CORR MOIRS EPSOM		5 >LOW CAL JELLIES			
M335492	10	CORR MOIRS BICARB		F014257	M1	L/CAL JELLY RASPBERRY	36X40G
M335508	10	CORR MOIRS CREAM TARTAR		F014265	M1	L/CAL JELLY ORANGE	36X40G
M335517	10	CORR MOIRS TARTARIC ACID		F014273	M1	L/CAL JELLY GREENGAGE	36X40G
M335544	10	CORR TABLE PACK	50G	F014281	M1	L/CAL JELLY LEMON	36X40G
M335599	10	CORR CREME CARAMEL	4 DOZ				
M335605	10	CORR BAKING POWDER	200G	6 >CONSUMER PACK IP			
M335614	10	CORR BAKING POWDER	500G	F014079	M1	IP CARAMEL	48X90G
M335687	10	CORR BAKING POWDER	100G	F014125	M1	IP STRAWBERRY	48X90G
M335702	10	CORR CAKE MIX	1 DOZ	F015482	M1	IP TROPICAL FRUIT	48X90G
M335720	10	CORR ESSENCE	100ML 2 DOZ	F015490	M1	IP FOREST BERRIES	48X90G
M335784	10	CORR TOWER JELLY	1/2GR				
M335793	10	CORR TOWER JELLY GROSS		7 >CONSUMER PACK IP WITH LIQUID AROMATICS			
M335818	10	CORR SPICE TINS	100G	F014087	M1	IP BUTTERSCOTCH	48X90G
M335924	10	CORR TOWER C/NUT	200G	F014117	M1	IP VANILLA	48X90G
M335951	10	CORR PEPPERONE	40X50G				
M335988	10	CORR CAKE DECORATIONS	100ML	8 >CONSUMER PACK IP WITH COCOA			
M336112	10	CORR CUSTARD	500G	F014095	M1	IP CHOCOLATE	48X90G
M336307	10	CORR CUSTARD	250G				
M336334	10	CORR FUN CAKE		9 >CREME CARAMEL			
M336343	10	CORR CUSTARD (PKTS)	500G	F014249	M1	CREME CARAMEL	24X125G
M336352	10	CORR FUNFETTI					
M336370	10	CORR MUFFINS APPLE		10 >CATERPACK IP			
M336389	10	CORR MUFFINS RAISIN		F017965	K1	IP CARAMEL	24X500G
M735058	10	CORR ESSENCE	1LT	F017981	K1	IP STRAWBERRY	24X500G
M335386	10	CORR ESSENCE	30ML 2X10				
M335401	10	CORR COL	30ML 2X10	11 >CATERPACK IP WITH COCOA			
M336486	10	CORR MEDIUM COCONUT	200G	F017973	K1	IP CHOCOLATE	24X500G
M336501	10	CORR MEDIUM COCONUT	500G				
M336237	10	CORR LOWCAL JELLY		12 >CATERPACK IP WITH LIQUID AROMATIC			
M336274	10	CORR LOWCAL INST PUDDING		F018007	K1	IP VANILLA	24X500G
M336361	10	CORR GENERAL SUPER MOIST					
M735016	10	CORR BAKING POWDER	2KG	13 >LOW CAL IP			
M735029	10	CORR CP	3KG	F014311	M1	MIP L/CAL VANILLA	36X20G
M735032	10	CORR CP	1KG	F015318	M1	MIP L/CAL CARAMEL	36X20G
M735061	10	CORR JELLY/INST PUDDING	12KG				
3 >TRAYS				14 >LOW CAL IP WTH COCOA & SIPERNATE			
M335711	12	TRAY ESS	30ML 2X10	F014303	M1	MIP L/CAL CHOCOLATE	36X20G
M336006	10	TRAY SILVER BALLS		15 >HSP			
M336015	10	TRAY CHOC CHIPS		F014192	M1	HSP LEMON	24X284G
M336024	10	TRAY CHOC VERMICELLI					
M336042	10	TRAY 100'S & 1000'S		16 >HSP WITH CARAMEL			
M336051	12	TRAY COLS	30ML 2X10	F014184	M1	HSP CARAMEL	24X284G
M336060	10	TRAY CUSTARD	500G				
M336291	10	TRAY CUSTARD	6X250G	17 >HSP WITH COCOA			
				F014222	M1	HSP CHOCOLATE	24X284G
4 >SLEEVES							
M336097	10	SLEEVE FINE COCONUT	200G	18 >HSP WITH FRUITS			
M336103	10	SLEEVE FINE COCONUT	500G	F014214	M1	HSP APRICOT	24X284G
M336477	10	SLEEVE MEDIUM COCONUT	200G	F015369	M1	HSP APPLE & CARAMEL	24X284G
M336495	10	SLEEVE MEDIUM COCONUT	500G	F015407	M1	HSP PEACH	24X284G

5 >DIVISIONS

M335863	10	DIVISIONS ESSENCE	100ML
M336398	10	DIVISIONS ESSENCE	1000ML
M342438	10	DIVISIONS ESSENCE	500ML
M342447	10	DIVISIONS SPICE DISPLAY	
M342474	10	DIVISIONS CAKE DEC SHORT	
M342483	10	DIVISIONS CAKE DEC LONG	

6 >LINERS

M330071	11	LINERS CUSTARD WAXED	125G
M330080	11	LINERS CUSTARD	500G

7 >BULK PACK BROWN BAG

M330099	11	SPICE BAGS PLAIN	25KG
M741246	15	BROWN PAPER SACK	20KG

8 >SPICE & IND B/POWDER BAG LINERS

M330105	11	BAG LINERS	25KG
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9 >BROWN BAGS FOR ISSUING DEPARTMENT

M341383	15	BAG BROWN VIKING NO 1	
M341392	15	BAG BROWN VIKING NO 2	
M341408	15	BAG BROWN VIKING NO 4	
M341417	15	BAG BROWN VIKING NO 6	
M341426	15	BAG BROWN VIKING NO 10	
M341435	15	BAG BROWN VIKING NO 12	
M341444	15	BAG BROWN VIKING NO 16	
M341453	15	BAG BROWN VIKING NO 25	

10 >CARRIERS

M341550	15	CARRIERS H/DUTY FACT/SHOP	
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11 >CATERPACK POLY BAG

M741204	15	POLY BAG CP	3KG
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12 >ENVELOPES

M330150	11	ENV MOIRS EPSOM SALTS	
M330169	11	ENV MOIRS BICARBONATE	
M330178	11	ENV MOIRS CREAM/TARTAR	
M330187	11	ENV MOIRS TARTARIC ACID	
M330284	11	SACHETS WHITE PEPPER	
M330293	11	SACHETS COMPOUND PEP	

13 >SHRINKFILM REELS

M227526	11	REELS S/FILM	525MM 65MIC
M341666	11	REELS S/FILM	280MM 40MIC
M341842	11	REELS S/FILM	250MM

14 >REELS

M341620	11	REELS POLYCOTE	250MM
M341639	11	REELS POLYCOTE	270MM
M341657	11	REELS POLYCOTE	300MM
M741259	11	REELS POLYCOTE	350MM
M341727	11	REELS CAYENNE PEPPER	
M341736	11	REELS CURRY	
M341745	11	REELS BORRIE	
M341912	11	REELS TOWER B/CURRANT	

19 >HSP WITH FRUITS & SPICES

F014230	M1	HSP MIX FRUIT	24X284G
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20 >CUSTARDS IN 125G CARTONS

F014346	M1	CUSTARD VANILLA	72X125G
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21 >CUSTARDS IN JARS

F015261	M1	CUSTARD VANILLA	36X250G
F014354	M1	CUSTARD VANILLA (JAR)	36X500G

22 >500G CATERPACK CUSTARDS

F018880	K1	CUSTARD VANILLA (PKT)	36X500G
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23 >2KG CATERPACK CUSTARDS

F018376	K1	CUSTARD POWDER	4X2KG
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24 >BULK PACK CUSTARDS

F018384	K1	CUSTARD POWDER	25KG
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25 >400G CAKEMIXES

F014427	M1	CAKE MIX VANILLA	12X400G
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26 >400G CAKEMIXES WITH COCOA & CARAMEL

F014419	M1	CAKE MIX CHOCOLATE	24X400G
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27 >FUNCAKES

F015458	M1	FUNCAKES	12X240G
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28 >FUNFETTI

F015474	M1	FUNFETTI	12X240G
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29 >RAISIN MUFFINS

F015512	M1	RAISIN MUFFIN	12X475G
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30 >APPLE MUFFINS

F015520	M1	APPLE MUFFINS	12X450G
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31 >SUPER MOISTS

F015415	M1	C/MX S/MST VAN/CARAM	12X800G
F015423	M1	C/MX S/MST CHOC/FUDG	12X800G

32 >30ML ESSENCES

F014508	M1	ESS S/BERRY	20X 30ML
F014516	M1	ESS LEMON	20X 30ML
F014559	M1	ESS RUM	20X 30ML
F015431	M1	ESS PEPPERMINT	20X 30ML
F021032	M1	ESS ROSE	20X 30ML

33 >30ML ESSENCES WITH FLAVOURS

F014494	M1	ESS VANILLA	20X 30ML
F014524	M1	ESS CARAMEL	20X 30ML
F020532	M1	ESS RASPBERRY	20X 30ML

34 >30ML ESSENCE WITHOUT COLOUR

F014532	M1	ESS ALMOND	20X 30ML
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35 >30ML ESS WITH FILTRATION

M341921	11	REELS TOWER G/GAGE	80G	F014540	M1	ESS ORANGE	20X 30ML
M341930	11	REELS TOWER LEMON	80G				
M341949	11	REELS TOWER ORANGE	80G	36	>100ML & 500ML	ESSENCES	
M341967	11	REELS TOWER S/BERRY	80G	F021040	M1	ESS ROSE	12X500ML
M341985	11	REELS TOWER P/WINE	80G	F021172	M1	ESS STRAWBERRY	12X500ML
M342049	11	REELS POLYCOTE B/POWDER	50G				
M342058	11	REELS PLN P/CELL	30MIC	37	>100ML & 500ML	ESSENCES WITH FLAVOUR	
M330275	11	REELS TOWER COCONUT	200G	F014567	M1	ESS VANILLA	24X100ML
M341675	11	REELS COCONUT	100G	F014583	M1	ESS VANILLA	12X500ML
M342100	11	REELS FINE COCONUT	200G	F020931	M1	ESS RASPBERRY	12X500ML
M342146	11	REELS MEDIUM COCONUT	200G	F020958	M1	ESS PINEAPPLE	12X500ML
M342155	11	REELS MEDIUM COCONUT	500G				
M342182	11	REELS FINE COCONUT	500G	38	>500ML	ESSENCE WITHOUT COLOUR	
M341781	11	REELS METALLIZED POLYEST	250MM	F020966	M1	ESS ALMOND	12X500ML
M342137	11	REELS METALLIZED POLYEST	300MM				
15	>	FOIL CUPS		39	>100ML	ESS WITH FILTRATION	
M341587	11	FOIL CUPS		F020923	M1	ESS ORANGE	12X500ML
16	>	FOIL LIDS		40	>	CATERPACK ESSENCES	
M342085	11	FOIL LID REEL B/P	80MM	F018856	K1	ESS VANILLA	12X1L
M342119	11	FOIL LID REEL B/P	60MM	F018511	K1	ESS CARAMEL	5LT
M342128	11	FOIL LID PLN B/P	80MM	41	>	COLOURANTS	
17	>	PLASTIC BAGS		F014591	M1	COL APPLE GREEN	20X30ML
M330309	15	PLASTIC BAG TOWER COCONUT		F014605	M1	COL SKY BLUE	20X30ML
M341879	11	PLASTIC BAG COCONUT	100G	F014613	M1	COL CRIMSON RED	20X30ML
18	>	CARTONS		42	>	COLOURANT WITH MALIC ACID	
M331001	12	CTN MJP ORANGE		F014621	M1	COL EGG YELLOW	20X30ML
M331010	12	CTN MJP GREENGAGE		43	>	CONSUMER PACK & CATERPACK B/P	
M331029	12	CTN MJP CHERRY		F014664	M1	BAKING POWDER	48X100G
M331038	12	CTN MJP LEMON		F014672	M1	BAKING POWDER	24X200G
M331047	12	CTN MJP RASPBERRY		F014680	M1	BAKING POWDER	24X500G
M331056	12	CTN MJP PINEAPPLE		F018546	K1	BAKING POWDER	6X2KG
M331065	12	CTN MJP LIME		44	>	FORM & FILL B/P	
M331074	12	CTN MJP PEACH		F014656	M1	BAKING POWDER	100X50G
M331083	12	CTN MJP STRAWBERRY		45	>	BULK PACK B/P	
M331348	12	CTN IP STRAWBERRY		F018554	K1	IND BAKING POWDER	20KG
M331357	12	CTN IP CHOCOLATE		46	>	COCONUTS	
M331366	12	CTN IP CARAMEL		F014699	M1	COCONUT (FINE)	24X100G
M331375	12	CTN IP VANILLA		F014702	M1	COCONUT (FINE)	48X200G
M331384	12	CTN IP BUTTERSCOTCH		F014710	M1	COCONUT (FINE)	24X500G
M332536	12	CTN IP BERRIES O/T FORREST		F014729	M1	TOWER COCONUT	40X200G
M332545	12	CTN IP TROPICAL FRUIT		F015563	M1	COCONUT (MEDIUM)	48X200G
M331904	12	CTN CREME CARAMEL		F015571	M1	COCONUT (MEDIUM)	24X500G
M332095	12	CTN MEAT MAGIC BBQ		47	>	CAKE DECORATIONS	
M332101	12	CTN MEAT MAGIC MEXICAN		F014745	M1	100'S & 1000'S	24X100G
M332110	12	CTN MEAT MAGIC ORIENTAL		F014753	M1	CHOC. VERMICELLI	24X 75G
M332217	12	CTN M/MAGIC SOSATIE		F015350	M1	SILVER BALLS	24X 50G
M331481	12	CTN HSP LEMON		48	>	HANDFILLED CAKE DECS	
M331490	12	CTN HSP APRICOT		F015342	M1	CHOC CHIPS	24X 70G
M331506	12	CTN HSP CHOCOLATE					
M331515	12	CTN HSP CARAMEL					
M331524	12	CTN HSP MIXED FRUIT					
M332420	12	CTN HSP APPLE & CARAMEL					
M332439	12	CTN HSP PEACH					
M331542	12	CTN CAKE CHOCOLATE					

M331588	12	CTN CAKE VANILLA		49 >MEAT MAGICS			
M332448	12	CTN S/MOIST CHOCOLATE		F014907	M1	MEAT MAGIC BARBEQUE	24X100G
M332457	12	CTN S/MOIST VANILLA		F014915	M1	MEAT MAGIC SOSATIE	24X100G
M332466	12	CTN FUN CAKES		F014923	M1	MEAT MAGIC ORIENTAL	24X100G
M332475	12	CTN FUNFETTI		F014931	M1	MEAT MAGIC MEXICAN	24X100G
M332554	12	CTN APPLE MUFFIN		50 >SPICES IN SELF MADE SACHETS /MIXED			
M332563	12	CTN RAISIN MUFFIN		F014974	M1	CURRY ENV	384X9G
M331667	12	CTN CUSTARD	125G	F014982	M1	BORRIE ENV	384X9G
M331676	12	CTN CUSTARD	500G	51 >SPICES IN SELF MADE SACHETS /PURE			
M331782	12	CTN EPSOM SALTS	500G	F014990	M1	CAYENNE PEPPER ENV	384X9G
M331791	12	CTN BICARB	500G	52 >SPICES IN READY MADE SACHETS /PURE			
M332305	12	CTN L/CAL ORANGE		F014966	M1	WHITE PEPPER ENV	384X9G
M332314	12	CTN L/CAL LEMON		53 >SPICES IN READY MADE SACHETS /MIXED			
M332323	12	CTN L/CAL R/BERRY		F015008	M1	COMPOUND PEPPER ENV	384X9G
M332332	12	CTN L/CAL G/GAGE		54 >TINNED SPICES			
M332350	12	CTN L/CAL IP CHOC		F015040	M1	BLACK PEPPER TIN	72X 50G
M332369	12	CTN L/CAL IP VANILLA		F015059	M1	WHITE PEPPER TIN	72X 50G
M332378	12	CTN L/CAL IP CARAMEL		F015067	M1	WHITE PEPPER TIN	48X100G
19 >CAPS				55 >SPICES IN CONES			
M334028	13	CAP ESSENCE	30ML	F015075	M1	PEPPERCONE	72X 50G
M334073	13	CAP COLOUR	30ML	F015083	M1	PEPPERCONE	40X 50G
M741291	13	CAP ESSENCE	1000ML	56 >PURE GROUND 3KG CATERPACK SPICE			
M334046	13	CAP ESSENCE	100ML	F018031	K1	MOIRS CAYENNE PEPPER	4X3KG
M334064	13	CAP ESSENCE	500ML	57 >PURE GROUND 6KG CATERPACK SPICE			
M334374	15	CAP BUNNYCAN	5LT	F018066	K1	MOIRS GRND WHT PEPPER	6X1KG
20 >PLASTIC JARS				58 >CATERPACK SPICE WITH BULKING AGENT			
M334082	13	PEPPERCONES	50G	F018015	K1	MOIRS CURRY MEDIUM	4X3KG
M334198	13	JAR B/POWDER	200G	59 >CATERPACK SPICE WITH BLKNG AGNT SGR&SALT			
M334213	13	JAR B/POWDER	500G	F018023	K1	MOIRS CURRY HOT	4X3KG
M334329	13	JAR B/POWDER	100G	60 >MIXED BULK PACK SPICE			
M334347	13	JAR CUSTARD	500G	F018228	K1	MOIRS MIX MASALA	25KG
M334383	13	JAR CUSTARD	250G	61 >MIXED BULK PACK SPICES WITH BULKING AGNT			
M741217	13	JAR B/POWDER	2KG	F018074	K1	MOIRS CURRY MEDIUM	25KG
21 >LIDS				F018104	K1	MOIRS BORRIE COMPOUND	25KG
M334091	13	YELLOW PEPPER SPOUTS T/P		F018147	K1	MOIRS WHT PEPPER COMP	25KG
M334204	13	LID B/POWDER	200G & 500G	F018155	K1	MOIRS BLK PEPPER COMP	25KG
M334338	13	LID B/POWDER	100G	62 >MXD BLK PCK SPICE WTH BLKNG AGNT SGR&SLT			
M334356	13	LID CUSTARD	250G & 500G	F018082	K1	MOIRS CURRY HOT	25KG
M741220	13	LID B/POWDER	2KG	63 >PURE BULK PACK SPICES #1			
M334310	13	LID CAKE DECORATION		F018090	K1	MOIRS TURMERIC	25KG
M334143	14	TWIN TOPS FOR TINS	50G	64 >PURE BULK PACK SPICES #2			
M334161	14	TWIN TOPS FOR TINS	100G	F018112	K1	MOIRS CAYENNE PEPPER	25KG
22 >TINS				F018120	K1	MOIRS GRD BLK PEPPER	25KG
M334125	14	TINS WHITE PEPPER	50G				
M334134	14	TINS BLACK PEPPER	50G				
M334152	14	TINS WHITE PEPPER	100G				
23 >TUBS FOR CAKE DECORATIONS							
M334408	15	TUB CAKE DECS	50G 273/10				
M334417	15	TUB CAKE DECS	100G 152/10				
24 >BAKING POWDER SPOONS							
M341268	15	SPOONS BAKING POWDER					

25 >SELLOTAPE ROLLS				F018139	K1	MOIRS GRD WHT PEPPER	25KG
M341277	15	SELLOTAPE ROLLS	1/2"	F018201	K1	MOIRS GRD GINGER	25KG
26 >GLUES				65 >PURE BULK PACK SPICES #3			
M227580	15	GLUE SYNTA A1733		F018198	K1	MOIRS GRD CORNDR	25KG
M341310	15	GLUE GLOBE HOTMELT 43		F018317	K1	GROUND CUMMIN	25KG
M341338	15	GLUE PRIMO C49		66 >PURE BULK PACK SPICE #4			
M341596	15	GLUE GLOBE NO 24		F018333	K1	GROUND FENNEL	25KG
M342508	15	GLUE TAC 1258 C/6		67 >UNMILLED BULK PACK SPICE			
27 >CLEAR TAPE				F018325	K1	WHOLE FENNEL	25KG
M341356	15	CLEAR TAPE	48X100MM	68 >15GR HOUSEHOLD CHEMICALS REPACKED ONLY			
28 >BUNNY CAN				F015113	M1	EPSOM SALTS	100X15G
M341499	15	CANS BUNNY	5LT	F015148	M1	TARTARIC ACID	100X15G
29 >OUTER STICKERS				69 >15GR HSEHLD CHMCLS RPCKED & USED IN FACT			
M231527	16	STCKR B/CODE S/W	4X4.5CM	F015121	M1	BICARB OF SODA	100X15G
M231536	16	STCKR B/CODE OUTER	4.8X10CM	F015156	M1	CREAM OF TARTAR	100X15G
30 >INNER STICKER				70 >500GR HOUSEHOLD CHEMICALS REPACKED ONLY			
M231882	16	STCKR B/CODE INN	40X29MM	F015091	M1	EPSOM SALTS	36X500G
31 >BEST BEFORE STICKER				71 >500GR HSHLD CHMCLS RPCKED & USED IN FACT			
M341480	16	STCKR BEST BEFORE S/C		F015105	M1	BICARB OF SODA	36X500G
32 >LABELS							
M337203	16	LAB ESS ORANGE	30ML				
M337212	16	LAB ESS LEMON	30ML				
M337221	16	LAB ESS RASPBERRY	30ML				
M337267	16	LAB ESS STRAWBERRY	30ML				
M337285	16	LAB ESS ROSE	30ML				
M337294	16	LAB ESS ALMOND	30ML				
M337300	16	LAB ESS CARAMEL	30ML				
M337319	16	LAB ESS VANILLA	30ML				
M337328	16	LAB ESS RUM	30ML				
M337878	16	LAB ESS PEPPERMINT	30ML				
M737302	16	LAB ESS R/BERRY	30ML				
M737315	16	LAB ESS ROSE	30ML				
M337504	16	LAB COL CRIMSON RED	30ML				
M337513	16	LAB COL EGG YELLOW	30ML				
M337522	16	LAB COL APPLE GREEN	30ML				
M337559	16	LAB COL SKY BLUE	30ML				
M337355	16	LAB ESS VANILLA	100ML				
M337452	16	LAB ESS VANILLA	500ML				
M737247	16	LAB ESS ALMOND	500ML				
M737250	16	LAB ESS S/BERRY	500ML				
M737263	16	LAB ESS P/APPLE	500ML				
M737276	16	LAB ESS ORANGE	500ML				
M737289	16	LAB ESS R/BERRY	500ML				
M737292	16	LAB ESS ROSE	500ML				
M737331	16	LAB ESS VANILLA	1LT				
M337780	16	LAB BAKING POWDER	200G				
M337799	16	LAB BAKING POWDER	500G				
M337805	16	LAB BAKING POWDER	100G				
M337832	16	LAB CUSTARD	500G				
M337869	16	LAB CUSTARD	250G				
M737027	16	LAB CUSTARD	2KG				

M737124	16	LAB GRD WHT PEP	1KG
M737153	16	LAB CAYENNE PEP	3KG
M737195	16	LAB CURRY MED	3KG
M737360	16	LAB INST PUDDING	500G
M737373	16	LAB JELLY	500G
M737030	16	LAB B/POWDER	2KG
M337975	16	S/ADH LBL 100'S&1000'S	100G
M337984	16	S/ADH LBL CHOC VERM	75G
M337993	16	S/ADH LBL SILVER BALLS	50G
M338002	16	S/ADH LBL CHOC CHIPS	70G

33 >NAMESTRIPS

M339209	16	NAMESTRIPS ORANGE	
M339218	16	NAMESTRIPS GREENGAGE	
M339227	16	NAMESTRIPS CHERRY	
M339236	16	NAMESTRIPS LEMON	
M339245	16	NAMESTRIPS RASPBERRY	
M339254	16	NAMESTRIPS PINEAPPLE	
M339263	16	NAMESTRIPS LIME	
M339281	16	NAMESTRIPS APRICOT	
M339290	16	NAMESTRIPS PEACH	
M339315	16	NAMESTRIPS STRAWBERRY	
M339351	16	NAMESTRIPS CHOCOLATE	
M339360	16	NAMESTRIPS CARAMEL	
M339379	16	NAMESTRIPS VANILLA	
M339388	16	NAMESTRIPS BUTTERSCOTCH	
M339582	16	NAMESTRIPS 100'S/1000'S	
M339591	16	NAMESTRIPS CHOC VERMICEL	
M339616	16	NAMESTRIPS EPSOM SALTS	
M339625	16	NAMESTRIPS BICARB SODA	
M339722	16	NAMESTRIPS WHITE PEPPER	
M339926	16	NAMESTRIPS ORIENTAL	
M339935	16	NAMESTRIPS MEXICAN	
M339944	16	NAMESTRIPS SOSATIE	
M340034	16	NAMESTRIPS APPLE & CARAMEL	
M340061	16	NAMESTRIPS B.O/T FOREST	
M340070	16	NAMESTRIPS TROP.FRUIT	
M340089	16	NAMESTRIPS COCONUT MED SHRED	
M341523	16	NAMESTRIPS CHOC CHIPS	
M341541	16	NAMESTRIPS TWR CCNUT 4X10X200G	

34 >GLASS BOTTLES

M334019	21	BOTTLES ESSENCE	30ML
M334037	21	BOTTLES ESSENCE	100ML
M334055	21	BOTTLES ESSENCE	500ML
M741301	21	BOTTLES ESSENCE	1000ML

APPENDIX C

PLANNER.....	1
6WKSPLN.....	5
MACLOAD.....	9
MACHINE LOAD CHARTS....	19
DETAILED INFORMATION...21	
ABOUT PLANNING MODULE	

P L A N N E R

CODE	DESCRIPTION	FRCST	FRCST	FRCST	FRCST	CP TWN	WVL/DB	TOTAL	10WKS	TOTAL	FRCST	ACT SL	DAYS
		P8	P8/2WK	P9	P10	STOCK	STOCK	STOCK	FRCST	PRD REQ	P11	P7	COVER
	MOIRS JELLY POWDER:												
13900	CHERRY 48X80G	473	237	658	422	337	0	337	1317	980	538	136	13
13919	LEMON 48X80G	153	77	306	472	504	0	504	855	350	456	144	30
13927	ORANGE 48X80G	165	83	332	401	556	0	556	816	260	465	113	34
13935	RASPBERRY 48X80G	766	383	731	600	847	0	847	1714	867	706	175	25
13943	GREENGAGE 48X80G	449	225	640	441	313	0	313	1306	993	522	141	12
13951	LIME 48X80G	143	72	357	276	604	0	604	705	100	322	80	43
13978	PEACH 48X80G	152	76	406	371	625	0	625	853	228	445	103	37
13986	PINEAPPLE 48X80G	333	167	640	775	412	0	412	1582	1169	788	205	13
13994	STRAWBERRY 48X80G	822	411	793	793	184	0	184	1997	1813	771	279	5
	TOWER JELLY:												
14001	ASSORTED JELLY 144X80G	1511	756	2791	2981	560	0	560	6528	5968	5869	851	4
14028	ASSORTED JELLY 72 X80G	1230	615	3340	2411	1471	0	1471	6366	4895	2321	1100	12
	MOIRS INSTANT PUDDING:												
14079	CARAMEL 48X90G	227	114	260	249	16	0	16	623	607	372	182	1
14087	BUTTERSCOTCH 48X90G	200	100	252	215	14	0	14	567	553	293	153	1
14095	CHOCOLATE 48X90G	272	136	400	340	282	0	282	876	594	400	192	16
14117	VANILLA 48X90G	197	99	344	260	431	0	431	703	272	398	152	31
14125	S/BERRY 48X90G	251	126	381	298	275	0	275	805	530	375	189	17
15482	TROPICAL FRUIT 48X90G	143	72	116	111	254	0	254	299	45	124	147	43
15490	FOREST BERRIES 48X90G	138	69	114	107	236	0	236	290	54	119	129	41
	HOT SPGE. PUDDING:												
14184	CARAMEL 24X284G	130	65	101	59	116	0	116	225	109	50	170	26
14192	LEMON 24X284G	68	34	51	35	59	0	59	120	62	30	123	24
14214	APRICOT 24X284G	142	71	134	87	358	0	358	292	0	71	117	61
14222	CHOCOLATE 24X284G	91	46	73	47	186	0	186	166	0	40	145	56
14230	MIX FRUIT 24X284G	74	37	67	41	135	0	135	145	11	32	119	46
15369	APPLE & CARAMEL 24X284G	103	52	70	40	93	0	93	162	69	37	117	29
15407	PEACH 24X284G	138	69	28	20	97	0	97	117	20	16	23	42
14249	CREME CARAMEL 24X125G	296	148	296	372	567	0	567	816	250	358	298	35
	MOIRS LOW CAL JELLY:												
14257	RASPBERRY 36X40G	181	91	290	290	62	127	189	671	482	301	172	14
14265	ORANGE 36X40G	132	66	220	220	400	106	506	506	0	229	102	50
14273	GREENGAGE 36X40G	144	72	199	210	194	97	291	481	190	180	98	30
14281	LEMON 36X40G	90	45	150	150	187	79	266	345	80	120	67	38
	MOIRS L/C INS/PUDDING:												
14303	CHOCOLATE 36X20G	85	43	129	200	36	58	94	372	278	189	74	13
14311	VANILLA 36X20G	31	16	91	69	23	60	83	176	93	81	72	24
15318	CARAMEL 36X20G	82	41	189	139	51	75	126	369	243	169	87	17
	CUSTARD POWDER:												
14346	VANILLA 72X125G	1904	952	2031	2677	1847	797	2644	5660	3016	2877	1602	23
15261	VANILLA 36X250G	368	184	415	458	433	0	433	1057	624	501	260	20
14354	VANILLA (JAR) 36X500G	396	198	352	403	330	0	330	953	623	416	379	17
18880	VANILLA (PKT) 36X500G	400	200	400	400	60	0	60	1000	940	160	0	3

P L A N N E R

CODE	DESCRIPTION	FRCST PB	FRCST PB/2WK	FRCST P9	FRCST P10	CP TWN STOCK	WVL/DB STOCK	TOTAL STOCK	10WKS FRCST	TOTAL PRD REQ	FRCST P11	ACT SL P7	DAYS COVER
CAKE MIXES:													
14419	CHOCOLATE 24X400G	129	65	177	124	128	0	128	366	238	191	94	17
14427	VANILLA 12X400G	160	80	281	265	24	0	24	626	602	336	147	2
15458	FUNCAKES 12X240G	331	166	502	113	491	370	861	781	0	502	342	55
15474	FUNFETTI 12X240G	769	385	1057	220	241	679	920	1662	742	1127	607	28
15512	RAISIN MUFFIN 12X475G	738	369	689	590	139	466	605	1648	1043	590	629	18
15520	APPLE MUFFINS 12X450G	589	295	589	394	229	429	658	1278	620	394	600	26
15415	VANILLA/CARAMEL 12X800G	969	485	1251	1199	562	873	1435	2935	1499	1308	736	24
15423	CHOCOLATE/FUDGE 12X800G	1298	649	1602	1504	783	808	1591	3755	2165	1740	1126	21
ESSENCES:													
14494	VANILLA 20X 30ML	2402	1201	3132	3399	3001	1650	4651	7732	3081	3701	2601	30
14508	S/BERRY 20X 30ML	239	120	363	311	135	59	194	794	600	385	212	12
14516	LEMON 20X 30ML	541	271	875	742	897	341	1238	1888	650	915	559	33
14524	CARAMEL 20X 30ML	791	396	1115	1003	1178	446	1624	2514	890	1203	751	32
14532	ALMOND 20X 30ML	386	193	582	509	493	292	785	1284	499	619	304	31
14540	ORANGE 20X 30ML	262	131	385	356	238	163	401	872	471	419	230	23
14559	RUM 20X 30ML	250	125	392	382	141	253	394	899	505	439	226	22
15431	PEPPERMINT 20X 30ML	352	176	176	150	428	11	439	502	64	186	99	44
20532	R/BERRY 20X 30ML	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
21032	ROSE 20X 30ML	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
14567	VANILLA 24X100ML	2265	1133	2279	2900	574	1191	1765	6312	4547	3181	1971	14
14583	VANILLA 12X500ML	1000	500	1101	1072	388	728	1116	2673	1557	1239	773	21
20923	ORANGE 12X500ML	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
20931	R/BERRY 12X500ML	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
20958	P/APPLE 12X500ML	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
20966	ALMOND 12X500ML	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
21040	ROSE 12X500ML	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
21172	S/BERRY 12X500ML	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
COLOURANTS:													
14591	APPLE GREEN 20X30ML	419	210	457	508	548	299	847	1175	327	762	421	36
14605	SKY BLUE 20X30ML	206	103	220	326	198	288	486	649	163	407	210	37
14613	CRIMSON RED 20X30ML	682	341	719	790	565	409	974	1850	877	968	654	26
14621	EGG YELLOW 20X30ML	816	408	1002	1199	1130	653	1783	2609	826	1305	670	34
MOIRS BAKING POWDER:													
14656	BAKING POWDER 100X50G	449	225	571	450	232	99	331	1246	914	480	332	13
14664	BAKING POWDER 48X100G	651	326	631	653	535	216	751	1610	859	688	449	23
14672	BAKING POWDER 24X200G	2949	1475	2858	3054	159	992	1151	7387	6236	3535	2303	8
14680	BAKING POWDER 24X500G	380	190	350	305	157	229	386	845	459	413	346	23
MOIRS COCONUT:													
14699	COCONUT (FINE) 24X100G	2000	1000	2350	3113	51	463	514	6463	5949	3292	1330	4
14702	COCONUT (FINE) 48X200G	1618	809	1634	2300	0	0	0	4743	4743	4000	326	0
14710	COCONUT (FINE) 24X500G	731	366	636	950	51	0	51	1952	1901	1320	856	1
14729	TOWER COCONUT 40X200G	250	125	290	250	54	0	54	665	611	309	274	4
15563	COCONUT (MEDIUM) 48X200G	624	312	711	1000	0	271	271	2023	1752	1401	0	7
15571	COCONUT (MEDIUM) 24X500G	312	156	359	450	0	258	258	965	707	541	0	13
CAKE DECORATIONS:													
14745	100'S & 1000'S 24X100G	951	476	1175	1475	0	450	450	3126	2676	1824	958	7

P L A N N E R

CODE	DESCRIPTION	FR CST P8	FR CST P8/2WK	FR CST P9	FR CST P10	CP TWN STOCK	WVL/DB STOCK	TOTAL STOCK	10WKS FR CST	TOTAL PRD REQ	FR CST P11	ACT SL P7	DAYS COVER
14753	CHOC. VERMICELLI 24X 75G	731	366	1068	916	1067	551	1618	2350	731	1214	820	34
15342	CHOC CHIPS 24X 70G	101	51	136	114	37	86	123	301	177	148	122	21
15350	SILVER BALLS 24X 50G	104	52	133	166	0	50	50	351	301	196	137	7
MOIRS MEAT MAGIC:													
14907	BARBEQUE 24X100G	1020	510	1009	921	1606	622	2228	2440	212	841	954	46
14915	SOSATIE 24X100G	243	122	260	239	537	165	702	621	0	229	280	57
14923	ORIENTAL 24X100G	622	311	592	563	718	435	1153	1466	313	563	602	39
14931	MEXICAN 24X100G	280	140	369	340	579	258	837	849	13	330	231	49
ENVELOPE SPICES:													
14966	WHITE PEPPER 384X9G	279	140	309	271	22	0	22	720	698	279	318	2
14974	CURRY 384X9G	621	311	650	581	364	0	364	1542	1178	611	610	12
14982	BORRIE 384X9G	562	281	689	680	728	0	728	1650	923	680	636	22
14990	CAYENNE PEPPER 384X9G	209	105	230	190	235	0	235	525	290	230	186	22
15008	COMPOUND PEPPER 384X9G	620	310	541	570	476	0	476	1421	945	629	722	17
PEPPER:													
15040	BLACK PEPPER TIN 72X 50G	180	90	261	200	67	0	67	551	484	191	160	6
15059	WHITE PEPPER TIN 72X 50G	270	135	320	211	0	0	0	666	666	280	211	0
15067	WHITE PEPPER TIN 48X100G	30	15	25	25	0	0	0	65	65	30	15	0
15075	PEPPERONE 72X 50G	571	286	680	620	959	0	959	1586	627	660	239	30
15083	PEPPERONE 40X 50G	150	75	272	179	463	0	463	526	63	239	90	44
HOUSEHOLD CHEMICALS:													
15091	EPSOM SALTS 36X500G	101	51	149	101	191	0	191	301	110	101	94	32
15105	BICARB OF SODA 36X500G	279	140	300	279	390	0	390	719	328	290	258	27
15113	EPSOM SALTS 100X15G	330	165	420	330	642	0	642	915	273	439	345	35
15121	BICARB OF SODA 100X15G	668	334	761	610	957	0	957	1705	748	700	674	28
15148	TARTARIC ACID 100X15G	110	55	170	100	684	0	684	325	0	190	220	105
15156	CREAM OF TARTAR 100X15G	280	140	309	251	396	0	396	700	305	318	300	28
CATERPACK JELLY:													
17914	MJP G/GAGE 24X500G	19	10	19	19	0	0	0	48	48	19	42	0
17922	MJP ORANGE 24X500G	70	35	20	20	25	0	25	75	50	20	32	17
17930	MJP R/BERRY 24X500G	60	30	25	25	18	0	18	80	63	25	46	11
17949	MJP LEMON 24X500G	65	33	15	15	20	6	25	63	38	15	40	20
CATERPACK PUDDING:													
17965	IP CARAMEL 24X500G	307	154	11	11	84	65	148	176	28	11	0	42
17973	IP CHOCOLATE 24X500G	224	112	10	10	43	64	107	132	25	10	3	41
17981	IP S/BERRY 24X500G	124	62	11	11	0	57	57	84	28	11	0	34
18007	IP VANILLA 24X500G	398	199	10	10	102	92	194	219	25	10	3	44
CATERPACK SPICES:													
18015	CURRY MED. 4X3KG	250	125	150	150	143	42	185	425	240	10	17	22
18074	CURRY MED. 25KG	29	15	29	29	0	10	10	73	63	29	94	7
18082	CURRY HOT 25KG	0	0	0	0	5	4	9	0	0	0	19	NO FRCS
18090	PURE TURM. 25KG	25	13	25	25	42	7	49	63	14	25	66	39
18104	BORRIE COMP. 25KG	50	25	50	50	117	0	117	125	8	50	65	47

P L A N N E R

CODE	DESCRIPTION	FRCST				CP TWN	WVL/DB	TOTAL	10WKS	TOTAL	FRCST	ACT SL	DAYS
		P8	P8/2WK	P9	P10	STOCK	STOCK	STOCK	FRCST	PRD REQ	P11	P7	COVER
18112	CAYENNE PEPPER 25KG	25	13	25	25	110	0	110	63	0	25	5	88
18120	GR. BLK PEPPER 25KG	0	0	0	0	27	1	28	0	0	0	0	NO FRCS
18139	GR. WH. PEPPER 25KG	15	8	15	15	38	0	38	38	0	15	10	50
18198	GR. CORNDR 25KG	7	4	7	7	1	0	1	18	17	7	18	3
18201	GR. GINGER 25KG	30	15	30	30	97	0	97	75	0	30	0	65
18228	MIX MASALA 25KG	45	23	45	45	113	0	113	113	0	45	50	50
18317	GROUND CUMIN 25KG	12	6	12	12	0	0	0	30	30	12	71	0
18325	WHOLE FENNEL 25KG	0	0	0	0	0	0	0	0	0	0	1	NO FRCS
18333	GROUND FENNEL 25KG	0	0	0	0	16	0	16	0	0	0	0	NO FRCS
CATERPACK CUSTARD:													
18376	CUSTARD 4X2KG	300	150	300	300	0	118	118	750	633	150	258	8
18384	CUSTARD 25KG	90	45	90	90	46	51	97	225	129	40	74	21
CATERPACK BAKING POWDER:													
18546	BAKING POWDER 6X2KG	250	125	150	150	0	63	63	425	362	129	168	7
18554	BAKING POWDER 20KG	551	276	551	601	50	10	60	1428	1368	551	825	2
CATERPACK ESSENCE:													
18856	VANILLA 12X1L	150	75	150	150	0	106	106	375	269	150	144	14
PRODUCTS MADE ON ORDER:													
17957	MJP GULL S/BERRY 24X500G	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
18023	MOIRS CURRY HOT 4X3KG	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
18031	MOIRS CAYENNE PEP 4X3KG	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
18066	MOIRS GRND WHT PEP 6X1KG	150	75	150	150	38	0	38	375	338	0	0	5
18147	MOIRS WHT PEP COMP 25KG	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
18155	MOIRS BLK PEP COMP 25KG	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
18511	ESS CARAMEL 5LT	0	0	0	0	0	0	0	0	0	0	0	NO FRCS
TOTALS		49617	25298	60211	59903	39143	17645	56788	145412	89354	71638	39907	20

6 W K S P L N

CODE	DESCRIPTION	TOT PROD REQUIRED	(1)	(2)	(3)	(4)	(5)	(6)	6WKS TOTALS	ACTUAL -THRTCL
			P8 WK3	P8 WK4	P9 WK1	P9 WK2	P9 WK3	P9 WK4		
	MOIRS JELLY POWDER:									
13900	CHERRY 48X80G	980		270	270	270	270	270	1350	370
13919	LEMON 48X80G	350		270	270			270	810	460
13927	ORANGE 48X80G	260		270				270	810	551
13935	RASPBERRY 48X80G	867		270	270	540	270	270	1620	753
13943	GREENGAGE 48X80G	993	270	270	270	270		270	1350	357
13951	LIME 48X80G	100	270	270		270			810	710
13978	PEACH 48X80G	228		270				270	810	582
13986	PINEAPPLE 48X80G	1169	270	270	270	270	270	540	1890	721
13994	STRAWBERRY 48X80G	1813	270	270	270	270	270	540	1890	77
	TOWER JELLY:									
14001	ASSORTED JELLY 144X80G	5968	900	1800	900	1800	600	600	6600	632
14028	ASSORTED JELLY 72 X80G	4895	1200	1200	1200	1200	1200	1200	7200	2305
	MOIRS INSTANT PUDDING:									
14079	CARAMEL 48X90G	607	270		270		540		1080	473
14087	BUTTERSCOTCH 48X90G	553	270		270		270	270	1080	527
14095	CHOCOLATE 48X90G	594	270		270		270	270	1080	486
14117	VANILLA 48X90G	272			180		180	180	540	268
14125	S/BERRY 48X90G	530	100		180		360	180	820	291
15482	TROPICAL FRUIT 48X90G	45			270				270	225
15490	FOREST BERRIES 48X90G	54			270				270	216
	HOT SPGE. PUDDING:									
14184	CARAMEL 24X284G	109		100	100				200	91
14192	LEMON 24X284G	62	100						100	39
14214	APRICOT 24X284G	0							0	0
14222	CHOCOLATE 24X284G	0							0	0
14230	MIX FRUIT 24X284G	11		100					100	90
15369	APPLE & CARAMEL 24X284G	69	100						100	31
15407	PEACH 24X284G	20	100						100	80
14249	CREME CARAMEL 24X125G	250	250				250	250	750	501
	MOIRS LOW CAL JELLY:									
14257	RASPBERRY 36X40G	482	220			220	220		660	179
14265	ORANGE 36X40G	0				110			110	110
14273	GREENGAGE 36X40G	190				110		110	220	30
14281	LEMON 36X40G	80				110			110	31
	MOIRS L/C INS/PUDDING:									
14303	CHOCOLATE 36X20G	278		220					220	-58
14311	VANILLA 36X20G	93			220				220	127
15318	CARAMEL 36X20G	243			220				220	-23
	CUSTARD POWDER:									
14346	VANILLA 72X125G	3016	600	600	600	600	600	600	3600	584
15261	VANILLA 36X250G	624	300	240	150	150	150	100	1090	466
14354	VANILLA (JAR) 36X500G	623	300	240	180		300	180	1200	577
18880	VANILLA (PKT) 36X500G	940	380	240	240		270	240	1370	430

6 W K S P L N

CODE	DESCRIPTION	TOT PROD REQUIRED	(1) P8 WK3	(2) P8 WK4	(3) P9 WK1	(4) P9 WK2	(5) P9 WK3	(6) P9 WK4	6WKS TOTALS	ACTUAL -THRTCL
	CAKE MIXES:									
14419	CHOCOLATE 24X400G	238	160		160			160	480	242
14427	VANILLA 12X400G	602	160		160	160	160		640	38
15458	FUNCAKES 12X240G	0							0	0
15474	FUNFETTI 12X240G	742	580	290		290		290	1450	708
15512	RAISIN MUFFIN 12X475G	1043	320	320	160	320	160	320	1600	557
15520	APPLE MUFFINS 12X450G	620	160	320	160	160	160		960	340
15415	VANILLA/CARAMEL 12X800G	1499	260	260	260	260	260	260	1560	61
15423	CHOCOLATE/FUDGE 12X800G	2165	520	520	390	390	260	390	2470	306
	ESSENCES:									
14494	VANILLA 20X 30ML	3081							0	-3081
14508	S/BERRY 20X 30ML	600							0	-600
14516	LEMON 20X 30ML	650							0	-650
14524	CARAMEL 20X 30ML	890							0	-890
14532	ALMOND 20X 30ML	499							0	-499
14540	ORANGE 20X 30ML	471							0	-471
14559	RUM 20X 30ML	505							0	-505
15431	PEPPERMINT 20X 30ML	64							0	-64
20532	R/BERRY 20X 30ML	0							0	0
21032	ROSE 20X 30ML	0							0	0
14567	VANILLA 24X100ML	4547	600						600	-3947
14583	VANILLA 12X500ML	1557	1029						1029	-528
20923	ORANGE 12X500ML	0							0	0
20931	R/BERRY 12X500ML	0							0	0
20958	P/APPLE 12X500ML	0							0	0
20966	ALMOND 12X500ML	0							0	0
21040	ROSE 12X500ML	0							0	0
21172	S/BERRY 12X500ML	0							0	0
	COLOURANTS:									
14591	APPLE GREEN 20X30ML	327							0	-327
14605	SKY BLUE 20X30ML	163							0	-163
14613	CRIMSON RED 20X30ML	877							0	-877
14621	EGG YELLOW 20X30ML	826							0	-826
	MOIRS BAKING POWDER:									
14656	BAKING POWDER 100X50G	914	402		402		134	804	1742	828
14664	BAKING POWDER 48X100G	859	280	280	280	280	280	280	1680	821
14672	BAKING POWDER 24X200G	6236	980	980	980	980	980	980	5880	-356
14680	BAKING POWDER 24X500G	459		168	168	168	168	168	840	381
	MOIRS COCONUT:									
14699	COCONUT (FINE) 24X100G	5949	900	400	400	1000		1000	3700	-2249
14702	COCONUT (FINE) 48X200G	4743	400	350	350	800		1000	2900	-1843
14710	COCONUT (FINE) 24X500G	1901	300	300	300	300	600		1800	-101
14729	TOWER COCONUT 40X200G	611	150	150	200	150	150		800	189
15563	COCONUT (MEDIUM) 48X200G	1752			650	650	650		1950	198
15571	COCONUT (MEDIUM) 24X500G	707			500	500	500		1500	793
	CAKE DECORATIONS:									
14745	100'S & 1000'S 24X100G	2676	400	600	600	600	600	600	3400	724

6 W K S P L N

CODE	DESCRIPTION	TOT PROD REQUIRED	(1) P8 WK3	(2) P8 WK4	(3) P9 WK1	(4) P9 WK2	(5) P9 WK3	(6) P9 WK4	6WKS TOTALS	ACTUAL -THRTCL
14753	CHOC. VERMICELLI 24X 75G	731		600				400	1000	269
15342	CHOC CHIPS 24X 70G	177		200		200			400	223
15350	SILVER BALLS 24X 50G	301	100		100	100	100	100	500	199
	MOIRS MEAT MAGIC:									
14907	BARBEQUE 24X100G	212				1200		1200	2400	2188
14915	SOSATIE 24X100G	0				600		600	1200	1200
14923	ORIENTAL 24X100G	313				600		600	1200	887
14931	MEXICAN 24X100G	13				600		600	1200	1188
	ENVELOPE SPICES:									
14966	WHITE PEPPER 384X9G	698	140	140	140	140	140	140	840	143
14974	CURRY 384X9G	1178	248	248	248	248	248	248	1488	310
14982	BORRIE 384X9G	923	248	248	248	248	248	248	1488	566
14990	CAYENNE PEPPER 384X9G	290	81	81	81	81	81	81	486	196
15008	COMPOUND PEPPER 384X9G	945	162	162	162	162	162	162	972	27
	PEPPER:									
15040	BLACK PEPPER TIN 72X 50G	484			100				100	-384
15059	WHITE PEPPER TIN 72X 50G	666			200				200	-466
15067	WHITE PEPPER TIN 48X100G	65	50				100		150	85
15075	PEPPERCONCONE 72X 50G	627	181	181	181	181			724	97
15083	PEPPERCONCONE 40X 50G	63			100				100	37
	HOUSEHOLD CHEMICALS:									
15091	EPSOM SALTS 36X500G	110	100	100		100			300	191
15105	BICARB OF SODA 36X500G	328	100	200			100	100	500	172
15113	EPSOM SALTS 100X15G	273		300	300				600	327
15121	BICARB OF SODA 100X15G	748	300	300	300			300	1200	452
15148	TARTARIC ACID 100X15G	0	150	300					450	450
15156	CREAM OF TARTAR 100X15G	305		300	150				450	146
	CATERPACK JELLY:									
17914	MJP G/GAGE 24X500G	48							0	-48
17922	MJP ORANGE 24X500G	50							0	-50
17930	MJP R/BERRY 24X500G	63							0	-63
17949	MJP LEMON 24X500G	38							0	-38
	CATERPACK PUDDING:									
17965	IP CARAMEL 24X500G	28							0	-28
17973	IP CHOCOLATE 24X500G	25							0	-25
17981	IP S/BERRY 24X500G	28							0	-28
18007	IP VANILLA 24X500G	25							0	-25
	CATERPACK SPICES:									
18015	CURRY MED. 4X3KG	240	80	80	80	80	80	80	480	240
18074	CURRY MED. 25KG	63	16	16	16	16	16	16	96	34
18082	CURRY HOT 25KG	0							0	0
18090	PURE TURM. 25KG	14	16			16			32	19
18104	BORRIE COMP. 25KG	8			16	16	16		48	40

6 W K S P L N

CODE	DESCRIPTION	TOT PROD REQUIRED	(1)	(2)	(3)	(4)	(5)	(6)	6WKS	ACTUAL
			P8 WK3	P8 WK4	P9 WK1	P9 WK2	P9 WK3	P9 WK4	TOTALS	-THRTCL
18112	CAYENNE PEPPER 25KG	0							0	0
18120	GR. BLK PEPPER 25KG	0							0	0
18139	GR. WH. PEPPER 25KG	0			16				16	16
18198	GR. CORNDR 25KG	17			16				16	-1
18201	GR. GINGER 25KG	0			16				16	16
18228	MIX MASALA 25KG	0	18		18				36	36
18317	GROUND CUMIN 25KG	30	16	16	16	16	16	16	96	66
18325	WHOLE FENNEL 25KG	0							0	0
18333	GROUND FENNEL 25KG	0							0	0
CATERPACK CUSTARD:										
18376	CUSTARD 4X2KG	633	270	135	270	135	135	270	1215	583
18384	CUSTARD 25KG	129	42	42	42	42			168	40
CATERPACK BAKING POWDER:										
18546	BAKING POWDER 6X2KG	362	112	112	56	56	112	112	560	198
18554	BAKING POWDER 20KG	1368	296	296	296	296	296	296	1776	409
CATERPACK ESSENCE:										
18856	VANILLA 12X1L	269	147						147	-122
PRODUCTS MADE ON ORDER:										
17957	MJP GULL S/BERRY 24X500G	0							0	0
18023	MOIRS CURRY HOT 4X3KG	0							0	0
18031	MOIRS CAYENNE PEP 4X3KG	0							0	0
18066	MOIRS GRND WHT PEP 6X1KG	338	75	75	75	75	75	75	450	113
18147	MOIRS WHT PEP COMP 25KG	0							0	0
18155	MOIRS BLK PEP COMP 25KG	0							0	0
18511	ESS CARAMEL 5LT	0							0	0
TOTALS		89354	16989	16240	16503	18406	13817	18776	100731	11377

MACLOAD

CODE	DESCRIPTION	6WK T	TOTA	MACHINE ALLOC COEFFICIENTS (MIXING FLR)						
				PAS1& NAU3& SNAUT	CUMIX	NAU1& SPMIX	MILL2	MILL3	MILL1	HNDPK SPARE
20532	R/BERRY 20X 30ML	0	0.00							
21032	ROSE 20X 30ML	0	0.00							
14567	VANILLA 24X100ML	600	0.00							
14583	VANILLA 12X500ML	1029	0.00							
20923	ORANGE 12X500ML	0	0.00							
20931	R/BERRY 12X500ML	0	0.00							
20958	P/APPLE 12X500ML	0	0.00							
20966	ALMOND 12X500ML	0	0.00							
21040	ROSE 12X500ML	0	0.00							
21172	S/BERRY 12X500ML	0	0.00							
COLOURANTS:										
14591	APPLE GREEN 20X30ML	0	0.00							
14605	SKY BLUE 20X30ML	0	0.00							
14613	CRIMSON RED 20X30ML	0	0.00							
14621	EGG YELLOW 20X30ML	0	0.00							
MOIRS BAKING POWDER:										
14656	BAKING POWDER 100X50	1742	0.16	0.16						
14664	BAKING POWDER 48X100	1680	0.16	0.16						
14672	BAKING POWDER 24X200	5880	0.16	0.16						
14680	BAKING POWDER 24X500	840	0.40	0.40						
MOIRS COCONUT:										
14699	COCONUT (FINE) 24X100G	3700	2.40	2.40						
14702	COCONUT (FINE) 48X200G	2900	1.20	1.20						
14710	COCONUT (FINE) 24X500G	1800	1.60	1.60						
14729	TOWER COCONUT 40X20	800	1.20	1.20						
15563	COCONUT (MEDIUM) 48X20	1950	1.20	1.20						
15571	COCONUT (MEDIUM) 24X50	1500	1.60	1.60						
CAKE DECORATIONS:										
14745	100'S & 1000'S 24X100G	3400	0.00							
14753	CHOC. VERMICELLI 24X 75	1000	0.00							
15342	CHOC CHIPS 24X 70G	400	0.00							
15350	SILVER BALLS 24X 50G	500	0.00							
MOIRS MEAT MAGIC:										
14907	BARBEQUE 24X100G	2400	0.00							
14915	SOSATIE 24X100G	1200	0.00							
14923	ORIENTAL 24X100G	1200	0.00							
14931	MEXICAN 24X100G	1200	0.00							
ENVELOPE SPICES:										
14966	WHITE PEPPER 384X9G	840	1.30						1.30	
14974	CURRY 384X9G	1488	1.57		0.17	0.70	0.70			
14982	BORRIE 384X9G	1488	1.33		0.17	0.70	0.46			
14990	CAYENNE PEPPER 384X9	486	1.55				0.62		0.93	
15008	COMPOUND PEPPER 384X	972	0.79		0.17				0.62	
PEPPER:										
15040	BLACK PEPPER TIN 72X 50	100	1.40						1.40	
15059	WHITE PEPPER TIN 72X 50	200	1.40						1.40	
15067	WHITE PEPPER TIN 48X100	150	2.00						2.00	
15075	PEPPERCONE 72X 50G	724	1.40						1.40	
15083	PEPPERCONE 40X 50G	100	0.80						0.80	
HOUSEHOLD CHEMICALS:										
15091	EPSOM SALTS 36X500G	300	0.00							
15105	BICARB OF SODA 36X500	500	0.00							
15113	EPSOM SALTS 100X15G	600	0.00							
15121	BICARB OF SODA 100X15	1200	0.00							
15148	TARTARIC ACID 100X15G	450	0.00							
15156	CREAM OF TARTAR 100X15	450	0.00							
CATERPACK JELLY:										
17914	MJP G/GAGE 24X500G	0	0.00							
17922	MJP ORANGE 24X500G	0	0.00							
17930	MJP R/BERRY 24X500G	0	0.00							

MACLOAD

CODE	DESCRIPTION	MACHINE LOADS (PACKING FLOOR)																			
		CMHLR	HLR2	HLR1	HWKA	PMD1&2	PMD7	HAMAC	SWRF1	SWRF2	DSTPM2	DSTPM1	CKDEC	CKPAC	COCHA	TEECMP	SHL1&2	SPHAG	ESS	PMD3-6	CPHPC
MOIRS JELLY POWDER:																					
13900	CHERRY 48X80G	0	0	2160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13919	LEMON 48X80G	0	1296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13927	ORANGE 48X80G	0	0	1296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13935	RASPBERRY 48X80G	0	0	2592	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13943	GREENGAGE 48X80G	0	2160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13951	LIME 48X80G	0	1296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13978	PEACH 48X80G	0	1296	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13986	PINEAPPLE 48X80G	0	0	3024	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13994	STRAWBERRY 48X80G	0	0	3024	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOWER JELLY:																					
14001	ASSORTED JELLY 144X80G	0	0	0	0	3660	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3660
14028	ASSORTED JELLY 72 X80G	0	0	0	0	2520	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2520
MOIRS INSTANT PUDDING:																					
14078	CARAMEL 48X90G	0	0	0	891	1296	0	0	618	0	0	0	0	0	0	0	0	0	0	0	0
14087	BUTTERSCOTCH 48X90G	0	0	0	891	1296	0	0	618	0	0	0	0	0	0	0	0	0	0	0	0
14095	CHOCOLATE 48X90G	0	0	0	891	1296	0	0	618	0	0	0	0	0	0	0	0	0	0	0	0
14117	VANILLA 48X90G	0	0	0	346	848	0	0	308	0	0	0	0	0	0	0	0	0	0	0	0
14125	S/BERRY 48X90G	0	0	0	325	984	0	0	467	0	0	0	0	0	0	0	0	0	0	0	0
15482	TROPICAL FRUIT 48X90G	0	0	0	173	324	0	0	154	0	0	0	0	0	0	0	0	0	0	0	0
15490	FOREST BERRIES 48X90G	0	0	0	173	324	0	0	154	0	0	0	0	0	0	0	0	0	0	0	0
HOT SPGE. PUDDING:																					
14184	CARAMEL 24X284G	0	100	0	0	0	0	180	80	0	0	0	0	240	0	0	0	0	0	0	0
14182	LEMON 24X284G	0	50	0	0	0	0	80	30	0	0	0	0	120	0	0	0	0	0	0	0
14214	APRICOT 24X284G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14222	CHOCOLATE 24X284G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14230	MIX FRUIT 24X284G	0	50	0	0	0	0	100	30	0	0	0	0	120	0	0	0	0	0	0	0
15389	APPLE & CARAMEL 24X284G	0	50	0	0	0	0	100	30	0	0	0	0	120	0	0	0	0	0	0	0
15407	PEACH 24X284G	0	50	0	0	0	0	100	30	0	0	0	0	120	0	0	0	0	0	0	0
14248	CREME CARAMEL 24X125G	0	0	0	488	838	0	0	113	0	0	0	0	0	0	0	0	0	0	0	0
MOIRS LOW CAL JELLY:																					
14257	RASPBERRY 36X40G	0	485	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14265	ORANGE 36X40G	0	83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14273	GREENGAGE 36X40G	0	185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14281	LEMON 36X40G	0	83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOIRS L/C INS/PUDDING:																					
14303	CHOCOLATE 36X20G	0	185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14311	VANILLA 36X20G	0	185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15318	CARAMEL 36X20G	0	185	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CUSTARD POWDER:																					
15346	VANILLA 72X125G	0	0	0	0	0	0	0	1548	0	0	1440	0	0	0	0	0	0	0	0	0
15261	VANILLA 36X250G	0	0	0	0	0	0	0	489	0	0	1308	0	0	0	0	0	0	0	0	0
14354	VANILLA (JAR) 36X500G	0	0	0	0	0	0	0	516	0	0	1440	0	0	0	0	0	0	0	0	0
18880	VANILLA (PKT) 36X500G	0	0	0	0	0	0	0	0	0	0	1844	0	0	0	0	0	0	0	0	0
CAKE MIXES:																					
14418	CHOCOLATE 24X400G	0	0	0	0	0	0	432	134	0	0	0	0	576	0	0	0	0	0	0	0
14427	VANILLA 12X400G	0	0	0	0	0	0	294	178	0	0	0	0	384	0	0	0	0	0	0	0
15438	PUNCAKES 12X240G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15474	FUNFETTI 12X240G	0	348	0	0	0	0	867	0	0	0	0	0	870	0	0	0	0	0	0	0
15512	RAISIN MUFFIN 12X475G	0	0	0	0	0	0	738	0	0	0	0	0	880	880	0	0	0	0	0	0
15920	APPLE MUFFINS 12X450G	0	0	0	0	0	0	442	0	0	0	0	0	576	576	0	0	0	0	0	0
15415	VANILLA/CARAMEL 12X800G	0	0	0	0	1082	718	0	0	0	0	0	0	808	0	0	0	0	0	0	0
15423	CHOCOLATE/FUDGE 12X800G	0	0	0	0	1729	1138	0	0	0	0	0	0	1482	0	0	0	0	0	0	0
ESSENCES:																					
14494	VANILLA 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14508	S/BERRY 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14518	LEMON 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14524	CARAMEL 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14532	ALMOND 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14540	ORANGE 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14559	RUM 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15431	PEPPERMINT 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20532	R/BERRY 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21032	ROSE 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14567	VANILLA 24X100ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14383	VANILLA 12X500ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20823	ORANGE 12X500ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20831	R/BERRY 12X500ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20858	P/APPLE 12X500ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20886	ALMOND 12X500ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21040	ROSE 12X500ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21172	R/BERRY 12X500ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLOURANTS:																					
14361	APPLE GREEN 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14805	SKY BLUE 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14613	CRIMSON RED 20X30ML	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14821	EGG YELLOW 20X30ML	0	0																		

MACLOAD

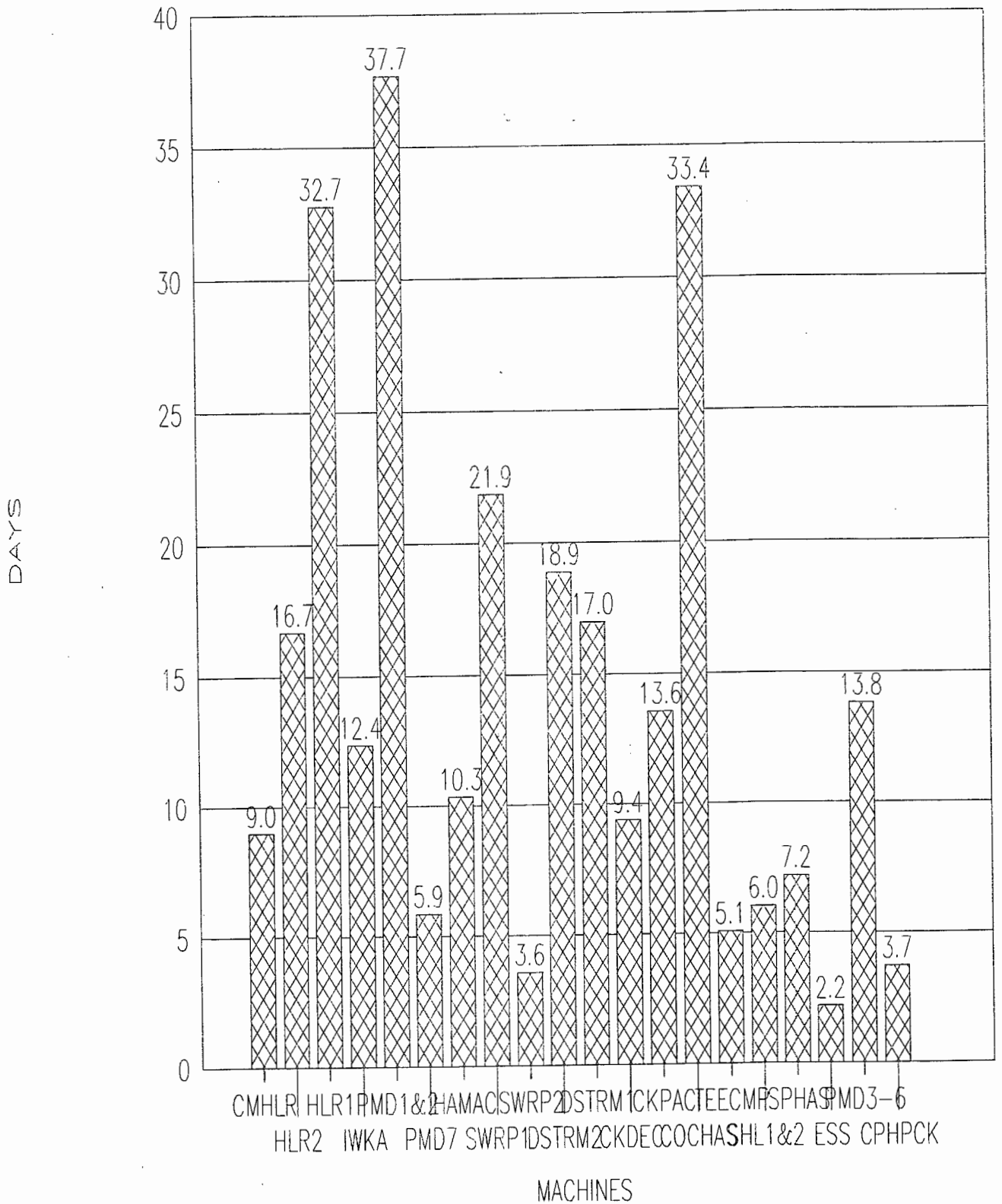
CODE	DESCRIPTION	MACHINE LOADS (PACKING FLOOR)																			
		CMHLR	HLR2	HLR1	HWKA	PMD1&2	PMD7	HAMAC	SWRP1	SWRP2	DSTRM2	DSTRM1	CKDEC	CKPAC	COCHA	TEECMP	SHL1&2	SPHAS	ESS	PMD3-6	CPHPC
14710	COCONUT (FINE) 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	1800	0	0	0	0	0	0
14729	TOWER COCONUT 40X200G	0	0	0	0	0	0	0	0	0	0	0	0	0	800	0	0	0	0	0	0
15083	COCONUT (MEDIUM) 48X200G	0	0	0	0	0	0	0	0	0	0	0	0	0	1950	0	0	0	0	0	0
15071	COCONUT (MEDIUM) 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	1500	0	0	0	0	0	0
CAKE DECORATIONS:																					
14745	100'S & 1000'S 24X100G	0	0	0	0	0	0	0	714	0	0	0	2660	0	0	0	0	0	0	0	0
14753	CHOC. VERMICELLI 24X 75G	0	0	0	0	0	0	0	210	0	0	0	650	0	0	0	0	0	0	0	0
15342	CHOC CHIPS 24X 70G	0	0	0	0	0	0	0	84	0	0	0	340	0	0	0	0	0	0	0	0
15350	SILVER BALLS 24X 50G	0	0	0	0	0	0	0	105	0	0	0	425	0	0	0	0	0	0	0	0
MOIRS MEAT MAGIC:																					
14907	BARBEQUE 24X100G	0	0	0	864	1800	0	0	240	0	0	0	0	0	0	0	0	0	0	0	0
14915	SOSATIE 24X100G	0	0	0	432	900	0	0	120	0	0	0	0	0	0	0	0	0	0	0	0
14923	ORIENTAL 24X100G	0	0	0	432	900	0	0	120	0	0	0	0	0	0	0	0	0	0	0	0
14931	MEXICAN 24X100G	0	0	0	432	900	0	0	120	0	0	0	0	0	0	0	0	0	0	0	0
ENVELOPE SPICES:																					
14988	WHITE PEPPER 384X9G	0	0	0	0	0	0	0	0	235	0	0	0	0	0	0	1344	0	0	0	0
14974	CURRY 384X9G	0	0	0	0	0	0	0	0	417	0	0	0	0	0	0	0	1488	0	0	0
14982	BORRE 384X9G	0	0	0	0	0	0	0	0	417	0	0	0	0	0	0	0	1488	0	0	0
14990	CAYENNE PEPPER 384X9G	0	0	0	0	0	0	0	0	138	0	0	0	0	0	0	0	486	0	0	0
15008	COMPOUND PEPPER 384X9G	0	0	0	0	0	0	0	0	272	0	0	0	0	0	0	1555	0	0	0	0
PEPPER:																					
15040	BLACK PEPPER TIN 72X 50G	0	0	0	0	0	0	0	0	43	0	0	0	0	0	182	0	0	0	0	0
15039	WHITE PEPPER TIN 72X 50G	0	0	0	0	0	0	0	0	86	0	0	0	0	0	364	0	0	0	0	0
15067	WHITE PEPPER TIN 48X100G	0	0	0	0	0	0	0	0	65	0	0	0	0	0	268	0	0	0	0	0
15075	PEPPER CONE 72X 50G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1380	0	0	0	0	0
15083	PEPPER CONE 40X 50G	0	0	0	0	0	0	0	0	50	0	0	0	0	0	192	0	0	0	0	0
HOUSEHOLD CHEMICALS:																					
15091	EPSOM SALTS 38X500G	0	0	0	0	0	0	0	80	0	480	0	0	0	0	0	0	0	0	0	0
15105	BICARB OF SODA 38X500G	0	0	0	0	0	0	0	100	0	800	0	0	0	0	0	0	0	0	0	0
15113	EPSOM SALTS 100X15G	980	0	0	0	0	0	0	120	0	0	0	0	0	0	0	0	0	0	0	0
15121	BICARB OF SODA 100X15G	1920	0	0	0	0	0	0	240	0	0	0	0	0	0	0	0	0	0	0	0
15148	TARTARIC ACID 100X15G	720	0	0	0	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0
15156	CREAM OF TARTAR 100X15G	720	0	0	0	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0
CATERPACK JELLY:																					
17914	MJP G/GAGE 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17922	MJP ORANGE 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17930	MJP R/BERRY 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17949	MJP LEMON 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CATERPACK PUDDING:																					
17989	IP CARAMEL 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17973	IP CHOCOLATE 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17981	IP S/BERRY 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18007	IP VANILLA 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CATERPACK SPICES:																					
18015	CURRY MED. 4X3KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	922
18074	CURRY MED. 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18082	CURRY HOT 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18080	PURE TURM. 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18104	BORRE COMP. 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18112	CAYENNE PEPPER 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18120	GR. BLK PEPPER 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18139	GR. WH. PEPPER 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18198	GR. CORNDR 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18201	GR. GINGER 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18228	MIX MASALA 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18317	GROUND CUMIN 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18325	WHOLE FENNEL 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18333	GROUND FENNEL 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CATERPACK CUSTARD:																					
18378	CUSTARD 4X2KG	0	0	0	0	0	0	0	0	0	0	2333	0	0	0	0	0	0	0	0	0
18384	CUSTARD 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CATERPACK BAKING POWDER:																					
18546	BAKING POWDER 8X2KG	0	0	0	0	0	0	0	0	0	1079	0	0	0	0	0	0	0	0	0	0
18554	BAKING POWDER 20KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CATERPACK ESSENCE:																					
18656	VANILLA 12X1L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRODUCTS MADE ON ORDER:																					
17957	MJP GULL S/BERRY 24X500G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18023	MOIRS CURRY HOT 4X3KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18031	MOIRS CAYENNE PEP 4X3KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18086	MOIRS GRND WHT PEP 8X1KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	864
18147	MOIRS WHT PEP COMP 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18155	MOIRS BLK PEP COMP 25KG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18511	EGG CARAMEL 5LT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

MACLOAD

CODE	DESCRIPTION	MACHINE LOADS (MIXING FLOOR)										
		PAS1&	NAU3&	SNAUT	CUMIX	NAU1&	SPMIX	MILL2	MILL3	MILL1	HNDPK	SPARE
17949	MJP LEMON 24X500G	0	0	0	0	0	0	0	0	0	0	0
	CATERPACK PUDDING:											
17965	IP CARAMEL 24X500G	0	0	0	0	0	0	0	0	0	0	0
17973	IP CHOCOLATE 24X500G	0	0	0	0	0	0	0	0	0	0	0
17981	IP S/BERRY 24X500G	0	0	0	0	0	0	0	0	0	0	0
18007	IP VANILLA 24X500G	0	0	0	0	0	0	0	0	0	0	0
	CATERPACK SPICES:											
18015	CURRY MED. 4X3KG	0	0	0	0	0	288	2304	2304	0	0	0
18074	CURRY MED. 25KG	0	0	0	0	0	120	960	1680	0	0	0
18082	CURRY HOT 25KG											
18090	PURE TURM. 25KG	0	0	0	0	0	0	520	0	0	0	0
18104	BORRIE COMP. 25KG	0	0	0	0	0	60	480	840	0	0	0
18112	CAYENNE PEPPER 25K	0	0	0	0	0	0	0	0	0	0	0
18120	GR. BLK PEPPER 25KG											
18139	GR. WH. PEPPER 25KG	0	0	0	0	0	0	0	0	280	0	0
18198	GR. CORNDR 25KG	0	0	0	0	0	0	0	0	280	0	0
18201	GR. GINGER 25KG	0	0	0	0	0	0	0	0	280	0	0
18228	MIX MASALA 25KG	0	0	0	0	0	225	270	585	0	0	0
18317	GROUND CUMIN 25KG	0	0	0	0	0	0	0	1560	1080	0	0
18325	WHOLE FENNEL 25KG	0	0	0	0	0	0	0	0	0	0	0
18333	GROUND FENNEL 25KG	0	0	0	0	0	0	0	0	0	0	0
	CATERPACK CUSTARD:											
18376	CUSTARD 4X2KG	0	0	0	1081	0	0	0	0	0	0	0
18384	CUSTARD 25KG	0	0	0	454	0	0	0	0	0	0	0
	CATERPACK BAKING POW											
18546	BAKING POWDER 6X2K	0	224	0	0	0	0	0	0	0	0	0
18554	BAKING POWDER 20KG	0	5506	0	0	0	0	0	0	0	0	0
	CATERPACK ESSENCE:											
18856	VANILLA 12X1L	0	0	0	0	0	0	0	0	0	0	0
	PRODUCTS MADE ON ORD											
17957	MJP GULL S/BERRY 24X500	0	0	0	0	0	0	0	0	0	0	0
18023	MOIRS CURRY HOT 4X3K	0	0	0	0	0	0	0	0	0	0	0
18031	MOIRS CAYENNE PEP 4X3	0	0	0	0	0	0	0	0	0	0	0
18066	MOIRS GRND WHT PEP 6X1	0	0	0	0	0	0	0	0	0	0	0
18147	MOIRS WHT PEP COMP 25	0	0	0	0	0	0	0	0	0	0	0
18155	MOIRS BLK PEP COMP 25K	0	0	0	0	0	0	0	0	0	0	0
18511	ESS CARAMEL 5LT	0	0	0	0	0	0	0	0	0	0	0
		14.2	53.6	45.2	27.4	16.1	2.8	13.8	18.7	12.3	0.0	0.0

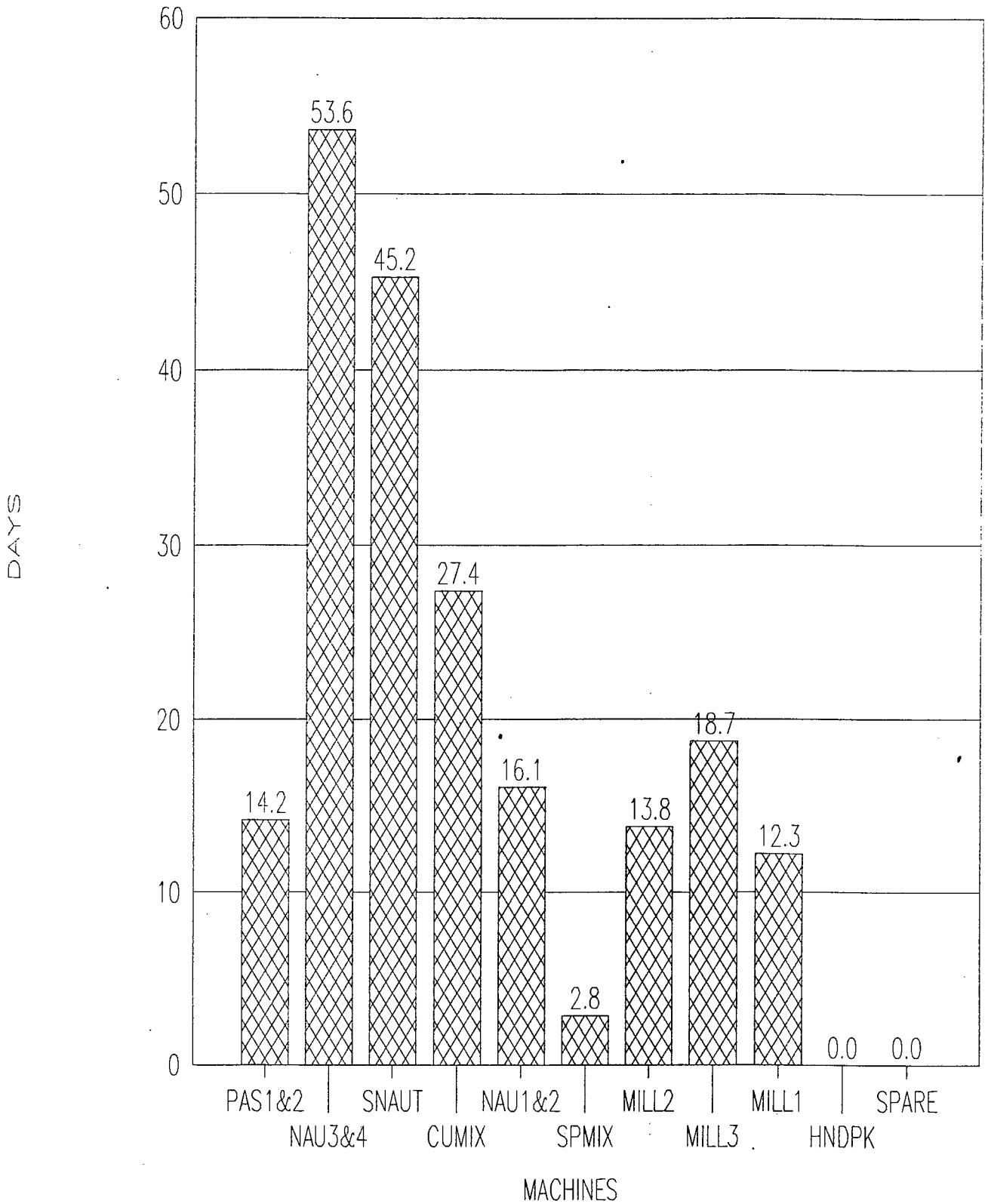
PACKING FLOOR MACHINE LOADS

6WK TOT



MIXING FLOOR MACHINE LOADS

6WK TOT



Detailed Information About Planning Module

The first spreadsheet called *Planner* contains the demand forecast and inventory information of all products. Marketing Department generates period based (1 Period = 4 Weeks) demand forecasts. *Planner* changes period based forecasts into 10 Weeks Demand forecasts and puts them into *10Wks Frcst* column. On the other hand, actual stock figures of finished goods are obtained from warehouses and are put in the spreadsheet. Total stock is calculated at *Total Stock* column. The total production required (*Total Prd Req*) is obtained by subtracting *Total Stock* from *10Wks Frcst*. Current sales (*Act Sl*) and *Days Cover* figures are given as additional information. *Days Cover* shows how many days the actual stock will last with the forecasted demand pattern and without any further production. It is calculated by dividing the *Total Stock* by *Average Daily Demand Forecast* (*Average Daily Demand Forecast* = $10Wks\ Frcst / 50$, $50 = 10\ Weeks \times 5\ Days$). A sample printout of *Planner* is given at page 1 of this appendix.

The second spreadsheet is called *6Wkspln* (6 Weeks Plan). In this spreadsheet there is a macro copying *Tot Prd Req* figures from *Planner*. These amounts are then distributed to six weeks by the planning team. That is how a preliminary schedule is obtained. There is also a column showing the total amount scheduled for six weeks (*6Wks Totals*) and one showing the difference between the theoretical and actual quantities (*Actual - Thrtcl*). This preliminary schedule is modified later according to the feedback coming from the last spreadsheet. A sample printout of *6Wkspln* is given at page 5 of this appendix.

The last spreadsheet is called *Macload* (Machine Loads). In this one, there is a set of macros that can import weekly or cumulative scheduled figures from *6Wkspln*. The two *Machine Allocation Coefficients* tables (one for Mixing and the other for Packing Floor) make the most important part of this spreadsheet. Through these tables it is possible to calculate the load that every scheduled product puts on each machine or machine group. Coefficients represent the time necessary to process one pack of product (packing details are given in *Description* column) at a specific machine. Their unit is *Minute/Case*. Cumulative loads on machines are calculated at the bottom of *Machine Loads* tables. These figures are used to plot the bar charts of machine loads. In practice, the only thing that the user has to do is to run a macro to transfer the desired scheduled quantities (weekly or six weekly) into *Macload*. The remaining calculations and *Machine Load Charts* are done automatically. These charts show whether it is possible to produce the scheduled amounts. After having seen these charts, the planning team may decide to modify the production plan or to use overtime or to do both. Sample

printouts of *Macload* and *Machine Load Charts* are given at pages 9 and 19 of this appendix.

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SPREADSHEET 2

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MACHINES	PRODUCTS / FLAVOURS (TYPES)	STANDARDS (MIN/CASE)	PLANNED PRODCTN (CSE/WK/CS)	UNIT WGT (GR)	UNITS/CASE	PLANNED PRODCTN (TNS/DAY)	RAW CAPACITIES (TNS/DAY)	PLANNED PDCN/PDCT (TNS/DAY)	PLANNED PDCN/MACH (TNS/DAY)	CRCTED CAPAC (TNS/DAY)	CRCTED CAPAC/PRD (TNS/DAY)	CRCTED CAPAC/MACH (TNS/DAY)	CAPACITY PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
CMHLR	HOUSEHOLD CHEMICALS							0.135	0.135		0.450	0.450	0.315	NO
	15113 EPSOM SALTS 100X15G	1.80	800	15	100	0.030	0.450			0.100				
	15121 BICARB OF SODA 100X15G	1.80	1200	15	100	0.060	0.450			0.200				
	15148 TARTARIC ACID 100X15G	1.80	450	15	100	0.023	0.450			0.075				
	15156 CREAM OF TARTAR 100X15G	1.80	450	15	100	0.023	0.450			0.075				
HLR2	MOIR'S JELLY POWDER							0.484	0.828		0.673	2.786	2.786	NO
	13819 LEMON 48X80G	1.80	810	80	48	0.104	1.132			0.144				
	13843 GREENGAGE 48X80G	1.60	1350	80	48	0.173	1.132			0.240				
	13851 LIME 48X80G	1.80	810	80	48	0.104	1.132			0.144				
	13878 PEACH 48X80G	1.60	810	80	48	0.104	1.132			0.144				
	MOIR'S LOW CAL JELLY							0.053			0.059			
	14257 RASPBERRY 36X40G	0.75	660	40	36	0.032	0.822			0.035				
	14265 ORANGE 36X40G	0.75	110	40	36	0.005	0.822			0.008				
	14273 GREENGAGE 36X40G	0.75	220	40	36	0.011	0.822			0.012				
	14281 LEMON 36X40G	0.75	110	40	36	0.005	0.822			0.008				
	HOT SPONGE PUDDING							0.136			1.077			
	14184 CARAMEL 24X284G	0.50	200	284	24	0.045	6.543			0.358				
	14182 LEMON 24X284G	0.50	100	284	24	0.023	6.543			0.180				
	14214 APRICOT 24X284G	0.50	0	284	24	0.000	6.543			0.000				
	14222 CHOCOLATE 24X284G	0.50	0	284	24	0.000	6.543			0.000				
	14230 MIX FRUIT 24X284G	0.50	100	284	24	0.023	6.543			0.180				
	15369 APPLE & CARAMEL 24X284G	0.50	100	284	24	0.023	6.543			0.180				
	15407 PEACH 24X284G	0.50	100	284	24	0.023	6.543			0.180				
	MOIR'S LOW CAL INSTANT PUDDING							0.018			0.008			
	14303 CHOCOLATE 36X20G	0.75	220	20	36	0.005	0.461			0.003				
	14311 VANILLA 36X20G	0.75	220	20	36	0.005	0.461			0.003				
	15318 CARAMEL 36X20G	0.75	220	20	36	0.005	0.461			0.003				
	CAKE MIXES							0.136			0.968			
	15456 FUNCAGES 12X240G	0.24	0	240	12	0.000	3.780			0.000				
	15474 FUNFETTI 12X240G	0.24	1450	240	12	0.136	3.780			0.968				
HLR1	MOIR'S JELLY POWDER							0.888	1.258		0.666	1.152	-0.106	YES
	13800 CHERRY 48X80G	1.80	1350	80	48	0.173	1.132			0.156				
	13827 ORANGE 48X80G	1.80	810	80	48	0.104	1.132			0.095				
	13838 RASPBERRY 48X80G	1.80	1620	80	48	0.207	1.132			0.190				
	13868 PINEAPPLE 48X80G	1.80	1680	80	48	0.242	1.132			0.222				
	13894 STRAWBERRY 48X80G	1.80	1680	80	48	0.242	1.132			0.222				
	MOIR'S BAKING POWDER							0.280			0.286			
	14656 BAKING POWDER 100X50G	2.08	1742	50	100	0.280	1.154			0.286				
HWKA	MOIR'S INSTANT PUDDING							0.740	1.285		1.852	3.166	1.871	NO
	14079 CARAMEL 48X80G	0.84	1080	80	48	0.156	3.240			0.388				
	14087 BUTTERSCHOTCH 48X80G	0.84	1080	80	48	0.156	3.240			0.388				
	14085 CHOCOLATE 48X80G	0.84	1080	80	48	0.156	3.240			0.388				
	14117 VANILLA 48X80G	0.84	540	80	48	0.078	3.240			0.195				
	14125 S/BERRY 48X80G	0.84	820	80	48	0.118	3.240			0.255				
	15482 TROPICAL FRUIT 48X80G	0.84	270	80	48	0.039	3.240			0.087				
	15480 FOREST BERRIES 48X80G	0.84	270	80	48	0.039	3.240			0.087				
	CREME CARAMEL							0.075			0.128			
	14249 CREME CARAMEL 24X125G	0.85	750	125	24	0.075	2.215			0.128				
	MOIR'S MEAT MAGIC							0.480			1.188			
	14807 BARBEQUE 24X100G	0.38	2400	100	24	0.182	3.200			0.474				
	14815 SOSATIE 24X100G	0.38	1200	100	24	0.098	3.200			0.237				
	14823 ORIENTAL 24X100G	0.38	1200	100	24	0.098	3.200			0.237				
	14831 MEXICAN 24X100G	0.38	1200	100	24	0.098	3.200			0.237				
PMD1&2	TOWER JELLY							3.817	5.212		6.577	6.880	1.768	NO
	14001 ASSORTED JELLY 144X80G	0.80	6800	80	144	2.534	9.216			4.461				
	14028 ASSORTED JELLY 72 X80G	0.35	7200	80	72	1.382	7.689			2.085				
	MOIR'S INSTANT PUDDING							0.740			0.245			
	14079 CARAMEL 48X80G	1.20	1080	80	48	0.156	1.728			0.032				
	14087 BUTTERSCHOTCH 48X80G	1.20	1080	80	48	0.156	1.728			0.032				
	14085 CHOCOLATE 48X80G	1.20	1080	80	48	0.156	1.728			0.032				
	14117 VANILLA 48X80G	1.20	540	80	48	0.078	1.728			0.026				
	14125 S/BERRY 48X80G	1.20	820	80	48	0.118	1.728			0.038				
	15482 TROPICAL FRUIT 48X80G	1.20	270	80	48	0.039	1.728			0.013				
	15480 FOREST BERRIES 48X80G	1.20	270	80	48	0.039	1.728			0.013				
	CREME CARAMEL							0.075			0.017			
	14249 CREME CARAMEL 24X125G	1.25	750	125	24	0.075	1.132			0.017				
	MOIR'S MEAT MAGIC							0.480			0.141			
	14807 BARBEQUE 24X100G	0.75	2400	100	24	0.182	1.536			0.057				
	14815 SOSATIE 24X100G	0.75	1200	100	24	0.098	1.536			0.028				
	14823 ORIENTAL 24X100G	0.75	1200	100	24	0.098	1.536			0.028				
	14831 MEXICAN 24X100G	0.75	1200	100	24	0.098	1.536			0.028				
PMD7	CAKE MIXES							1.280	1.280		6.583	6.583	5.283	NO
	15415 VANILLA/CARAMEL 12X800G	0.70	1580	800	12	0.488	6.583			2.548				
	15423 CHOCOLATE/FUDGE 12X800G	0.70	2470	800	12	0.790	6.583			4.035				
HAMAC	HOT SPONGE PUDDING							0.136	2.288		0.218	7.788	5.500	NO
	14184 CARAMEL 24X284G	0.80	200	284	24	0.045	4.080			0.081				
	14182 LEMON 24X284G	0.80	100	284	24	0.023	4.080			0.040				
	14214 APRICOT 24X284G	1.00	0	284	24	0.000	3.272			0.000				
	14222 CHOCOLATE 24X284G	0.80	0	284	24	0.000	4.080			0.000				
	14230 MIX FRUIT 24X284G	1.00	100	284	24	0.023	3.272			0.032				
	15369 APPLE & CARAMEL 24X284G	1.00	100	284	24	0.023	3.272			0.032				
	15407 PEACH 24X284G	1.00	100	284	24	0.023	3.272			0.032				
	CAKE MIXES							2.182			7.580			
	14418 CHOCOLATE 24X400G	0.90	480	400	24	0.154	5.120			0.342				
	14427 VANILLA 12X400G	0.48	840	400	12	0.102	5.008			0.223				
	15438 FUNCAGES 12X240G	0.48	0	240	12	0.000	3.005			0.000				
	15474 FUNFETTI 12X240G	0.48	1450	240	12	0.136	3.005			0.182				

SPREADSHEET 2

[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
MACHINES	PRODUCTS / FLAVOURS (TYPES)	STANDARDS (MIN/CASE)	PLANNED PRODCTN (CSE/#WKS)	UNIT WGT (GR)	UNITS/CASE	PLANNED PRODCTN (TNS/DAY)	RAW CAPACITIES (TNS/DAY)	PLANNED PDCN/PDCT (TNS/DAY)	PLANNED PDCN/MACH (TNS/DAY)	CRCTED CAFAC (TNS/DAY)	CRCTED CAPAC/PRD (TNS/DAY)	CRCTED CAPAC/MACH (TNS/DAY)	PLND PDCN (TNS/DAY)	CAPACITY- PROBLEM
	13512 RAISIN MUFFIN 12X475G	0.48	1600	475	12	0.304	5.948			0.787				
	15520 APPLE MUFFINS 12X450G	0.46	960	450	12	0.173	5.635			0.424				
	15415 VANILLA/CARAMEL 12X800G	0.46	1560	800	12	0.489	10.017			2.178				
	15423 CHOCOLATE/FUDGE 12X800G	0.46	2470	800	12	0.790	10.017			3.446				
	CATERPACK JELLY							0.000			0.000			
	17914 MJP G/GAGE 24X500G	1.50	0	500	24	0.000	3.840			0.000				
	17922 MJP ORANGE 24X500G	1.50	0	500	24	0.000	3.840			0.000				
	17930 MJP R/BERRY 24X500G	1.50	0	500	24	0.000	3.840			0.000				
	17946 MJP LEMON 24X500G	1.50	0	500	24	0.000	3.840			0.000				
	CATERPACK PUDDING							0.000			0.000			
	17965 IP CARAMEL 24X500G	1.50	0	500	24	0.000	3.840			0.000				
	17973 IP CHOCOLATE 24X500G	1.50	0	500	24	0.000	3.840			0.000				
	17981 IP S/BERRY 24X500G	1.50	0	500	24	0.000	3.840			0.000				
	18007 IP VANILLA 24X500G	1.50	0	500	24	0.000	3.840			0.000				
SWRP1	MOIR'S INSTANT PUDDING							0.740	8.840		0.408	12.368	5.726	NO
	14079 CARAMEL 48X90G	0.57	1080	90	48	0.156	3.636			0.085				
	14087 BUTTERSCHOTCH 48X90G	0.57	1080	90	48	0.156	3.636			0.085				
	14085 CHOCOLATE 48X90G	0.57	1080	90	48	0.156	3.636			0.085				
	14117 VANILLA 48X90G	0.57	540	90	48	0.078	3.636			0.043				
	14125 S/BERRY 48X90G	0.57	870	90	48	0.118	3.636			0.085				
	15482 TROPICAL FRUIT 48X90G	0.57	920	90	48	0.039	3.636			0.021				
	15480 FOREST BERRIES 48X90G	0.57	270	90	48	0.039	3.636			0.021				
	HOT SPONGE PUDDING							0.136			0.224			
	14184 CARAMEL 24X284G	0.30	200	284	24	0.045	10.908			0.075				
	14192 LEMON 24X284G	0.30	100	284	24	0.023	10.908			0.037				
	14214 APRICOT 24X284G	0.30	0	284	24	0.000	10.908			0.000				
	14222 CHOCOLATE 24X284G	0.30	0	284	24	0.000	10.908			0.000				
	14230 MIX FRUIT 24X284G	0.30	100	284	24	0.023	10.908			0.037				
	15369 APPLE & CARAMEL 24X284G	0.30	100	284	24	0.023	10.908			0.037				
	15407 PEACH 24X284G	0.30	100	284	24	0.023	10.908			0.037				
	CREME CARAMEL							0.075			0.108			
	14248 CREME CARAMEL 24X125G	0.15	750	125	24	0.075	9.600			0.108				
	CUSTARD POWDER							2.127			4.308			
	14346 VANILLA 72X125G	0.43	3600	125	72	1.080	10.047			1.634				
	15261 VANILLA 36X250G	0.43	1080	250	36	0.327	10.047			0.485				
	14354 VANILLA (JAR) 36X500G	0.43	1200	500	36	0.720	20.093			2.179				
	CAKE MIXES							0.256			0.508			
	14419 CHOCOLATE 24X400G	0.28	480	400	24	0.154	16.457			0.361				
	14427 VANILLA 12X400G	0.28	840	400	12	0.102	8.228			0.127				
	MOIR'S BAKING POWDER							1.836			4.136			
	14656 BAKING POWDER 100X50G	0.14	1742	50	100	0.290	17.143			0.750				
	14664 BAKING POWDER 48X100G	0.21	1880	100	48	0.269	10.971			0.444				
	14672 BAKING POWDER 24X200G	0.21	5980	200	24	0.941	10.971			1.555				
	14680 BAKING POWDER 24X500G	0.21	940	500	24	0.336	27.429			1.398				
	CAKE DECORATIONS							0.374			0.283			
	14745 100'S & 1000'S 24X100G	0.21	3400	100	24	0.272	5.488			0.225				
	14753 CHOC. VERMICELLI 24X 75G	0.21	1000	75	24	0.080	4.114			0.037				
	15342 CHOC CHIPS 24X 70G	0.21	400	70	24	0.022	3.840			0.013				
	15350 SILVER BALLS 24X 50G	0.21	500	50	24	0.020	2.743			0.008				
	MOIR'S MEAT MAGIC							0.480			0.833			
	14807 BARBEQUE 24X100G	0.10	2400	100	24	0.182	11.520			0.333				
	14915 SOSATIE 24X100G	0.10	1200	100	24	0.096	11.520			0.167				
	14923 ORIENTAL 24X100G	0.10	1200	100	24	0.096	11.520			0.167				
	14931 MEXICAN 24X100G	0.10	1200	100	24	0.096	11.520			0.167				
	HOUSEHOLD CHEMICALS							0.815			1.560			
	15081 EPSOM SALTS 36X500G	0.42	300	500	36	0.180	20.571			0.556				
	15105 BICARB OF SODA 36X500G	0.42	500	500	36	0.300	20.571			0.829				
	15113 EPSOM SALTS 100X15G	0.20	600	15	100	0.030	3.600			0.016				
	15121 BICARB OF SODA 100X15G	0.20	1200	15	100	0.060	3.600			0.033				
	15148 TARTARIC ACID 100X15G	0.20	450	15	100	0.023	3.600			0.012				
	15156 CREAM OF TARTAR 100X15G	0.20	450	15	100	0.023	3.600			0.012				
SWRP2	ENVELOPE SPICES							0.606	0.678		5.328	5.780	5.084	NO
	14986 WHITE PEPPER 36X9G	0.28	840	9	364	0.087	5.925			0.849				
	14974 CURRY 36X9G	0.28	1488	9	364	0.171	5.925			1.503				
	14982 BORRNE 36X9G	0.28	1488	9	364	0.171	5.925			1.503				
	14990 CAYENNE PEPPER 36X9G	0.28	488	9	364	0.056	5.925			0.461				
	15008 COMPOUND PEPPER 36X9G	0.28	872	9	364	0.112	5.925			0.882				
	PEPPER							0.068			0.432			
	15040 BLACK PEPPER TIN 72X 50G	0.43	100	50	72	0.012	4.019			0.071				
	15059 WHITE PEPPER TIN 72X 50G	0.43	200	50	72	0.024	4.019			0.143				
	15067 WHITE PEPPER TIN 48X100G	0.43	150	100	48	0.024	5.338			0.190				
	15083 PEPPER CONE 40X 50G	0.50	100	50	49	0.008	2.304			0.027				
DSTRM2	MOIR'S BAKING POWDER							1.546	2.250		2.707	4.158	1.808	NO
	14664 BAKING POWDER 48X100G	1.00	1680	100	48	0.288	2.304			0.275				
	14672 BAKING POWDER 24X200G	0.75	5680	200	24	0.941	3.072			1.285				
	14680 BAKING POWDER 24X500G	0.75	840	500	24	0.336	7.680			1.147				
	CATERPACK BAKING POWDER							0.224			0.288			
	18546 BAKING POWDER 8X2KG	1.82	580	2000	8	0.224	3.000			0.288				
	HOUSEHOLD CHEMICALS							0.480			1.152			
	15081 EPSOM SALTS 36X500G	1.80	300	500	36	0.180	5.400			0.432				
	15105 BICARB OF SODA 36X500G	1.80	500	500	36	0.300	5.400			0.720				
DSTRM1	CUSTARD POWDER							2.949	3.273		7.315	7.513	4.240	NO
	14346 VANILLA 72X125G	0.40	3600	125	72	1.080	10.800			3.564				
	15261 VANILLA 36X250G	1.20	1080	250	36	0.327	3.900			0.380				
	14354 VANILLA (JAR) 36X500G	1.20	1200	500	36	0.720	7.200			1.564				
	16880 VANILLA (PKT) 36X500G	1.20	1370	500	36	0.822	7.200			1.808				
	CATERPACK CUSTARD							0.324			0.198			
	18378 CUSTARD 4X2KG	1.82	1215	2000	4	0.324	2.000			0.198				
CKDEC	CAKE DECORATIONS							0.374	0.374		1.240	1.240	0.888	NO

APPENDIX D

SPREADSHEET 2

[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
MACHINES	PRODUCTS / FLAVOURS (TYPES)	STANDARDS (MIN/CASE)	PLANNED PRODCTN (CSE/GWKS)	UNIT WGT (GR)	UNITS/CASE	PLANNED PRODCTN (TNS/DAY)	RAW CAPACITIES (TNS/DAY)	PLANNED PDCN/PDCT (TNS/DAY)	PLANNED PDCN/MACH (TNS/DAY)	CRCTED CAPAC (TNS/DAY)	CRCTED CAPAC/PRD (TNS/DAY)	CRCTED CAPAC/MACH (TNS/DAY)	CAPACITY- PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
	14745 100'S & 1000'S 24X100G	0.85	3400	100	24	0.272	1.355			0.885				
	14753 CHOC. VERMICELLI 24X 75G	0.85	1000	75	24	0.080	1.018			0.183				
	15342 CHOC CHIP 24X 70G	0.85	400	70	24	0.022	0.948			0.057				
	15350 SILVER BALLS 24X 50G	0.85	500	50	24	0.020	0.878			0.038				
CKPAC	HOT SPONGE PUDDING							0.138	2.298		0.182	5.967	3.888	NO
	14184 CARAMEL 24X284G	1.20	200	284	24	0.045	2.728			0.054				
	14182 LEMON 24X284G	1.20	100	284	24	0.023	2.728			0.027				
	14214 APRICOT 24X284G	1.20	0	284	24	0.000	2.728			0.000				
	14222 CHOCOLATE 24X284G	1.20	0	284	24	0.000	2.728			0.000				
	14230 MIX FRUIT 24X284G	1.20	100	284	24	0.023	2.728			0.027				
	15389 APPLE & CARAMEL 24X284G	1.20	100	284	24	0.023	2.728			0.027				
	15407 PEACH 24X284G	1.20	100	284	24	0.023	2.728			0.027				
	CAKE MIXES							2.162			5.808			
	14419 CHOCOLATE 24X400G	1.20	480	400	24	0.154	3.840			0.257				
	14427 VANILLA 12X400G	0.80	640	400	12	0.102	3.840			0.171				
	15436 FUNCAKES 12X240G	0.80	0	240	12	0.000	2.304			0.000				
	15474 FUNFETTI 12X240G	0.80	1450	240	12	0.138	2.304			0.140				
	15512 RAISIN MUFFIN 12X475G	0.80	1800	475	12	0.304	4.800			0.803				
	15520 APPLE MUFFINS 12X450G	0.80	980	450	12	0.173	4.320			0.325				
	15415 VANILLA/CARAMEL 12X800G	0.60	1560	800	12	0.489	7.680			1.888				
	15423 CHOCOLATE/FUDGE 12X800G	0.80	2470	800	12	0.790	7.680			2.842				
COCHAS	CAKE MIXES							0.477	3.828		0.553	4.848	0.790	NO
	15512 RAISIN MUFFIN 12X475G	0.80	1800	475	12	0.304	4.800			0.358				
	15520 APPLE MUFFINS 12X450G	0.80	980	450	12	0.173	4.320			0.183				
	MOIR'S COCONUT							3.381			4.098			
	14688 COCONUT (FINE) 24X100G	1.50	3700	100	24	0.298	0.788			0.059				
	14702 COCONUT (FINE) 48X200G	1.00	2900	200	48	0.828	4.808			1.108				
	14710 COCONUT (FINE) 24X300G	1.00	1800	500	24	0.720	5.780			1.075				
	14728 TOWER COCONUT 40X200G	1.00	800	200	40	0.213	3.840			0.212				
	15583 COCONUT (MEDIUM) 48X200G	1.00	1950	200	48	0.824	4.808			0.745				
	15571 COCONUT (MEDIUM) 24X300G	1.00	1500	300	24	0.800	5.780			0.888				
TEECMP	PEPPER							0.154	0.154		0.930	0.930	0.778	NO
	15040 BLACK PEPPER TIN 72X 50G	1.92	100	50	72	0.012	0.800			0.070				
	15058 WHITE PEPPER TIN 72X 50G	1.92	200	50	72	0.024	0.800			0.141				
	15067 WHITE PEPPER TIN 48X100G	1.92	150	100	48	0.024	1.200			0.188				
	15075 PEPPER CONE 72X 50G	1.92	724	50	72	0.087	0.800			0.508				
	15083 PEPPER CONE 40X 50G	1.92	100	50	40	0.007	0.500			0.022				
SHL182	ENVELOPE SPICES							0.208	0.208		1.037	1.037	0.828	NO
	14888 WHITE PEPPER 384X8G	1.80	840	9	384	0.087	1.037			0.481				
	15008 COMPOUND PEPPER 384X8G	1.80	972	9	384	0.112	1.037			0.556				
SPHAS	ENVELOPE SPICES							0.388	0.388		1.658	1.658	1.280	NO
	14874 CURRY 384X8G	1.00	1488	9	384	0.171	1.858			0.713				
	14882 BORRRE 384X8G	1.00	1488	9	384	0.171	1.858			0.713				
	14880 CAYENNE PEPPER 384X8G	1.00	488	9	384	0.058	1.858			0.233				
PMDS-6	TOWER JELLY							3.917	3.917		8.801	8.801	4.884	NO
	14001 ASSORTED JELLY 144X80G	0.80	8800	80	144	2.534	9.218			5.883				
	14028 ASSORTED JELLY 72 X80G	0.37	7200	80	72	1.382	7.472			2.837				
CPHPCK	CATERPACK SPICES							0.182	0.182		3.000	3.000	2.808	NO
	18013 CURRY MED. 4X3KG	1.92	480	3000	4	0.182	3.000			3.000				
PAS182	MOIR'S JELLY POWDER							1.482	1.482		3.072	3.072	1.820	NO
	13800 CHERRY 48X80G	0.80	1350	80	48	0.173	3.072			0.388				
	13819 LEMON 48X80G	0.80	810	80	48	0.104	3.072			0.219				
	13827 ORANGE 48X80G	0.80	810	80	48	0.104	3.072			0.219				
	13835 RASPBERRY 48X80G	0.80	1820	80	48	0.207	3.072			0.438				
	13943 GREENGAGE 48X80G	0.80	1350	80	48	0.173	3.072			0.388				
	13851 LIME 48X80G	0.80	810	80	48	0.104	3.072			0.219				
	13978 PEACH 48X80G	0.80	810	80	48	0.104	3.072			0.219				
	13888 PINEAPPLE 48X80G	0.80	1880	80	48	0.242	3.072			0.512				
	13884 STRAWBERRY 48X80G	0.80	1880	80	48	0.242	3.072			0.512				
NAU384	TOWER JELLY							3.917	9.810		1.610	8.532	-1.078	YES
	14001 ASSORTED JELLY 144X80G	1.40	8800	80	144	2.534	3.950			1.042				
	14028 ASSORTED JELLY 72 X80G	0.70	7200	80	72	1.382	3.950			0.588				
	MOIR'S LOW CAL JELLY							0.083			0.012			
	14257 RASPBERRY 38X40G	0.31	880	40	38	0.032	2.230			0.007				
	14285 ORANGE 38X40G	0.31	110	40	38	0.005	2.230			0.001				
	14273 GREENGAGE 38X40G	0.31	220	40	38	0.011	2.230			0.002				
	14281 LEMON 38X40G	0.31	110	40	38	0.005	2.230			0.001				
	MOIR'S INSTANT PUDDING							0.740			0.484			
	14079 CARAMEL 48X80G	0.33	1080	80	48	0.158	8.284			0.102				
	14087 BUTTERSOTCH 48X80G	0.33	1080	80	48	0.158	8.284			0.102				
	14085 CHOCOLATE 48X80G	0.33	1080	80	48	0.158	8.284			0.102				
	14117 VANILLA 48X80G	0.33	540	80	48	0.078	8.284			0.051				
	14125 S/BERRY 48X80G	0.33	820	80	48	0.118	8.284			0.077				
	15482 TROPICAL FRUIT 48X80G	0.33	270	80	48	0.038	8.284			0.025				
	15480 FOREST BERRIES 48X80G	0.33	270	80	48	0.038	8.284			0.025				
	MOIR'S LOW CAL INSTANT PUDDING							0.018			0.002			
	14303 CHOCOLATE 38X20G	0.31	220	20	38	0.005	1.115			0.001				
	14311 VANILLA 38X20G	0.31	220	20	38	0.005	1.115			0.001				
	15318 CARAMEL 38X20G	0.31	220	20	38	0.005	1.115			0.001				
	HOT SPONGE PUDDING							0.138			0.108			
	14184 CARAMEL 24X284G	0.43	200	284	24	0.045	7.808			0.038				
	14182 LEMON 24X284G	0.43	100	284	24	0.023	7.808			0.018				
	14214 APRICOT 24X284G	0.43	0	284	24	0.000	7.808			0.000				
	14222 CHOCOLATE 24X284G	0.43	0	284	24	0.000	7.808			0.000				
	14230 MIX FRUIT 24X284G	0.43	100	284	24	0.023	7.808			0.018				

SPREADSHEET 2

[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
MACHINES	PRODUCTS / FLAVOURS (TYPES)	STANDARDS (MIN/CASE)	PLANNED PRODCTN (CSE/#WKS)	UNIT WGT (GR)	UNITS/CASE	PLANNED PRODCTN (TNS/DAY)	RAW CAPACITIES (TNS/DAY)	PLANNED PDCN/PDCT (TNS/DAY)	PLANNED PDCN/MACH (TNS/DAY)	CRCTED CAPAC (TNS/DAY)	CRCTED CAPAC/PRD (TNS/DAY)	CRCTED CAPAC/MACH (TNS/DAY)	CAPACITY- PLIND PDCN (TNS/DAY)	CAPACITY PROBLEM
	15369 APPLE & CARAMEL 24X284G	0.43	100	284	24	0.023	7.808			0.018				
	15407 PEACH 24X284G	0.43	100	284	24	0.023	7.808			0.018				
	CREME CARAMEL							0.075			0.054			
	14248 CREME CARAMEL 24X125G	0.21	750	125	26	0.075	6.857			0.054				
	CAKE MIXES							1.429			2.778			
	15456 FUNCAKES 12X240G	0.23	0	240	12	0.000	3.010			0.000				
	15474 FUNFETTI 12X240G	0.23	1450	240	12	0.139	6.010			0.087				
	15415 VANILLA/CARAMEL 12X800G	0.23	1560	800	12	0.499	20.035			1.041				
	15423 CHOCOLATE/FUDGE 12X800G	0.23	2470	800	12	0.790	20.035			1.848				
	MOIR'S BAKING POWDER							1.836			2.769			
	14656 BAKING POWDER 100X50G	0.18	1742	50	100	0.290	15.000			0.453				
	14666 BAKING POWDER 48X100G	0.18	1680	100	48	0.269	14.400			0.400				
	14672 BAKING POWDER 24X200G	0.18	5930	200	24	0.941	14.400			1.410				
	14680 BAKING POWDER 24X500G	0.40	640	500	24	0.338	14.400			0.503				
	CATERPACK BAKING POWDER							1.408			0.717			
	18548 BAKING POWDER 6X2KG	0.40	560	2000	8	0.224	14.400			0.338				
	18504 BAKING POWDER 20KG	3.10	1778	20000	1	1.194	3.087			0.382				
SHAUT	HOT SPONGE PUDDING							0.136	3.583		0.298	3.550	-0.043	YES
	14184 CARAMEL 24X284G	0.42	200	284	24	0.045	7.790			0.068				
	14182 LEMON 24X284G	0.42	100	284	24	0.023	7.790			0.048				
	14214 APRICOT 24X284G	0.42	0	284	24	0.000	7.790			0.000				
	14222 CHOCOLATE 24X284G	0.42	0	284	24	0.000	7.790			0.000				
	14230 MIX FRUIT 24X284G	0.42	100	284	24	0.023	7.790			0.048				
	15389 APPLE & CARAMEL 24X284G	0.42	100	284	24	0.023	7.790			0.048				
	15407 PEACH 24X284G	0.42	100	284	24	0.023	7.790			0.048				
	CREME CARAMEL							0.075			0.043			
	14248 CREME CARAMEL 24X125G	0.70	750	125	24	0.075	2.057			0.043				
	MOIR'S COCONUT							3.361			3.211			
	14698 COCONUT (FINE) 24X100G	2.40	3700	100	24	0.298	0.460			0.040				
	14702 COCONUT (FINE) 48X200G	1.20	2900	200	48	0.928	3.840			0.982				
	14710 COCONUT (FINE) 24X500G	1.80	1800	500	24	0.720	3.840			0.721				
	14729 TOWER COCONUT 40X200G	1.20	800	200	40	0.213	3.200			0.180				
	15563 COCONUT (MEDIUM) 48X200G	1.20	1950	200	48	0.624	3.840			0.667				
	15571 COCONUT (MEDIUM) 24X500G	1.80	1500	500	24	0.600	3.800			0.601				
CUMIX	CUSTARD POWDER							2.949	3.413		3.553	4.145	0.732	NO
	14346 VANILLA 72X125G	1.80	3600	125	72	1.080	2.700			0.854				
	15281 VANILLA 36X250G	1.80	1090	250	36	0.327	2.700			0.258				
	14354 VANILLA (JAR) 36X500G	1.80	1200	500	36	0.720	5.400			1.138				
	18980 VANILLA (PKT) 36X500G	1.80	1370	500	36	0.822	5.400			1.301				
	CATERPACK CUSTARD							0.464			0.592			
	18378 CUSTARD 4X2KG	0.89	1215	2000	4	0.324	4.315			0.410				
	18384 CUSTARD 25KG	2.70	188	25000	1	0.140	4.444			0.182				
HAU1&2	CAKE MIXES							2.182	2.182		4.634	4.634	2.473	NO
	14419 CHOCOLATE 24X400G	1.20	480	400	24	0.154	3.840			0.273				
	14427 VANILLA 12X400G	1.20	840	400	12	0.102	1.820			0.091				
	15456 FUNCAKES 12X240G	0.48	0	240	12	0.000	2.880			0.000				
	15474 FUNFETTI 12X240G	0.48	1450	240	12	0.139	2.680			0.185				
	15512 RAISIN MUFFIN 12X475G	0.33	1800	475	12	0.204	8.291			1.188				
	15520 APPLE MUFFINS 12X450G	0.33	960	450	12	0.173	7.855			0.828				
	15415 VANILLA/CARAMEL 12X800G	1.20	1560	800	12	0.498	3.840			0.987				
	15423 CHOCOLATE/FUDGE 12X800G	1.20	2470	800	12	0.790	3.840			1.404				
SPMIX	ENVELOPE SPICES							0.455	0.797		5.570	9.401	8.604	NO
	14874 CURRY 36X9G	0.17	1488	9	364	0.171	9.758			2.089				
	14982 BORRRE 36X9G	0.17	1488	9	364	0.171	9.758			2.089				
	15008 COMPOUND PEPPER 36X9G	0.17	972	9	364	0.112	9.758			1.371				
	CATERPACK SPICES							0.342			3.831			
	18015 CURRY MED. 4X3KG	0.80	480	3000	4	0.182	9.600			2.313				
	18074 CURRY MED. 25KG	1.25	96	25000	1	0.080	9.600			0.964				
	18082 CURRY HOT 25KG	1.25	0	25000	1	0.000	9.800			0.000				
	18104 BORRRE COMP. 25KG	1.25	48	25000	1	0.040	9.600			0.482				
	18228 MIX MASALA 25KG	6.25	36	25000	1	0.030	1.820			0.072				
MILL2	ENVELOPE SPICES							0.343	0.712		1.142	1.783	1.052	NO
	14874 CURRY 36X9G	0.70	1488	9	364	0.171	2.370			0.571				
	14982 BORRRE 36X9G	0.70	1488	9	364	0.171	2.370			0.571				
	CATERPACK SPICES							0.368			0.621			
	18015 CURRY MED. 4X3KG	4.80	480	3000	4	0.182	1.200			0.324				
	18074 CURRY MED. 25KG	10.00	96	25000	1	0.080	1.200			0.135				
	18082 CURRY HOT 25KG	10.00	0	25000	1	0.000	1.200			0.000				
	18080 PURE TURM. 25KG	18.25	32	25000	1	0.027	0.738			0.028				
	18104 BORRRE COMP. 25KG	10.00	48	25000	1	0.040	1.200			0.087				
	18228 MIX MASALA 25KG	7.50	36	25000	1	0.030	1.800			0.087				
MILL3	ENVELOPE SPICES							0.389	0.821		1.431	1.910	1.080	NO
	14874 CURRY 36X9G	0.70	1488	9	364	0.171	2.370			0.485				
	14982 BORRRE 36X9G	0.48	1488	9	364	0.171	3.608			0.753				
	14990 CAYENNE PEPPER 36X9G	0.82	488	9	364	0.058	2.678			0.182				
	CATERPACK SPICES							0.422			0.480			
	18015 CURRY MED. 4X3KG	4.80	480	3000	4	0.182	1.200			0.281				
	18074 CURRY MED. 25KG	17.50	96	25000	1	0.050	0.688			0.087				
	18082 CURRY HOT 25KG	17.50	0	25000	1	0.000	0.688			0.000				
	18104 BORRRE COMP. 25KG	17.50	48	25000	1	0.040	0.688			0.033				
	18112 CAYENNE PEPPER 25KG	18.75	0	25000	1	0.000	0.840			0.000				
	18228 MIX MASALA 25KG	18.25	36	25000	1	0.030	0.738			0.027				
	18317 GROUND CUMIN 25KG	18.25	96	25000	1	0.080	0.738			0.072				
MILL1	ENVELOPE SPICES							0.265	0.538		0.972	1.529	0.981	NO
	14886 WHITE PEPPER 36X9G	1.30	640	9	364	0.087	1.278			0.228				
	14980 CAYENNE PEPPER 36X9G	0.83	488	9	364	0.058	1.784			0.188				
	15008 COMPOUND PEPPER 36X9G	0.82	972	9	364	0.112	2.678			0.557				

APPENDIX D

SPREADSHEET 2

[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
MACHINES	PRODUCTS / FLAVOURS (TYPES)	STANDARDS (MIN/CASE)	PLANNED PRODCTN (CSE/WKS)	UNIT WGHT (GR)	UNITS/CASE	PLANNED PRODCTN (TNS/DAY)	RAW CAPACITIES (TNS/DAY)	PLANNED PDCN/PDCT (TNS/DAY)	PLANNED PDCN/MACH (TNS/DAY)	CRCTED CAPAC (TNS/DAY)	CRCTED CAPAC/PRD (TNS/DAY)	CRCTED CAPAC/MACH (TNS/DAY)	PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
	CATERPACK SPICES							0.120			0.208			
18112	CAYENNE PEPPER 25KG	17.50	0	25000	1	0.000	0.888			0.000				
18120	GR. BLK PEPPER 25KG	17.50	0	25000	1	0.000	0.888			0.000				
18133	GR. WH. PEPPER 25KG	17.50	18	25000	1	0.013	0.888			0.017				
18188	GR. CORNDR 25KG	17.50	18	25000	1	0.013	0.888			0.017				
18201	GR. GINGER 25KG	17.50	18	25000	1	0.013	0.888			0.017				
18317	GROUND CUMIN 25KG	11.25	86	25000	1	0.080	1.067			0.198				
18333	GROUND FENNEL 25KG	18.25	0	25000	1	0.000	0.738			0.000				
	PEPPER							0.154			0.348			
15040	BLACK PEPPER TIN 72X 50G	1.40	100	50	72	0.012	1.234			0.028				
15058	WHITE PEPPER TIN 72X 50G	1.40	200	50	72	0.024	1.234			0.055				
15067	WHITE PEPPER TIN 48X100G	2.00	150	100	48	0.024	1.152			0.051				
15075	PEPPERCONC 72X 50G	1.40	724	50	72	0.087	1.234			0.198				
15083	PEPPERCONC 40X 50G	0.80	100	50	40	0.007	1.200			0.015				

SPREADSHEET 3

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[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
MACHINES	PRODUCTS / FLAVOURS (TYPES)	STANDAR (MIN/CASE)	PLANNED PRODCTN (CSE/6WK)	UNIT WGHT (GR)	UNITS/CAS	PLANNED PRODCTN (TNS/DAY)	RAW CAPACITIE (TNS/DAY)	PLANNED PDCN/PDC (TNS/DAY)	PLANNED PDCN/MA (TNS/DAY)	CRCTED CAPAC (TNS/DAY)	CRCTED CAPAC/P (TNS/DAY)	CAPACITY- PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
CMHLR	HOUSEHOLD CHEMICALS							0.135	0.135		0.450	0.315	NO
HLR2	+ MOIR'S JELLY POWDER							0.484	0.828		0.673	0.189	NO
	MOIR'S LOW CAL JELLY							0.053			0.059	0.006	NO
	HOT SPONGE PUDDING							0.138			1.077	0.941	NO
	MOIR'S LOW CAL INSTANT PUDDING							0.016			0.009	-0.007	YES
	CAKE MIXES							0.139			0.968	0.829	NO
	15458 FUNCAKES 12X240G	0.24	0	240	12	0.000	5.780		0.000				
	15474 FUNFETTI 12X240G	0.24	1450	240	12	0.139	5.780		0.968				
HLR1	+ MOIR'S JELLY POWDER							0.968	1.258		0.886	-0.082	YES
	+ MOIR'S BAKING POWDER							0.290			0.266	-0.024	YES
WKA	MOIR'S INSTANT PUDDING							0.740	1.295		1.852	1.111	NO
	CREME CARAMEL							0.075			0.128	0.053	NO
	MOIR'S MEAT MAGIC							0.480			1.186	0.706	NO
PMD1&2	TOWER JELLY							3.917	5.212		6.577	2.690	NO
	MOIR'S INSTANT PUDDING							0.740			0.245	-0.495	YES
	CREME CARAMEL							0.075			0.017	-0.058	YES
	MOIR'S MEAT MAGIC							0.480			0.141	-0.339	YES
PMD7	CAKE MIXES							1.290	1.290		6.583	5.293	NO
	15415 VANILLA/CARAMEL 12X80	0.70	1560	800	12	0.499	6.583			2.548			
	15423 CHOCOLATE/FUDGE 12X8	0.70	2470	800	12	0.790	6.583			4.035			
HAMAC	HOT SPONGE PUDDING							0.138	2.298		0.218	0.082	NO
	CAKE MIXES							2.182			7.580	5.418	NO
	14419 CHOCOLATE 24X400G	0.90	480	400	24	0.154	5.120			0.342			
	14427 VANILLA 12X400G	0.46	640	400	12	0.102	5.009			0.223			
	15458 FUNCAKES 12X240G	0.46	0	240	12	0.000	3.005			0.000			
	15474 FUNFETTI 12X240G	0.46	1450	240	12	0.139	3.005			0.182			
	15512 RAISIN MUFFIN 12X475G	0.48	1600	475	12	0.304	5.948			0.787			
	15520 APPLE MUFFINS 12X450	0.46	960	450	12	0.173	5.635			0.424			
	15415 VANILLA/CARAMEL 12X80	0.48	1560	800	12	0.499	10.017			2.176			
	15423 CHOCOLATE/FUDGE 12X8	0.48	2470	800	12	0.790	10.017			3.446			
SWRP1	MOIR'S INSTANT PUDDING							0.740	6.640		0.406	-0.335	YES
	HOT SPONGE PUDDING							0.138			0.224	0.088	NO
	CREME CARAMEL							0.075			0.108	0.033	NO
	CUSTARD POWDER							2.127			4.308	2.181	NO
	14346 VANILLA 72X125G	0.43	3600	125	72	1.080	10.047			1.634			
	15261 VANILLA 36X250G	0.43	1090	250	36	0.327	10.047			0.495			
	14354 VANILLA (JAR) 36X500G	0.43	1200	500	36	0.720	20.093			2.179			
	CAKE MIXES							0.256			0.508	0.252	NO
	14419 CHOCOLATE 24X400G	0.28	480	400	24	0.154	16.457			0.381			
	14427 VANILLA 12X400G	0.28	640	400	12	0.102	8.229			0.127			
	MOIR'S BAKING POWDER							1.836			4.136	2.300	NO
	CAKE DECORATIONS							0.374			0.283	-0.091	YES
	MOIR'S MEAT MAGIC							0.480			0.833	0.353	NO
	HOUSEHOLD CHEMICALS							0.615			1.560	0.945	NO
SWRP2	ENVELOPE SPICES							0.608	0.676		5.328	4.721	NO
	14966 WHITE PEPPER 384X9G	0.28	640	9	384	0.097	5.925			0.649			
	14974 CURRY 384X9G	0.28	1488	9	384	0.171	5.925			1.503			
	14982 BORRIE 384X9G	0.28	1488	9	384	0.171	5.925			1.503			
	14990 CAYENNE PEPPER 384X	0.28	488	9	384	0.056	5.925			0.491			
	15008 COMPOUND PEPPER 384	0.28	972	9	384	0.112	5.925			0.982			
	PEPPER							0.068			0.432	0.364	NO
	15040 BLACK PEPPER TIN 72X 50	0.43	100	50	72	0.012	4.019			0.071			
	15059 WHITE PEPPER TIN 72X 50	0.43	200	50	72	0.024	4.019			0.143			
	15067 WHITE PEPPER TIN 48X100	0.43	150	100	48	0.024	5.358			0.190			
	15083 PEPPER CONE 40X 50G	0.50	100	50	48	0.008	2.304			0.027			
DSTRM2	+ MOIR'S BAKING POWDER							1.546	2.250		2.707	1.162	NO
	CATERPACK BAKING POWDER							0.224			0.299	0.075	NO
	18548 BAKING POWDER 6X2K	1.92	560	2000	6	0.224	3.000			0.299			
	HOUSEHOLD CHEMICALS							0.480			1.152	0.672	NO
DSTRM1	CUSTARD POWDER							2.949	3.273		7.315	4.368	NO
	14346 VANILLA 72X125G	0.40	3600	125	72	1.080	10.800			3.564			
	15261 VANILLA 36X250G	1.20	1090	250	36	0.327	3.600			0.380			
	14354 VANILLA (JAR) 36X500G	1.20	1200	500	36	0.720	7.200			1.564			
	18880 VANILLA (PKT) 36X500G	1.20	1370	500	36	0.822	7.200			1.808			
	CATERPACK CUSTARD							0.324			0.198	-0.126	YES
	18378 CUSTARD 4X2KG	1.92	1215	2000	4	0.324	2.000			0.198			
CKDEC	CAKE DECORATIONS							0.374	0.374		1.240	0.866	NO
CKPAC	HOT SPONGE PUDDING							0.138	2.298		0.162	0.025	NO
	CAKE MIXES							2.162			5.806	3.644	NO
	14419 CHOCOLATE 24X400G	1.20	480	400	24	0.154	3.840			0.257			
	14427 VANILLA 12X400G	0.60	640	400	12	0.102	3.840			0.171			
	15458 FUNCAKES 12X240G	0.60	0	240	12	0.000	2.304			0.000			

SPREADSHEET 3

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[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
MACHINES	PRODUCTS / FLAVOURS (TYPES)	STANDAR (MIN/CASE	PLANNED PRODCTN (CSE/6WK	UNIT WGH (GR)	UNITS/CAS	PLANNED PRODCTN (TNS/DAY)	RAW CAPACITIE (TNS/DAY)	PLANNED PDCN/PDC (TNS/DAY)	PLANNED PDCN/MA (TNS/DAY)	CRCTED CAPAC (TNS/DAY)	CRCTED CAPAC/P (TNS/DAY)	CAPACITY- PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
	15474 FUNFETTI 12X240G	0.60	1450	240	12	0.139	2.304			0.140			
	15512 RAISIN MUFFIN 12X475G	0.80	1600	475	12	0.304	4.560			0.603			
	15520 APPLE MUFFINS 12X450	0.60	960	450	12	0.173	4.320			0.325			
	15415 VANILLA/CARAMEL 12X80	0.60	1560	800	12	0.499	7.680			1.668			
	15423 CHOCOLATE/FUDGE 12X8	0.60	2470	800	12	0.790	7.680			2.642			
COCHAS	CAKE MIXES							0.477	3.858		0.553	0.076	NO
	15512 RAISIN MUFFIN 12X475G	0.80	1600	475	12	0.304	4.560			0.359			
	15520 APPLE MUFFINS 12X450	0.60	960	450	12	0.173	4.320			0.193			
	MOIR'S COCONUT							3.381			4.096	0.714	NO
TEECMP	PEPPER							0.154	0.154		0.930	0.776	NO
	15040 BLACK PEPPER TIN 72X 50	1.92	100	50	72	0.012	0.900			0.070			
	15059 WHITE PEPPER TIN 72X 50	1.92	200	50	72	0.024	0.900			0.141			
	15067 WHITE PEPPER TIN 48X100	1.92	150	100	48	0.024	1.200			0.188			
	15075 PEPPERCONCONE 72X 50G	1.92	724	50	72	0.087	0.900			0.509			
	15083 PEPPERCONCONE 40X 50G	1.92	100	50	40	0.007	0.500			0.022			
SHL1&2	ENVELOPE SPICES							0.209	0.209		1.037	0.628	NO
	14968 WHITE PEPPER 384X9G	1.60	840	9	384	0.097	1.037			0.481			
	15008 COMPOUND PEPPER 384	1.60	972	9	384	0.112	1.037			0.556			
SPHAS	ENVELOPE SPICES							0.399	0.399		1.659	1.260	NO
	14974 CURRY 384X9G	1.00	1488	9	384	0.171	1.659			0.713			
	14982 BORRIE 384X9G	1.00	1488	9	384	0.171	1.659			0.713			
	14990 CAYENNE PEPPER 384X	1.00	488	9	384	0.056	1.659			0.233			
PMD3-6	TOWER JELLY							3.917	3.917		8.601	4.884	NO
CPHPCK	CATERPACK SPICES							0.192	0.192		3.000	2.808	NO
	18015 CURRY MED. 4X3KG	1.92	480	3000	4	0.192	3.000			3.000			
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PAS1&2	MOIR'S JELLY POWDER							1.452	1.452		3.072	1.620	NO
NAU3&4	TOWER JELLY							3.917	9.610		1.610	-2.307	YES
	MOIR'S LOW CAL JELLY							0.053			0.012	-0.041	YES
	MOIR'S INSTANT PUDDING							0.740			0.484	-0.256	YES
	MOIR'S LOW CAL INSTANT PUDDING							0.016			0.002	-0.014	YES
	HOT SPONGE PUDDING							0.136			0.108	-0.026	YES
	CREME CARAMEL							0.075			0.054	-0.021	YES
	CAKE MIXES							1.429			2.776	1.347	NO
	15458 FUNCAGES 12X240G	0.23	0	240	12	0.000	6.010			0.000			
	15474 FUNFETTI 12X240G	0.23	1450	240	12	0.139	6.010			0.087			
	15415 VANILLA/CARAMEL 12X80	0.23	1560	800	12	0.499	20.035			1.041			
	15423 CHOCOLATE/FUDGE 12X8	0.23	2470	800	12	0.790	20.035			1.648			
	MOIR'S BAKING POWDER							1.836			2.769	0.933	NO
	CATERPACK BAKING POWDER							1.408			0.717	-0.691	YES
	18546 BAKING POWDER 6X2K	0.40	560	2000	6	0.224	14.400			0.336			
	18554 BAKING POWDER 20K	3.10	1776	20000	1	1.184	3.097			0.382			
SNAUT	HOT SPONGE PUDDING							0.136	3.593		0.296	0.159	NO
	CREME CARAMEL							0.075			0.043	-0.032	YES
	MOIR'S COCONUT							3.381			3.211	-0.170	YES
CUMIX	CUSTARD POWDER							2.949	3.413		3.553	0.604	NO
	14346 VANILLA 72X125G	1.80	3600	125	72	1.080	2.700			0.854			
	15261 VANILLA 36X250G	1.80	1090	250	36	0.327	2.700			0.259			
	14354 VANILLA (JAR) 36X500G	1.80	1200	500	36	0.720	5.400			1.139			
	18680 VANILLA (PKT) 36X500G	1.80	1370	500	36	0.822	5.400			1.301			
	CATERPACK CUSTARD							0.464			0.592	0.128	NO
	18376 CUSTARD 4X2KG	0.89	1215	2000	4	0.324	4.315			0.410			
	18384 CUSTARD 25KG	2.70	168	25000	1	0.140	4.444			0.182			
NAU1&2	CAKE MIXES							2.162	2.162		4.634	2.473	NO
	14419 CHOCOLATE 24X400G	1.20	480	400	24	0.154	3.840			0.273			
	14427 VANILLA 12X400G	1.20	640	400	12	0.102	1.920			0.091			
	15458 FUNCAGES 12X240G	0.48	0	240	12	0.000	2.880			0.000			
	15474 FUNFETTI 12X240G	0.48	1450	240	12	0.139	2.880			0.185			
	15512 RAISIN MUFFIN 12X475G	0.33	1800	475	12	0.304	6.291			1.166			
	15520 APPLE MUFFINS 12X450	0.33	960	450	12	0.173	7.855			0.628			
	15415 VANILLA/CARAMEL 12X80	1.20	1560	800	12	0.499	3.840			0.887			
	15423 CHOCOLATE/FUDGE 12X8	1.20	2470	800	12	0.790	3.840			1.404			
SPMIX	ENVELOPE SPICES							0.455	0.797		5.570	5.115	NO
	14974 CURRY 384X9G	0.17	1488	9	384	0.171	9.758			2.099			
	14982 BORRIE 384X9G	0.17	1488	9	384	0.171	9.758			2.099			
	15008 COMPOUND PEPPER 384	0.17	972	9	384	0.112	9.758			1.371			
	CATERPACK SPICES							0.342			3.831	3.489	NO
	18015 CURRY MED. 4X3KG	0.60	480	3000	4	0.192	9.600			2.313			
	18074 CURRY MED. 25KG	1.25	96	25000	1	0.080	9.600			0.964			
	18082 CURRY HOT 25KG	1.25	0	25000	1	0.000	9.600			0.000			
	18104 BORRIE COMP. 25KG	1.25	48	25000	1	0.040	9.600			0.482			
	18228 MIX MASALA 25KG	6.25	36	25000	1	0.030	1.920			0.072			

SPREADSHEET 3

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[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
MACHINES	PRODUCTS / FLAVOURS (TYPES)	STANDAR (MIN/CASE	PLANNED PRODCTN (CSE/6WK	UNIT WGHT (GR)	UNITS/CAS	PLANNED PRODCTN (TNS/DAY)	RAW CAPACITIE (TNS/DAY)	PLANNED PDCN/PDC (TNS/DAY)	PLANNED PDCN/MA (TNS/DAY)	CRCTED CAPAC (TNS/DAY)	CRCTED CAPAC/P (TNS/DAY)	CAPACITY- PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
MILL2	ENVELOPE SPICES							0.343	0.712		1.142	0.799	NO
	14974 CURRY 384X9G	0.70	1488	9	384	0.171	2.370			0.571			
	14982 BORRIE 384X9G	0.70	1488	9	384	0.171	2.370			0.571			
	CATERPACK SPICES							0.369			0.621	0.253	NO
	18015 CURRY MED. 4X3KG	4.80	480	3000	4	0.192	1.200			0.324			
	18074 CURRY MED. 25KG	10.00	96	25000	1	0.080	1.200			0.135			
	18082 CURRY HOT 25KG	10.00	0	25000	1	0.000	1.200			0.000			
	18090 PURE TURM. 25KG	16.25	32	25000	1	0.027	0.738			0.028			
	18104 BORRIE COMP. 25KG	10.00	48	25000	1	0.040	1.200			0.067			
	18228 MIX MASALA 25KG	7.50	36	25000	1	0.030	1.600			0.067			
MILL3	ENVELOPE SPICES							0.399	0.821		1.431	1.032	NO
	14974 CURRY 384X9G	0.70	1488	9	384	0.171	2.370			0.495			
	14982 BORRIE 384X9G	0.48	1488	9	384	0.171	3.806			0.753			
	14990 CAYENNE PEPPER 384X	0.62	488	9	384	0.058	2.676			0.182			
	CATERPACK SPICES							0.422			0.480	0.058	NO
	18015 CURRY MED. 4X3KG	4.80	480	3000	4	0.192	1.200			0.281			
	18074 CURRY MED. 25KG	17.50	96	25000	1	0.080	0.688			0.067			
	18082 CURRY HOT 25KG	17.50	0	25000	1	0.000	0.688			0.000			
	18104 BORRIE COMP. 25KG	17.50	48	25000	1	0.040	0.688			0.033			
	18112 CAYENNE PEPPER 25K	18.75	0	25000	1	0.000	0.840			0.000			
	18228 MIX MASALA 25KG	16.25	36	25000	1	0.030	0.738			0.027			
	18317 GROUND CUMIN 25KG	18.25	96	25000	1	0.080	0.738			0.072			
MILL1	ENVELOPE SPICES							0.265	0.538		0.972	0.707	NO
	14966 WHITE PEPPER 384X9G	1.30	840	9	384	0.097	1.276			0.229			
	14990 CAYENNE PEPPER 384X	0.93	486	9	384	0.058	1.784			0.186			
	15008 COMPOUND PEPPER 384	0.62	972	9	384	0.112	2.676			0.557			
	CATERPACK SPICES							0.120			0.209	0.089	NO
	18112 CAYENNE PEPPER 25K	17.50	0	25000	1	0.000	0.688			0.000			
	18120 GR. BLK PEPPER 25KG	17.50	0	25000	1	0.000	0.688			0.000			
	18139 GR. WH. PEPPER 25KG	17.50	16	25000	1	0.013	0.688			0.017			
	18198 GR. CORNDR 25KG	17.50	16	25000	1	0.013	0.688			0.017			
	18201 GR. GINGER 25KG	17.50	16	25000	1	0.013	0.688			0.017			
	18317 GROUND CUMIN 25KG	11.25	96	25000	1	0.080	1.067			0.159			
	18333 GROUND FENNEL 25K	16.25	0	25000	1	0.000	0.738			0.000			
	PEPPER							0.154			0.348	0.194	NO
	15040 BLACK PEPPER TIN 72X 50	1.40	100	50	72	0.012	1.234			0.028			
	15059 WHITE PEPPER TIN 72X 50	1.40	200	50	72	0.024	1.234			0.055			
	15067 WHITE PEPPER TIN 48X100	2.00	150	100	48	0.024	1.152			0.051			
	15075 PEPPERCONC 72X 50G	1.40	724	50	72	0.087	1.234			0.199			
	15083 PEPPERCONC 40X 50G	0.80	100	50	40	0.007	1.200			0.015			

SPREADSHEET 4

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[1]	[2]	[3]	[4]	[5]	[6]
MACHINES	PRODUCTS	PLANNED PDCN/PDC (TNS/DAY)	CRCTED CAPAC/P (TNS/DAY)	CAPACITY- PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
CMHLR	HOUSEHOLD CHEMICALS	0.135	0.450	0.315	NO
HLR2	+ MOIR'S JELLY POWDER	0.484	0.673	0.189	NO
	MOIR'S LOW CAL JELLY	0.053	0.059	0.006	NO
	HOT SPONGE PUDDING	0.136	1.077	0.941	NO
	MOIR'S LOW CAL INSTANT PUDDIN	0.016	0.009	-0.007	YES
HLR1	+ MOIR'S JELLY POWDER	0.968	0.886	-0.082	YES
	+ MOIR'S BAKING POWDER	0.290	0.266	-0.024	YES
IWKA	MOIR'S INSTANT PUDDING	0.740	1.852	1.111	NO
	CREME CARAMEL	0.075	0.128	0.053	NO
	MOIR'S MEAT MAGIC	0.480	1.186	0.706	NO
PMD1&2	TOWER JELLY	3.917	6.577	2.660	NO
	MOIR'S INSTANT PUDDING	0.740	0.245	-0.495	YES
	CREME CARAMEL	0.075	0.017	-0.058	YES
	MOIR'S MEAT MAGIC	0.480	0.141	-0.339	YES
HAMAC	HOT SPONGE PUDDING	0.136	0.218	0.082	NO
SWRP1	MOIR'S INSTANT PUDDING	0.740	0.406	-0.335	YES
	HOT SPONGE PUDDING	0.136	0.224	0.088	NO
	CREME CARAMEL	0.075	0.108	0.033	NO
	+ CUSTARD POWDER	1.080	1.634	0.554	NO
	MOIR'S BAKING POWDER	1.836	4.136	2.300	NO
	CAKE DECORATIONS	0.374	0.283	-0.091	YES
	MOIR'S MEAT MAGIC	0.480	0.833	0.353	NO
	HOUSEHOLD CHEMICALS	0.615	1.560	0.945	NO
DSTRM2	+ MOIR'S BAKING POWDER	1.546	2.707	1.162	NO
	HOUSEHOLD CHEMICALS	0.480	1.152	0.672	NO
DSTRM1	+ CUSTARD POWDER	1.869	3.752	1.883	NO
CKDEC	CAKE DECORATIONS	0.374	1.240	0.866	NO
CKPAC	HOT SPONGE PUDDING	0.136	0.162	0.025	NO
	+ CAKE MIXES	1.685	4.877	3.193	NO
COCHAS	+ CAKE MIXES	0.477	0.553	0.076	NO
	MOIR'S COCONUT	3.381	4.096	0.714	NO
TEECMP	PEPPER	0.154	0.930	0.776	NO
SHL1&2	+ ENVELOPE SPICES	0.209	1.037	0.828	NO
SPHAS	+ ENVELOPE SPICES	0.399	1.659	1.260	NO

SPREADSHEET 4

[1]	[2]	[3]	[4]	[5]	[6]
		PLANNED PDCN/PDC (TNS/DAY)	CRCTED CAPAC/P (TNS/DAY)	CAPACITY- PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
MACHINES	PRODUCTS				
PMD3-6	TOWER JELLY	3.917	8.601	4.684	NO
PAS1&2	MOIR'S JELLY POWDER	1.452	3.072	1.620	NO
NAU3&4	TOWER JELLY	3.917	1.610	-2.307	YES
	MOIR'S LOW CAL JELLY	0.053	0.012	-0.041	YES
	MOIR'S INSTANT PUDDING	0.740	0.484	-0.256	YES
	MOIR'S LOW CAL INSTANT PUDDIN	0.016	0.002	-0.014	YES
	HOT SPONGE PUDDING	0.136	0.108	-0.028	YES
	CREME CARAMEL	0.075	0.054	-0.021	YES
	+ CAKE MIXES	0.139	0.087	-0.052	YES
	MOIR'S BAKING POWDER	1.836	2.769	0.933	NO
	CATERPACK BAKING POWDER	1.408	0.717	-0.691	YES
SNAUT	HOT SPONGE PUDDING	0.136	0.296	0.159	NO
	CREME CARAMEL	0.075	0.043	-0.032	YES
	MOIR'S COCONUT	3.381	3.211	-0.170	YES
CUMIX	CUSTARD POWDER	2.949	3.553	0.604	NO
	CATERPACK CUSTARD	0.464	0.592	0.128	NO
NAU1&2	+ CAKE MIXES	2.022	4.449	2.426	NO
MILL2	+ ENVELOPE SPICES	0.171	0.571	0.400	NO
MILL3	+ ENVELOPE SPICES	0.227	0.677	0.450	NO
	+ CATERPACK SPICES	0.422	0.480	0.058	NO
MILL1	+ ENVELOPE SPICES	0.209	0.786	0.577	NO
	+ CATERPACK SPICES	0.040	0.051	0.011	NO
	PEPPER	0.154	0.348	0.194	NO

SPREADSHEET 5

=====

[1]	[2]	[3]	[4]	[5]	[6]
MACHINES	PRODUCTS	PLANNED PDCN/PDC (TNS/DAY)	CRCTED CAPAC/P (TNS/DAY)	CAPACITY- PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
HLR1	+ MOIR'S JELLY POWDER	0.968	0.886	-0.082	YES
HLR2	+ MOIR'S JELLY POWDER	0.484	0.673	0.189	NO
HLR1+HLR	MOIR'S JELLY POWDER	1.452	1.559	0.108	NO
PMD1&2	TOWER JELLY	3.917	6.577	2.660	NO
PMD3-6	TOWER JELLY	3.917	8.601	4.684	NO
HLR2	MOIR'S LOW CAL JELLY	0.053	0.059	0.006	NO
CKPAC	+ CAKE MIXES	1.685	4.877	3.193	NO
COCHAS	+ CAKE MIXES	0.477	0.553	0.076	NO
CKPC+CH	CAKE MIXES	2.162	5.430	3.269	NO
HLR2	HOT SPONGE PUDDING	0.136	1.077	0.941	NO
HAMAC	HOT SPONGE PUDDING	0.136	0.218	0.082	NO
CKPAC	HOT SPONGE PUDDING	0.136	0.162	0.025	NO
SWRP1	HOT SPONGE PUDDING	0.136	0.224	0.088	NO
IWKA	MOIR'S INSTANT PUDDING	0.740	1.852	1.111	NO
PMD1&2	MOIR'S INSTANT PUDDING	0.740	0.245	-0.495	YES
SWRP1	MOIR'S INSTANT PUDDING	0.740	0.406	-0.335	YES
HLR2	MOIR'S LOW CAL INSTANT PUDDIN	0.016	0.009	-0.007	YES
IWKA	CREME CARAMEL	0.075	0.128	0.053	NO
PMD1&2	CREME CARAMEL	0.075	0.017	-0.058	YES
SWRP1	CREME CARAMEL	0.075	0.108	0.033	NO
HLR1	+ MOIR'S BAKING POWDER	0.290	0.266	-0.024	YES
DSTRM2	+ MOIR'S BAKING POWDER	1.546	2.707	1.162	NO
HLR1+DR	MOIR'S BAKING POWDER	1.836	2.973	1.137	NO
SWRP1	MOIR'S BAKING POWDER	1.836	4.136	2.300	NO
SWRP1	+ CUSTARD POWDER	1.080	1.634	0.554	NO
DSTRM1	+ CUSTARD POWDER	1.869	3.752	1.883	NO
SWR1+DR	CUSTARD POWDER	2.949	5.386	2.437	NO
TEECMP	PEPPER	0.154	0.930	0.776	NO
SHL1&2	+ ENVELOPE SPICES	0.209	1.037	0.828	NO
SPHAS	+ ENVELOPE SPICES	0.399	1.659	1.260	NO
SH1&2+SH	ENVELOPE SPICES	0.608	2.696	2.088	NO
COCHAS	MOIR'S COCONUT	3.381	4.096	0.714	NO
CMHLR	HOUSEHOLD CHEMICALS	0.135	0.450	0.315	NO
SWRP1	HOUSEHOLD CHEMICALS	0.615	1.560	0.945	NO
DSTRM2	HOUSEHOLD CHEMICALS	0.480	1.152	0.672	NO

SPREADSHEET 5

=====

[1]	[2]	[3]	[4]	[5]	[6]
MACHINES	PRODUCTS	PLANNED PDCN/PDC (TNS/DAY)	CRCTED CAPAC/P (TNS/DAY)	CAPACITY- PLND PDCN (TNS/DAY)	CAPACITY PROBLEM
IWKA	MOIR'S MEAT MAGIC	0.480	1.186	0.706	NO
PMD1&2	MOIR'S MEAT MAGIC	0.480	0.141	-0.339	YES
SWRP1	MOIR'S MEAT MAGIC	0.480	0.833	0.353	NO
SWRP1	CAKE DECORATIONS	0.374	0.283	-0.091	YES
CKDEC	CAKE DECORATIONS	0.374	1.240	0.866	NO
PAS1&2	MOIR'S JELLY POWDER	1.452	3.072	1.620	NO
NAU3&4	TOWER JELLY	3.917	1.610	-2.307	YES
NAU3&4	MOIR'S LOW CAL JELLY	0.053	0.012	-0.041	YES
NAU1&2	+ CAKE MIXES	2.022	4.449	2.426	NO
NAU3&4	+ CAKE MIXES	0.139	0.087	-0.052	YES
NA1&2+3&	CAKE MIXES	2.162	4.536	2.374	NO
NAU3&4	HOT SPONGE PUDDING	0.136	0.108	-0.028	YES
SNAUT	HOT SPONGE PUDDING	0.136	0.296	0.159	NO
NAU3&4	MOIR'S INSTANT PUDDING	0.740	0.484	-0.256	YES
NAU3&4	MOIR'S LOW CAL INSTANT PUDDIN	0.016	0.002	-0.014	YES
NAU3&4	CREME CARAMEL	0.075	0.054	-0.021	YES
SNAUT	CREME CARAMEL	0.075	0.043	-0.032	YES
NAU3&4	MOIR'S BAKING POWDER	1.836	2.769	0.933	NO
NAU3&4	CATERPACK BAKING POWDER	1.408	0.717	-0.691	YES
CUMIX	CUSTARD POWDER	2.949	3.553	0.604	NO
CUMIX	CATERPACK CUSTARD	0.464	0.592	0.128	NO
MILL1	PEPPER	0.154	0.348	0.194	NO
MILL1	+ ENVELOPE SPICES	0.209	0.786	0.577	NO
MILL2	+ ENVELOPE SPICES	0.171	0.571	0.400	NO
MILL3	+ ENVELOPE SPICES	0.227	0.677	0.450	NO
MILL1+2+3	ENVELOPE SPICES	0.608	2.034	1.427	NO
SNAUT	MOIR'S COCONUT	3.381	3.211	-0.170	YES
MILL1	+ CATERPACK SPICES	0.040	0.051	0.011	NO
MILL3	+ CATERPACK SPICES	0.422	0.480	0.058	NO
MLL1+MLL	CATERPACK SPICES	0.462	0.531	0.069	NO

SPREADSHEET 6

[1]	[2]	[3]	[4]	[5]	[6]	[12]	[7]	[8]	[9]	[10]	[11]
PRODUCTS	MACHINES WITH CAPACITY CONSTRAINT		PLANNED PDCN/PDCT	CORRECTED CAPACITY/ PRODUCT (TONS/DAY)			RELATIVE CAPACITY CONSTRAINT	RATIO	CRCTD CPCTY - PLND PRODUCTN (TONS/DAY)		CAPACITY SHORTAGE
	PACKING FLR	MIXING FLR	(TNS/DAY)	PCKG FLR	MXNG FLR	(TNS/DAY)	AT	(MAX CAP/ MIN CAP)	PCKG FLR	MXNG FLR	AT
MOIR'S JELLY POWDER	HLR1+HLR2	PAS1&2	1.452	1.559	3.072	1.559	PCKG FLR	2.0	0.108	1.820	NOWHERE
TOWER JELLY	PMD1&2	NAU3&4	3.917	6.577	1.810	1.810	MXNG FLR	4.1	2.660	-2.307	MXNG FLR
MOIR'S LOW CAL JELLY	HLR2	NAU3&4	0.053	0.059	0.012	0.012	MXNG FLR	4.8	0.006	-0.041	MXNG FLR
CAKE MIXES	CKPC+CHAS	NA1&2+3&4	2.182	5.430	4.538	4.538	MXNG FLR	1.2	3.269	2.374	NOWHERE
HOT SPONGE PUDDING	CKPAC	NAU3&4	0.136	0.182	0.108	0.108	MXNG FLR	1.5	0.025	-0.028	MXNG FLR
MOIR'S INSTANT PUDDING	PMD1&2	NAU3&4	0.740	0.245	0.484	0.245	PCKG FLR	2.0	-0.495	-0.258	BOTH FLR
MOIR'S LOW CAL INSTANT PDNG	HLR2	NAU3&4	0.016	0.009	0.002	0.002	MXNG FLR	4.8	-0.007	-0.014	BOTH FLR
CREME CARAMEL	PMD1&2	SNAUT	0.075	0.017	0.043	0.017	PCKG FLR	2.8	-0.058	-0.032	BOTH FLR
MOIR'S BAKING POWDER	HLR1+DSTRM2	NAU3&4	1.838	2.973	2.769	2.769	MXNG FLR	1.1	1.137	0.933	NOWHERE
CUSTARD POWDER	SWR1+DRM1	CUMIX	2.949	5.388	3.553	3.553	MXNG FLR	1.5	2.437	0.804	NOWHERE
PEPPER	TEECMP	MILL1	0.154	0.930	0.348	0.348	MXNG FLR	2.7	0.776	0.194	NOWHERE
ENVELOPE SPICES	SHL1&2+SPHA	MILL1+2+3	0.808	2.698	2.034	2.034	MXNG FLR	1.3	2.088	1.427	NOWHERE
MOIR'S COCONUT	COCHAS	SNAUT	3.381	4.098	3.211	3.211	MXNG FLR	1.3	0.714	-0.170	MXNG FLR
HOUSEHOLD CHEMICALS	CMHLR	N/A	0.135	0.450	N/A	0.450	N/A	N/A	0.315	N/A	NOWHERE
MOIR'S MEAT MAGIC	PMD1&2	N/A	0.480	0.141	N/A	0.141	N/A	N/A	-0.339	N/A	PCKG FLR
CAKE DECORATIONS	SWRP1	N/A	0.374	0.283	N/A	0.283	N/A	N/A	-0.091	N/A	PCKG FLR
CATERPACK BAKING POWDER	N/A	NAU3&4	1.408	N/A	0.717	0.717	N/A	N/A	N/A	-0.891	MXNG FLR
CATERPACK CUSTARD	N/A	CUMIX	0.484	N/A	0.592	0.592	N/A	N/A	N/A	0.128	NOWHERE
CATERPACK SPICES	N/A	MILL1+MILL3	0.482	N/A	0.531	0.531	N/A	N/A	N/A	0.059	NOWHERE
TOTALS			17.477	30.138	21.782	20.004			12.545	3.811	

CUMULATIVE COMPARABLE CAPACITY RATIO = COMPARABLE TOT CAPAC AT PACKING FLR / COMPARABLE TOT CAPAC AT MIXING FLR =

1.4

Detailed Description of The Analysis Method

To know the product mix is crucial for capacity considerations. Usually each machine process more than one product, and the process time varies from one product to the other (e.g. on the same machine it will take 1 minute to process 1 Kg of A whereas 2 minutes will be necessary to process 1 Kg of B). As the capacity is product dependent, it is only possible to talk about the capacity of a machine for a specific product. Therefore, to be able to predict the capacity that will be available at a specific time, it is necessary to know the product mix that will be manufactured at that time. Hence, the first step of the analysis should be to choose a representative production plan which gives a typical product mix. The six weeks production plan corresponding to the last two weeks of Period 8 and to four weeks of Period 9 and which is reflecting an average market demand, is chosen for this purpose.

Initially, cumulative production figures planned for the above six weeks interval are imported into *Macload* where *Machine Allocation Coefficients* (or *Machine Standards*) are kept. Details about *Macload* are given in CHAPTER 3 when explaining *The Planning Module*. *Totals* and *Machine Loads* columns are deleted from *Macload*. The resulting modified spreadsheet is called *Spreadsheet 1* and it is given at page 1 of this appendix.

In the next step, *Spreadsheet 1* is arranged in such a way that, products processed by the same machine are grouped under that machine. Database functions of Lotus are used for this purpose. The transformed spreadsheet is called *Spreadsheet 2* (see page 7 of this appendix). By this way it has been possible to condense *Machine Standards* into one column (*Column 3*). At the same time the packing information is extracted from *Column 2* and put under *Columns 5 & 6*. This is used to convert the *Planned Production* figures that were in *Cases/6Weeks* (30 Days) and *Machine Standards* that were in *Minutes/Case* into *Tons/Day*. The conversion is done according to following formulae.

$$\text{Plnd Prdctn (Tons/Day)} = \text{Plnd Prdctn (Cases/30Days)} \times \frac{\text{Unit Wght(gr)} \times \text{Units/Case}}{30(\text{Days}) \times 1\,000\,000}$$

$$\text{Raw Cap(Tons/Day)} = \frac{480(\text{Min/Day}) \times \text{Unit Wght(gr)} \times \text{Units/Case}}{\text{Machine Standard (Min/Case)} \times 1\,000\,000}$$

Converted *Machine Standards* are called *Raw Capacities* (*Column 8*). *Raw Capacity* is the amount of flavour (in Tons), or product type, that a machine can process if it is dedicated to process this one only. In the real life no machine has such a set-up. Therefore *Raw Capacity* is not a realistic figure, it is just a starting point. In order to have more meaningful numbers, the total capacity available at each machine has to be allocated to different flavours and product types processed by it. Ratio of the total *Planned Production* of each machine (*Column 10*) to the individual *Planned Production* of each item (*Column 7*) is used as the criteria of capacity distribution.

$\text{Crctd Cap per Item} = \frac{\text{Raw Capac(Tns/Day)} \times \text{Plnd Prodcn(Tns/Day)}}{\text{Planned Production Per Machine (Tns/Day)}}$
--

Corrected Capacity (*Column 11*), i.e. the capacity available for each item, is the result of the distribution. *Corrected Capacity Per Product* and *Corrected Capacity Per Machine* are calculated in the next two columns (*Columns 12 & 13*). *Corrected Capacity Per Machine* is a fairly realistic figure about the available capacity and it is comparable with *Planned Production Per Machine* (*Column 10*). The evaluation of the present capacity situation is done in the last two columns (*Columns 14 & 15*) of *Spreadsheet 2* which is given at page 7 of this appendix.

Planned Production Per Product (*Column 9*) and *Corrected Capacity Per Product* columns summarise the information about the individual flavours and product types. Therefore the data related to these subgroups can be deleted from the spreadsheet without effecting its relevance. This will only reduce its size and will make it more manageable.

Products can be classified into three groups according to the way their flavours/types are processed.

- Group 1 : All flavours/types of the same product go through the same machine(s).
- Group 2 : Some flavours/types of a product are processed by one machine and remaining ones by another machine.
- Group 3 : Some flavours/types of a product are processed by more machines than the other flavours/types of the same product.

A different method of elimination is used for each group.

Flavours/types of Group 1 & 2 products are simply deleted from the spreadsheet. Differently from Group 1, the headings of Group 2 products are marked with a "+" sign to show that the corresponding capacities have to be added up to obtain the total capacity available. For these products there is an available capacity at every machine where their flavours/types are processed. The elimination process is more complicated for Group 3 products and it is done in *Spreadsheet 4*. In *Spreadsheet 3* which is given at page 12 of this appendix, only an initial elimination of Group 1 & 2 is done.

Flavours or types of Group 3 products are neither processed by the same set of machines (Group 1) nor by exclusively different sets of machines (Group 2). Some of them go through the same set as others but also through some additional ones. In this situation it is necessary to determine the capacity which is significant for the calculation of *Corrected Capacity Per Product* before deleting any subgroup. This is done by comparing the available *Corrected Capacities* of the same flavour/type at different machines. The smallest values presenting the highest capacity constraints are kept and the others are deleted. *Corrected Capacity Per Product* is then calculated by adding the minimum individual capacities. All intermediate columns are also deleted from the spreadsheet. Only *Planned Production Per Product*, *Corrected Capacity Per Product*, *Capacity - Planned Production* and *Capacity Problem* columns (*Columns 3, 4, 5 and 6*) are kept. This is how *Spreadsheet 4* which is given at page 15 of this appendix, is obtained.

In *Spreadsheets 2, 3 and 4* the information is grouped in a machine based format. In *Spreadsheet 5* (see page 17 of this appendix), this information is rearranged in a product based format. This is done to facilitate the calculation of *Corrected Capacity Per Product*.

In *Spreadsheet 6* (see page 19 of this appendix) capacities of products marked by a "+" sign have been added up. If a product is processed by more than a machine, then the one with the smallest capacity is kept and the others are deleted. Some extra columns are inserted in order to give the information about Packing and Mixing Floors at the same line. In *Column 12* the *Minimum Capacity* (Minimum of Packing and Mixing Floors) is calculated for each product. Totals are given at the bottom.

The complete analysis procedure is summarized in FIGURE D1.

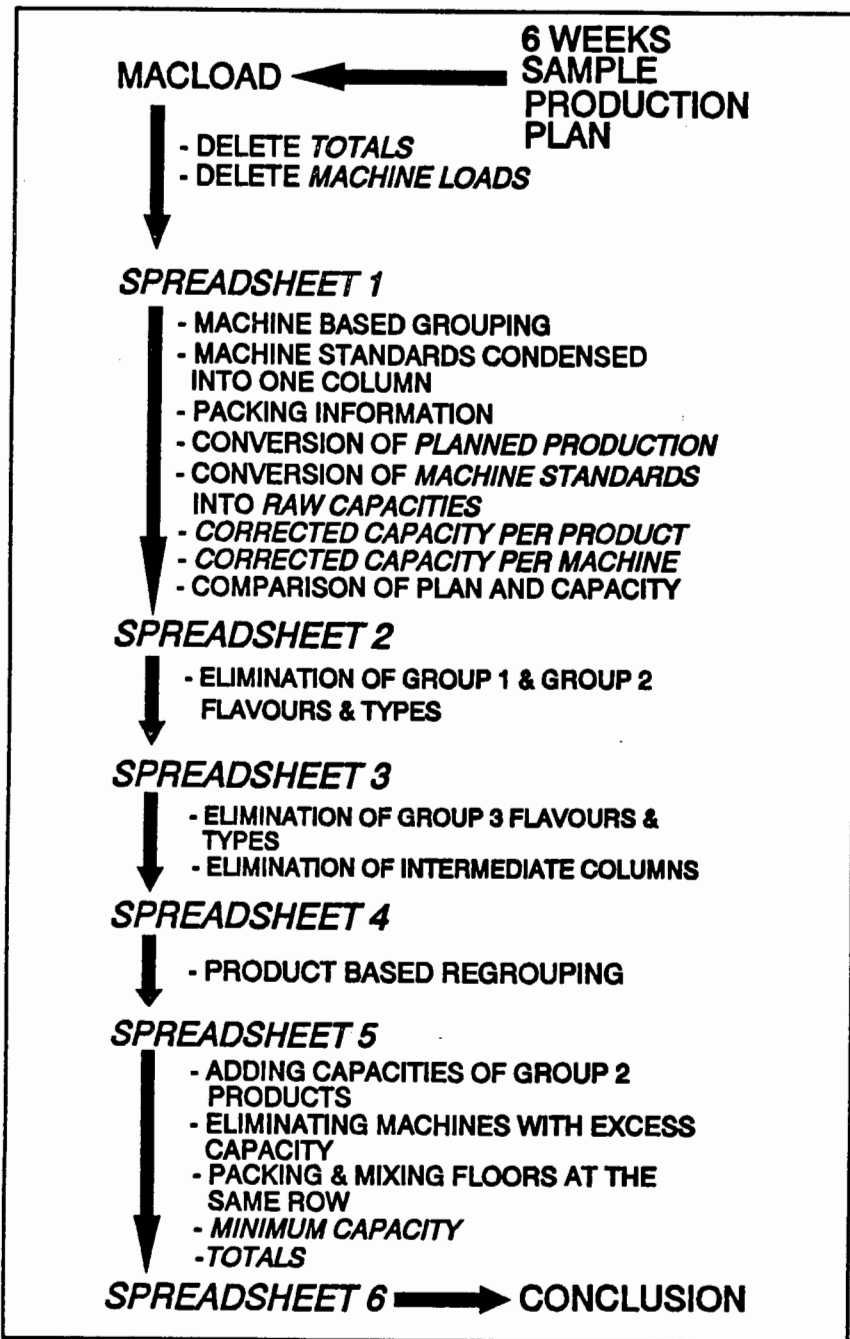


FIGURE D1

Illustration of Capacity Redistribution

The following case illustrates how the capacity can be redistributed by modifying some of the machines, to eliminate the capacity shortages.

There is capacity shortage for NAUTA 3 & 4 mixers at the Mixing Floor. The total shortage can be calculated by using

Column 10 of Spreadsheet 6.

$$\begin{aligned} & \Sigma \text{ Corrected Capacity - Planned Production for NAUTA 3 \& 4} \\ & = - 2.307 - 0.041 - 0.028 - 0.256 - 0.014 + 0.933 - 0.691 \\ & = - 2.404 \text{ Tons/Day} \end{aligned}$$

On the other hand, after a small modification, NAUTA 1 & 2 can share the workload of NAUTA 3 & 4 and by this way the capacity shortage can be eliminated to a large extend.

$$\begin{aligned} & \Sigma \text{ Corrected Capacity - Planned Production for NAUTA 1, 2, 3} \\ & \text{\& 4} \\ & = - 2.404 + 2.374 = - 0.03 \text{ Tons/Day} \end{aligned}$$

APPENDIX E

DETAILED EXPLANATION OF.....	1
PRODUCTION PLANNING POLICY MODEL 1	
PRODUCTION PLANNING POLICY MODEL 2...	2
PRODUCTION PLANNING POLICY MODEL 3...	2
PRODUCTION PLANNING POLICY MODEL 4...	4
PRODUCTION PLANNING POLICY MODEL 5...	5
PRODUCTION PLANNING POLICY MODEL 6...	6
STEP FUNCTION AND PRODUCTION.....	7
PLANNING POLICY MODEL 6T1	
PRODUCTION PLANNING POLICY MODEL 7...	9
PRODUCTION PLANNING POLICY MOD 7T1...	10
PRODUCTION PLANNING POLICY MODEL 8...	10
PULSE AND RAMP FUNCTIONS AND.....	12
TEST MODELS	

Detailed Explanation of Production Planning Policy Model 1

* PRODUCTION PLANNING POLICY MODEL 1

```

L   FGI.K=FGI.J+DT*(SPD.JK+OPD.JK-ORD.JK)
N   FGI=8
R   SPD.KL=CLIP(PLPD.K,CAP,CAP,PLPD.K)
R   OPD.KL=CLIP(PLPD.K-CAP,0,PLPD.K,CAP)
R   ORD.KL=TABLE(TORD,TIME.K,0,19,1)
T   TORD=3/4/6/9/5/2/3/8/5/4/3/4/6/9/5/2/3/8/5/4
A   PLPD.K=DFC.K-FGI.K+MSC
A   DFC.K=TABLE(TDFC,TIME.K,0,19,1)
T   TDFC=4/5/6/8/4/3/3/7/6/3/4/5/6/8/4/3/3/7/6/3
C   MSC=6
C   CAP=5

```

SAVE FGI,SPD,OPD

SPEC REL_ERR=.1/DT=1/LENGTH=19/SAVPER=1

In the calculation of first two rates (*Standard Production* and *Overtime Production*), *CLIP* function is used. It is one of the *Logical Functions* of DYNAMO. It selects the *FIRST* argument IF the *THIRD* is *GREATER* than or *EQUAL* to the fourth, otherwise it selects the second argument. Therefore it is also called *FIFGE* function. This function provides the equivalent of a *conditional branch* in general purpose computer languages. In the case of *Standard Production* (*SPD*), *CLIP* function is used to select between *Planned Production* (*PLPD*) and *Capacity* (*CAP*), whichever is smaller. Because in the real life, it is not possible to have a *Standard Production* which is bigger than the available *Capacity*. A similar logic is used in the calculation of *Overtime Production* (*OPD*).

TABLE function can express one variable in terms of its rather arbitrary relationship to another variable. In *Production Planning Model 1*, *TABLE* function is used to express *Orders* (*ORD*) and *Demand Forecast* (*DFC*) in terms of *TIME*. The values that are used by these functions are given in tables called *TORD* (*Orders Table*) and *TDFC* (*Demand Forecasts Table*).

Minimum Stock Cover (*MSC*) and *Capacity* (*CAP*) are assumed to be constant in this first modelling exercise. *MSC* and *CAP* values and also the values used in the tables have a meaning relative to each other. In other words, it is the ratio between them which is important and not their absolute values.

The last two lines of the model shows which variables are to be saved, what is the *Relative Error* (integration interval), what is the time between simulation periods (*DT*), what is the *Length* of the simulation (in periods) and per how many

periods results will be saved (Savper).

Production Planning Policy Model 2

```
*      PRODUCTION PLANNING POLICY MODEL 2
*      CHANGES: 1 MNTH LAPSE FOR TDFC /MSC=DFC

L      FGI.K=FGI.J+DT*(SPD.JK+OPD.JK-ORD.JK)
N      FGI=8
R      SPD.KL=CLIP(PLPD.K,CAP,CAP,PLPD.K)
R      OPD.KL=CLIP(PLPD.K-CAP,0,PLPD.K,CAP)
R      ORD.KL=TABLE(TORD,TIME.K,0,19,1)
T      TORD=3/4/6/9/5/2/3/8/5/4/3/4/6/9/5/2/3/8/5/4
A      PLPD.K=DFC.K-FGI.K+MSC.K
A      DFC.K=TABLE(TDFC,TIME.K,0,19,1)
T      TDFC=3/3/5/6/8/6/4/5/7/4/3/3/6/8/7/3/3/5/7/6
A      MSC.K=DFC.K
C      CAP=5
```

```
SAVE FGI,SPD,OPD
SPEC REL_ERR=.1/DT=1/LENGTH=19/SAVPER=1
```

Production Planning Policy Model 2 is very similar to the first model. There is a difference in Demand Forecast Tables (TDFC) and also in the calculation of Minimum Stock Cover (MSC).

Both models represent the system described in FLOW DIAGRAM 1. In *Production Planning Policy Models 1 & 2, Standard Production and Overtime Production* play the same role as *Total Production* in FLOW DIAGRAM 1. *Total Production* is simply equal to the sum of *Standard Production* and *Overtime Production*.

Production Planning Policy Model 3

PRODUCTION PLANNING POLICY MODEL 3 which is given below is the encoded form of FLOW DIAGRAM 2.

```
*      PRODUCTION PLANNING POLICY MODEL 3
*      CHANGES: FGI=6 /LENGTH=38 /+MCV

L      FGI.K=FGI.J+DT*(SPD.JK+OPD.JK-ORD.JK)
N      FGI=6
R      SPD.KL=CLIP(PLPD.K,CAP,CAP,PLPD.K)
R      OPD.KL=CLIP(PLPD.K-CAP,0,PLPD.K,CAP)
```

```

R   ORD.KL=TABLE(TORD,TIME.K,0,38,1)
T   TORD=3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4/6^
    /3/4/6/9/5/2/3/8/5/4/3/4/6
A   PLPD.K=DFC.K-FGI.K+MSC.K
A   DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T   TDFC=3/3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6^
    /3/3/5/6/8/6/4/5/7/4/3/3/6
A   MSC.K=DFC.K
A   MCV.K=FGI.K/DFC.K
C   CAP=5

```

```

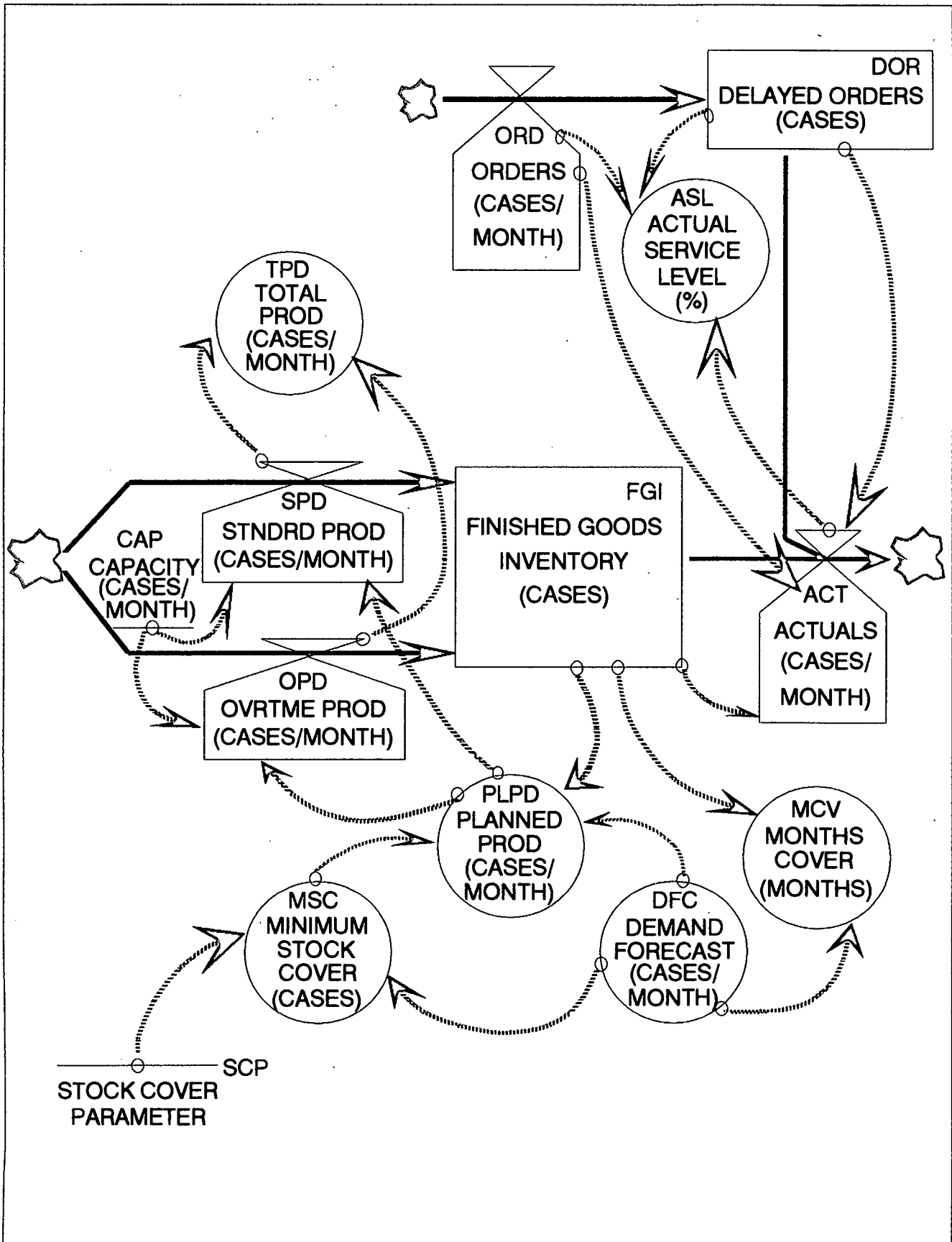
SAVE FGI,SPD,OPD,MCV
SPEC REL_ERR=.1/DT=1/LENGTH=38/SAVPER=1

```

Compared to the previous one, there are three changes in this model. The initial value of *Finished Goods Inventory* (*FGI*) is reduced to 6, *Length* of the simulation is increased to 38 periods (therefore more values are added to Tables) and an auxiliary variable called *Months Cover* (*MCV*) is included in the model.

From this stage on, previous causal loop diagrams are only used as a reference. The model development is mainly based on the cyclic process described in FIGURE 8. FLOW DIAGRAM 3 is obtained by developing the FLOW DIAGRAM 2 and not by converting the CAUSAL LOOP DIAGRAM 3. Only the auxiliary variable *Actual Service Level* (*ASL*) is taken from CAUSAL LOOP DIAGRAM 3.

In the real life, it is not always possible supply whatever is ordered and this results in a *backlog*. In FLOW DIAGRAM 3 an additional material flow (straight blue arrow) is used to accomodate for *Delayed Orders* (*DOR*). *Orders* (*ORD*), *Delayed Orders* and *Actuals* (*ACT*) are used for calculating the *Actual Service Level* which is also a new variable. The formula of *Finished Goods Inventory* (*FGI*) is modified according to this flow structure. Another modification is done in the calculation of *Overtime Production* (*OPD*) by reducing the maximum possible overtime production to 1/2 of the available capacity. In the calculation of *Minimum Stock Cover* an additional parameter called *Stock Cover Parameter* is used for testing purposes in later stages. Finally, an auxiliary variable used to express and to monitor the *Total Production*.



FLOW DIAGRAM 3

Production Planning Policy Model 4

The list of modifications and additions is given at the second and third lines of PRODUCTION PLANNING POLICY MODEL 4. This model corresponds to FLOW DIAGRAM 3.

```

*   PRODUCTION PLANNING POLICY MODEL 4
*   CHANGES: MOD> FGI, OPD, MSC
*               ADD> TPD, DOR, ASL, ACT, SCP

L   FGI.K=FGI.J+DT*(SPD.JK+OPD.JK-ACT.JK)
N   FGI=6
R   SPD.KL=CLIP(PLPD.K,CAP,CAP,PLPD.K)
R   OPD.KL=CLIP(CLIP(PLPD.K-CAP,0,PLPD.K,CAP),.5*CAP,.5*CAP,^
PLPD.K-CAP)
R   ACT.KL=CLIP(ORD.KL+DOR.K,FGI.K,FGI.K,ORD.KL+DOR.K)
L   DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)
N   DOR=0
R   ORD.KL=TABLE(TORD,TIME.K,0,38,1)
A   ASL.K=ACT.KL/(ORD.KL+DOR.K)
T   TORD=3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4/6^
/3/4/6/9/5/2/3/8/5/4/3/4/6
A   PLPD.K=DFC.K-FGI.K+MSC.K
A   DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T   TDFC=3/3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6^
/3/3/5/6/8/6/4/5/7/4/3/3/6
A   MSC.K=SCP*DFC.K
A   MCV.K=FGI.K/DFC.K
A   TPD.K=SPD.KL+OPD.KL
C   CAP=5
C   SCP=1.5

SAVE FGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD
SPEC REL_ERR=.1/DT=1/LENGTH=38/SAVPER=1

```

Production Planning Policy Model 5

PRODUCTION PLANNING POLICY MODEL 5 is an intermediate attempt to generate a more realistic model behaviour. The major change here, is an additional auxiliary variable called *Final Finished Goods Inventory* (*FFGI*) which is used in the calculation of *Planned Production* instead of *Finished Goods Inventory*. *FFGI* is equal to *FGI* - *ACT*. But in contradiction with what is expected, this final modification did not make the model behaviour more realistic but just the opposite. The reason for this was that, *Actuals* were already deducted from *Finished Goods Inventory* when calculating *FGI* and therefore it was unrealistic to deduct it again in the calculation of *FFGI*.

PRODUCTION PLANNING POLICY MODEL 5 is given as an example of an unsuccessful attempt. This kind of situations are quite usual when developing models. After all, modelling is an activity which is based, to some extent, on trial and error. The critical skill is to be able to draw necessary conclusions from the comparison of the model behaviour and the actual behaviour of the system (refer to FIGURE 8), in order to develop representative models.

```

*   PRODUCTION PLANNING POLICY MODEL 5
*   CHANGES: MOD> SCP, TDFC, TORD, PLPD
*           ADD> FFGI

L   FGI.K=FGI.J+DT*(SPD.JK+OPD.JK-ACT.JK)
N   FGI=4
R   SPD.KL=CLIP(PLPD.K,CAP,CAP,PLPD.K)
R   OPD.KL=CLIP(CLIP(PLPD.K-CAP,0,PLPD.K,CAP),.5*CAP,.5*CAP,^
PLPD.K-CAP)
R   ACT.KL=CLIP(ORD.KL+DOR.K,FGI.K,FGI.K,ORD.KL+DOR.K)
L   DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)
N   DOR=0
R   ORD.KL=TABLE(TORD,TIME.K,0,38,1)
A   ASL.K=ACT.KL/(ORD.KL+DOR.K)
T   TORD=3/3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4^
/6/3/4/6/9/5/2/3/8/5/4/3/4
A   PLPD.K=DFC.K-FFGI.K+MSC.K
A   DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T   TDFC=3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6/3^
/3/5/6/8/6/4/5/7/4/3/3/5/5
A   MSC.K=SCP*DFC.K
A   MCV.K=FGI.K/DFC.K
A   TPD.K=SPD.KL+OPD.KL
A   FFGI.K=FGI.K-ACT.KL
C   CAP=5
C   SCP=1

```

```

SAVE FGI,FFGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD
SPEC REL_ERR=.1/DT=1/LENGTH=38/SAVPER=1

```

Production Planning Policy Model 6

The final model is presented in FLOW DIAGRAM 4 (see CHAPTER 6) and the corresponding DYNAMO codes are given in PRODUCTION PLANNING POLICY MODEL 6.

```

*   PRODUCTION PLANNING POLICY MODEL 6
*   CHANGES: MOD> FGI, SPD, OPD, TPD, ACT, PLPD
*           DEL> FFGI, REL_ERR

L   FGI.K=FGI.J+DT*(TPD.JK-ACT.JK)

```

```

N   FGI=2
A   SPD.K=MIN(PLPD.K,CAP)
A   OPD.K=MIN(CLIP(PLPD.K-CAP,0,PLPD.K,CAP),.5*CAP)
R   TPD.KL=SPD.K+OPD.K
R   ACT.KL=MIN(ORD.KL+DOR.K,FGI.K+TPD.KL)
L   DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)
N   DOR=0
R   ORD.KL=TABLE(TORD,TIME.K,0,38,1)
A   ASL.K=ACT.KL/(ORD.KL+DOR.K)
T   TORD=3/3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4^
      /6/3/4/6/9/5/2/3/8/5/4/3/4
A   PLPD.K=MAX(DFC.K-FGI.K+MSC.K,0)
A   DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T   TDFC=3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6/3^
      /3/5/6/8/6/4/5/7/4/3/3/5/5
A   MSC.K=SCP*DFC.K
A   MCV.K=FGI.K/DFC.K
C   CAP=5
C   SCP=1

```

```

SAVE FGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD
SPEC DT=1/LENGTH=38/SAVPER=1

```

FLOW DIAGRAM 4 is quite similar to FLOW DIAGRAM 3 (see APPENDIX E for FLOW DIAGRAM 3). Same variables are used in both of them. The most noticeable difference is that, in FLOW DIAGRAM 4, *Total Production* is shown as a rate while *Standard Production* and *Overtime Production* are shown as auxiliary variables. In FLOW DIAGRAM 3 the situation is just the opposite. From computational aspect, this does not make any difference and it does not change the model behaviour. The second modification that can be observed in FLOW DIAGRAM 4 is an information link which is established between *Total Production* and *Actuals*. This link changes slightly the way how *Actuals* are calculated. According to the new way of calculation, whatever is produced during this period (*Total Production*) can be shipped together with the *Actuals* of this period. In the previous model, it was not possible to do that. Whatever produced in this period could only be shipped in the next period. The third difference can only be observed in the listing of the DYNAMO model (i.e PRODUCTION PLANNING POLICY MODEL 6). Here, CLIP function which is used in the calculation of *SPD*, *OPD* and *ACT* is replaced by *MIN* function. From functional point of view they both do exactly the same thing. The advantage of *MIN* function is that, it allows to use a shorter DYNAMO statement.

STEP Function and Production Planning Policy Model 6T1

STEP function is one of the *test input functions* of DYNAMO. Functions in this category are used to test the model's

behaviour in response to outside influences, or they can be used to model time-triggered events. Other similar test input functions are, the PULSE function and the RAMP function.

The STEP function can be used whenever it is necessary to simulate a sudden step change in a system rate. The general DYNAMO form of the STEP function is :

STEP(*height*,*steptm*)

where *height* is the height of the STEP, and *steptm* is the abbreviation for step time, the time when the STEP increase occurs. Any numerical value can be used for *height* and *steptm*. The STEP is equal to zero until the TIME becomes equal to *steptm*. The TIME is equal to zero in the beginning of the simulation. It is automatically increased by one at every period until it becomes equal to LENGTH.

PPPM6 is modified in the following way in order to simulate the STEP increase of Orders.

```
* PRODUCTION PLANNING POLICY MODEL 6T1 (STEP TEST)
* CHANGES: MOD> ORD
* ADD> HGT, TM

L FGI.K=FGI.J+DT*(TPD.JK-ACT.JK)
N FGI=2
A SPD.K=MIN(PLPD.K,CAP)
A OPD.K=MIN(CLIP(PLPD.K-CAP,0,PLPD.K,CAP),.5*CAP)
R TPD.KL=SPD.K+OPD.K
R ACT.KL=MIN(ORD.KL+DOR.K,FGI.K+TPD.KL)
L DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)
N DOR=0
R ORD.KL=TABLE(TORD,TIME.K,0,38,1)+STEP(HGT,TM)
A ASL.K=ACT.KL/(ORD.KL+DOR.K)
T TORD=3/3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4^
/6/3/4/6/9/5/2/3/8/5/4/3/4
A PLPD.K=MAX(DFC.K-FGI.K+MSC.K,0)
A DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T TDFC=3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6/3^
/3/5/6/8/6/4/5/7/4/3/3/5/5
A MSC.K=SCP*DFC.K
A MCV.K=FGI.K/DFC.K
C CAP=5
C SCP=1
C HGT=1
C TM=15

SAVE FGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD
SPEC DT=1/LENGTH=38/SAVPER=1
```

STEP function is added to end of the formula calculating the

rate *ORD*.

R $ORD.KL=TABLE(TORD, TIME.K, 0, 38, 1)+STEP(HGT, TM)$

HGT is the height and *TM* is the time of the STEP. These parameters are defined as constants (annotated with letter C) at the end of the model.

C HGT=1

C TM=15

Due to this modification, *Orders* go up by 1 hundred tons per month from period 15 on in addition to the values given in table *TORD*. The increase induced by the STEP function is permanent until the end of the simulation.

Production Planning Policy Model 7

MPD effects the way *PLPD* is calculated. As it can be seen in PRODUCTION PLANNING POLICY MODEL 7, *Planned Production* is now calculated in the following way :

A $PLPD.K=MAX(DFC.K-FGI.K+MSC.K, MPD)$

According to this formula, the *Planned Production* is equal to the sum of *Demand Forecast* and *Minimum Stock Cover* minus *Finished Goods Inventory* or to *Minimum Production* (300 tons/month), whichever is greater. In other words, the new way of calculating the *Planned Production* does not allow any production which is less than *MPD*.

* PRODUCTION PLANNING POLICY MODEL 7

* CHANGES: MOD> PLPD

* ADD> MPD

L $FGI.K=FGI.J+DT*(TPD.JK-ACT.JK)$

N FGI=2

A $SPD.K=MIN(PLPD.K, CAP)$

A $OPD.K=MIN(CLIP(PLPD.K-CAP, 0, PLPD.K, CAP), .5*CAP)$

R $TPD.KL=SPD.K+OPD.K$

R $ACT.KL=MIN(ORD.KL+DOR.K, FGI.K+TPD.KL)$

L $DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)$

N DOR=0

R $ORD.KL=TABLE(TORD, TIME.K, 0, 38, 1)$

A $ASL.K=ACT.KL/(ORD.KL+DOR.K)$

T $TORD=3/3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4^$
 $/6/3/4/6/9/5/2/3/8/5/4/3/4$

A $PLPD.K=MAX(DFC.K-FGI.K+MSC.K, MPD)$

```

A   DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T   TDFC=3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6/3^
    /3/5/6/8/6/4/5/7/4/3/3/5/5
A   MSC.K=SCP*DFC.K
A   MCV.K=FGI.K/DFC.K
C   CAP=5
C   SCP=1
C   MPD=3

```

```

SAVE FGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD
SPEC DT=1/LENGTH=38/SAVPER=1

```

Production Planning Policy Model 7T1

```

*   PRODUCTION PLANNING POLICY MODEL 7T1 (STEP)
*   CHANGES: MOD> PLPD
*           ADD> MPD

L   FGI.K=FGI.J+DT*(TPD.JK-ACT.JK)
N   FGI=2
A   SPD.K=MIN(PLPD.K,CAP)
A   OPD.K=MIN(CLIP(PLPD.K-CAP,0,PLPD.K,CAP),.5*CAP)
R   TPD.KL=SPD.K+OPD.K
R   ACT.KL=MIN(ORD.KL+DOR.K,FGI.K+TPD.KL)
L   DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)
N   DOR=0
R   ORD.KL=TABLE(TORD,TIME.K,0,38,1)+STEP(HGT,TM)
A   ASL.K=ACT.KL/(ORD.KL+DOR.K)
T   TORD=3/3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4^
    /6/3/4/6/9/5/2/3/8/5/4/3/4
A   PLPD.K=MAX(DFC.K-FGI.K+MSC.K,MPD)
A   DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T   TDFC=3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6/3^
    /3/5/6/8/6/4/5/7/4/3/3/5/5
A   MSC.K=SCP*DFC.K
A   MCV.K=FGI.K/DFC.K
C   CAP=5
C   SCP=1
C   MPD=3
C   HGT=1
C   TM=15

```

```

SAVE FGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD
SPEC DT=1/LENGTH=38/SAVPER=1

```

The only difference between PPPM7 and PPPM7T1 is the additional STEP function which is used in the calculation of Orders (ORD). This function is simulating the unexpected market demand increase.

Production Planning Policy Model 8

```

*   PRODUCTION PLANNING POLICY MODEL 8
*   CHANGES: MOD> PLPD
*           ADD> CGP, CPR, RFC

L   FGI.K=FGI.J+DT*(TPD.JK-ACT.JK)
N   FGI=2
A   SPD.K=MIN(PLPD.K,CAP)
A   OPD.K=MIN(CLIP(PLPD.K-CAP,0,PLPD.K,CAP),.5*CAP)
R   TPD.KL=SPD.K+OPD.K
R   ACT.KL=MIN(ORD.KL+DOR.K,FGI.K+TPD.KL)
L   DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)
N   DOR=0
R   ORD.KL=TABLE(TORD,TIME.K,0,38,1)
A   ASL.K=ACT.KL/(ORD.KL+DOR.K)
T   TORD=3/3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4^
      /6/3/4/6/9/5/2/3/8/5/4/3/4
L   CGP.K=CGP.J+DT*(ORD.JK-TPD.JK)
N   CGP=0
A   CPR.K=1+RFC*CGP.K
A   PLPD.K=MAX(CPR.K*(DFC.K-FGI.K+MSC.K),MPD)
A   DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T   TDFC=3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6/3^
      /3/5/6/8/6/4/5/7/4/3/3/5/5
A   MSC.K=SCP*DFC.K
A   MCV.K=FGI.K/DFC.K
C   CAP=5
C   SCP=1
C   MPD=3
C   RFC=.08

SAVE FGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD,CPR
SPEC DT=1/LENGTH=38/SAVPER=1

```

There are three additions and one modification in PPPM8. Additions are, the level called *Cumulative Gap* (*CGP*), the auxiliary variable called *Correction Parameter* (*CPR*) and the constant called *Reduction Factor* (*RFC*). The modification is done to *PLPD* by adding *CPR* into its formula.

```
A   PLPD.K=MAX(CPR.K*(DFC.K-FGI.K+MSC.K),MPD)
```

This formula allows *Correction Parameter* to adjust the *PLPD* value which is calculated in the usual way (*DFC - FGI + MSC*), according to the feed-back coming from *Cumulative Gap*.

Correction Parameter is calculated in the following way.

```
A   CPR.K=1+RFC*CGP.K
```

Reduction Factor (RFC) is a coefficient that can change the influence level of *Cumulative Gap (CGP)*. After several trial and errors, it is found that 0.08 is the right value to use as *RFC*.

Finally, the new monitoring criteria *Cumulative Gap* is calculated as :

$$L \quad CGP.K = CGP.J + DT * (ORD.JK - TPD.JK)$$

This is a typical level formula which is computing the cumulative gap between *Orders* and *Total Production*. It calculates and updates the actual performance of the production system and sends it immediately to *PLPD* as a feedback.

PULSE and RAMP Functions and Test Models

DYNAMO has two more test functions that can simulate two other types of fluctuations. These are PULSE and RAMP functions.

PULSE function has the form :

$$PULSE(\text{height}, \text{width}, \text{first}, \text{intrvl})$$

In this equation *height* is the pulse height, *width* is the pulse width, *first* is the time of the first pulse and *intrvl* is the interval between pulses. PULSE function provides a train of pulses which are of width *width* and height *height*. The first pulse appears at $\text{TIME} = \text{first}$ and subsequent pulses appear at $\text{TIME} = \text{first} + \text{intrvl}$, $\text{first} + 2 * \text{intrvl}$, $\text{first} + 3 * \text{intrvl}$, and so on.

STEP function induces a sudden shift in *Orders* at $\text{TIME} = \text{steptm}$ and of size=*height*. *Orders* stay at that shifted level until the end of the simulation. STEP function is a good tool for testing the adaptation ability of the system to a sudden and permanent change in the environment. Whereas PULSE function generates a cyclic temporary change. Differently from STEP function, it allows to monitor what system does when everything goes back to the normal.

```
*   PRODUCTION PLANNING POLICY MODEL 8T2 (PULSE)
*   CHANGES: MOD> PLPD
*             ADD> CGP, CPR, RFC
```

$$L \quad FGI.K = FGI.J + DT * (TPD.JK - ACT.JK)$$

$$N \quad FGI = 2$$

```

A   SPD.K=MIN(PLPD.K,CAP)
A   OPD.K=MIN(CLIP(PLPD.K-CAP,0,PLPD.K,CAP),.5*CAP)
R   TPD.KL=SPD.K+OPD.K
R   ACT.KL=MIN(ORD.KL+DOR.K,FGI.K+TPD.KL)
L   DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)
N   DOR=0
R   ORD.KL=TABLE(TORD,TIME.K,0,38,1)+PULSE(HGT,WDT,TM,INT)
A   ASL.K=ACT.KL/(ORD.KL+DOR.K)
T   TORD=3/3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4^
      /6/3/4/6/9/5/2/3/8/5/4/3/4
L   CGP.K=CGP.J+DT*(ORD.JK-TPD.JK)
N   CGP=0
A   CPR.K=1+RFC*CGP.K
A   PLPD.K=MAX(CPR.K*(DFC.K-FGI.K+MSC.K),MPD)
A   DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T   TDFC=3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6/3^
      /3/5/6/8/6/4/5/7/4/3/3/5/5
A   MSC.K=SCP*DFC.K
A   MCV.K=FGI.K/DFC.K
C   CAP=5
C   SCP=1
C   MPD=3
C   RFC=.08
C   HGT=1
C   TM=5
C   WDT=5
C   INT=10

```

```

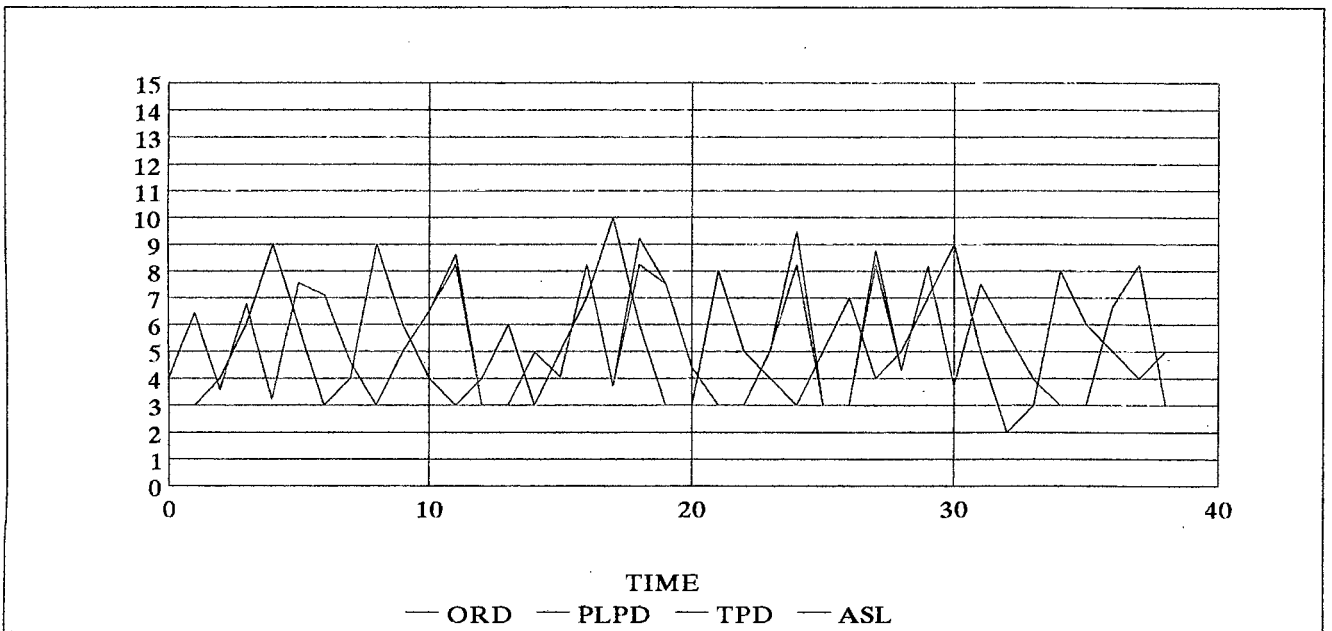
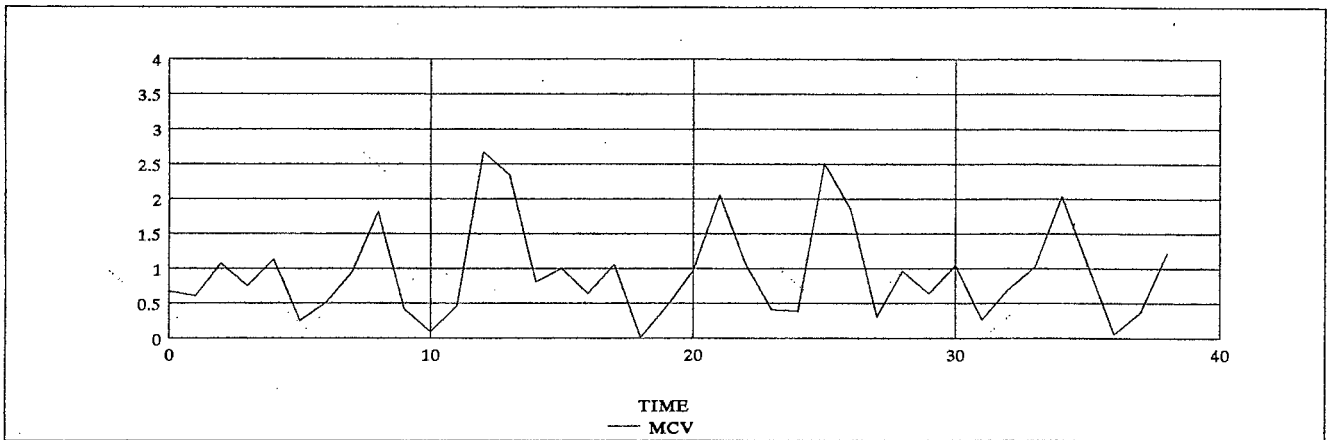
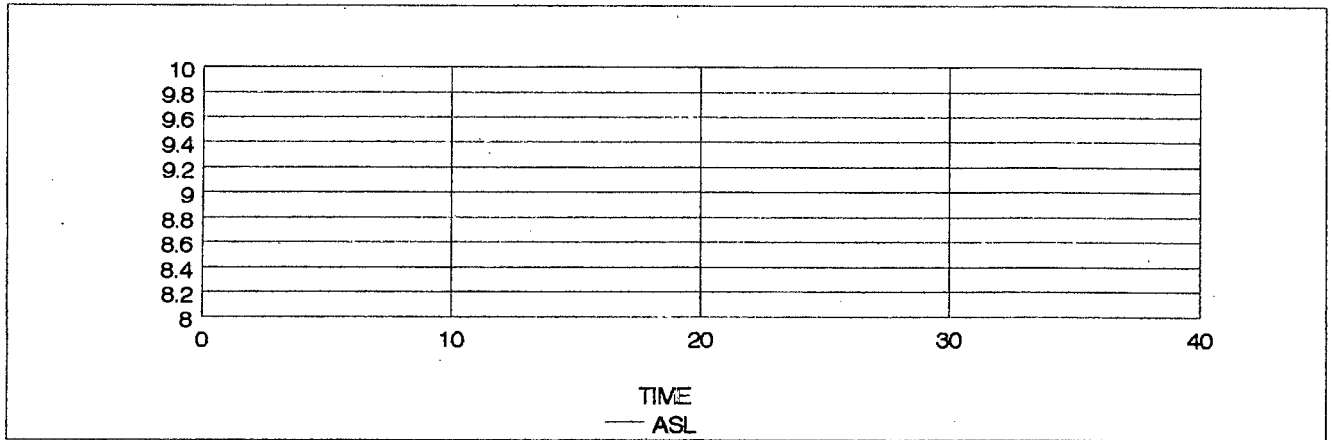
SAVE FGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD,CPR
SPEC DT=1/LENGTH=38/SAVPER=1

```

In the DYNAMO model which is used to simulate the PULSE increase of orders, STEP function has been replaced by PULSE function in the equation of *Orders*. According to constants given at the end of the model, PULSE has a height of 100 tons ($HGT=1$), the first one happens at period 5, the second one at period 15 ($INT=10$), the third one at period 25, the last one at period 35 and they all last for 5 periods ($WDT=5$).

For the purpose of this study it is important to see whether ASL stays at 100 %, whether there is an inventory build up and how *PLPD* behaves under PULSE test conditions. Simulation results given in GRAPH SET 3.6 show that, PPPM8 (with $CAP=5.5$) maintains the ASL at 100 % and it does not build-up more *MCV* than the previous case (STEP test). In other words, its production planning function (*PLPD*) can adapt itself to unexpected demand fluctuations which are simulated by the PULSE test.

PPPM8T2/PULSE TEST (CAP=5.5 SCP=1)



GRAPH SET 3.6

The last test that will be applied to PPPM8 is called a RAMP test. RAMP function which is used in this test has the form :

RAMP(slope,start)

RAMP function simulates a slow, gradual increase which starts at TIME=start and which goes up an amount of slope at each period thereafter.

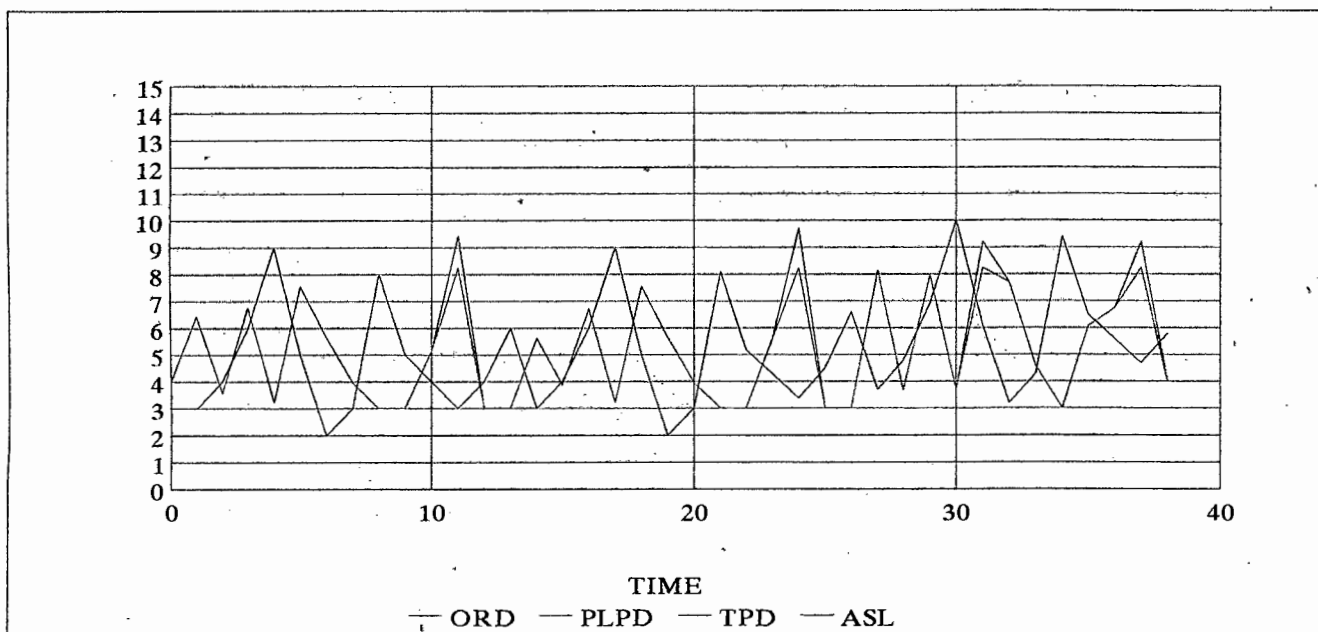
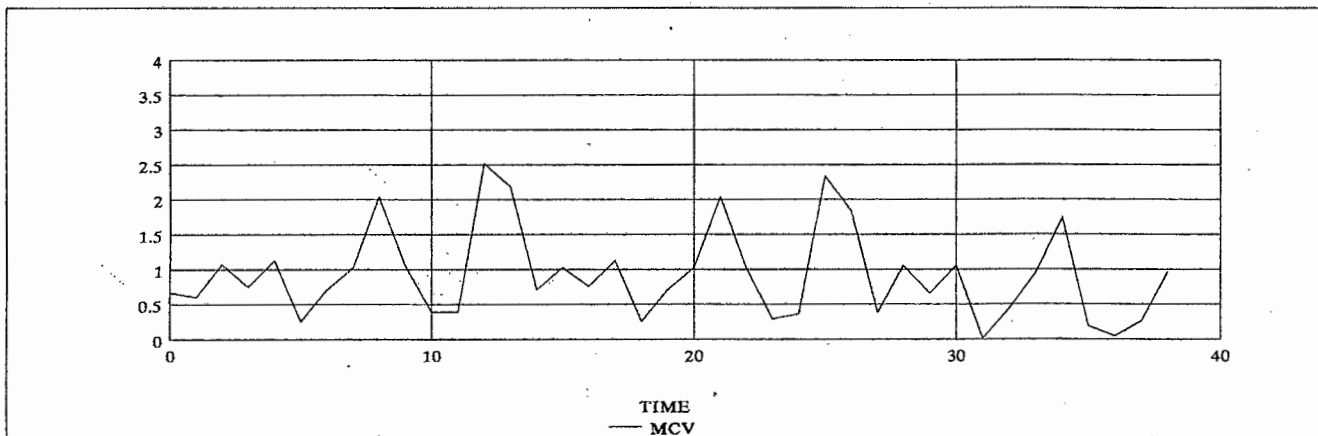
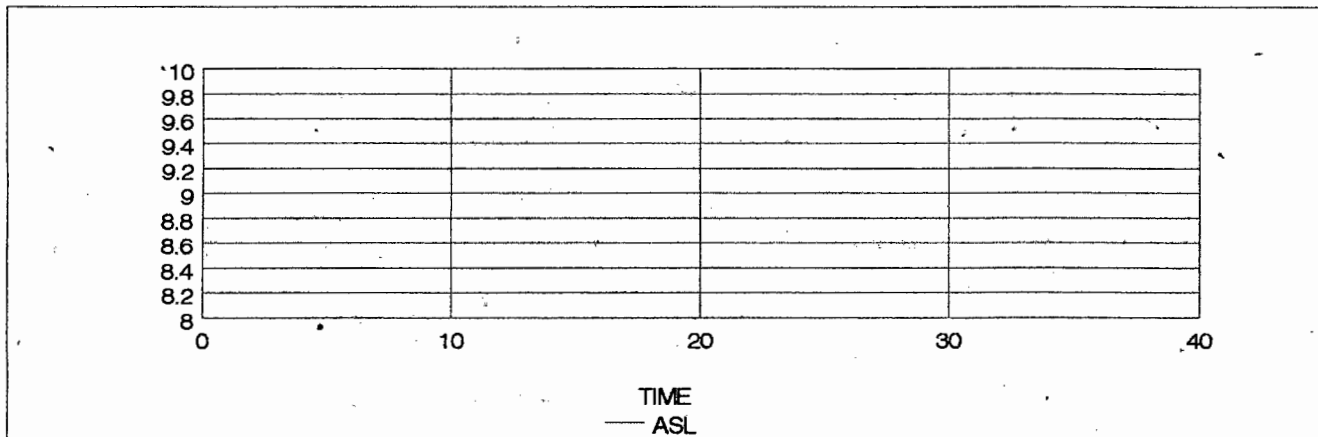
In the real life some systems can detect and respond to a sudden change in their environment but they may fail to notice a slow, gradual change over time. In some cases, this deficiency may have fatal consequences for the system (boiled frog syndrome). In this study RAMP test is used to check whether PPPM8 has such a deficiency. DYNAMO model used for this purpose is given below.

```
*      PRODUCTION PLANNING POLICY MODEL 8T3 (RAMP)
*      CHANGES: MOD> PLPD
*              ADD> CGP, CPR, RFC

L      FGI.K=FGI.J+DT*(TPD.JK-ACT.JK)
N      FGI=2
A      SPD.K=MIN(PLPD.K,CAP)
A      OPD.K=MIN(CLIP(PLPD.K-CAP,0,PLPD.K,CAP),.5*CAP)
R      TPD.KL=SPD.K+OPD.K
R      ACT.KL=MIN(ORD.KL+DOR.K,FGI.K+TPD.KL)
L      DOR.K=DOR.J+DT*(ORD.JK-ACT.JK)
N      DOR=0
R      ORD.KL=TABLE(TORD,TIME.K,0,38,1)+RAMP(SLP,TM)
A      ASL.K=ACT.KL/(ORD.KL+DOR.K)
T      TORD=3/3/4/6/9/5/2/3/8/5/4/3/4/6/3/4/6/9/5/2/3/8/5/4/3/4^
        /6/3/4/6/9/5/2/3/8/5/4/3/4
L      CGP.K=CGP.J+DT*(ORD.JK-TPD.JK)
N      CGP=0
A      CPR.K=1+RFC*CGP.K
A      PLPD.K=MAX(CPR.K*(DFC.K-FGI.K+MSC.K),MPD)
A      DFC.K=TABLE(TDFC,TIME.K,0,38,1)
T      TDFC=3/5/6/8/6/4/5/7/4/3/3/6/3/3/5/6/8/6/4/5/7/4/3/3/6/3^
        /3/5/6/8/6/4/5/7/4/3/3/5/5
A      MSC.K=SCP*DFC.K
A      MCV.K=FGI.K/DFC.K
C      CAP=5
C      SCP=1
C      MPD=3
C      RFC=.08
C      SLP=.1
C      TM=20

SAVE FGI,SPD,OPD,MCV,ACT,DOR,ASL,TPD,ORD,PLPD,CPR
SPEC DT=1/LENGTH=38/SAVPER=1
```

PPPM8T3/RAMP TEST (CAP=5.5 SCP=1)



GRAPH SET 3.7

This time RAMP function has replaced the previous PULSE function in the equation of *Orders*. The RAMP increase of *Orders* starts at month 20 ($TM=20$) and goes up by 10 tons ($SLP=.1$) every month thereafter.

According to simulation results given in GRAPH SET 3.7, PPPM8 can detect and cope with slow, gradual and continuous demand increase situations as well. 100 % *ASL*, a relatively low *MCV* and a regular pattern of *PLPD* and *TPD* are supporting this opinion.