# Conflicts and Compatibilities in the Priorities Axes in the Architecture of the Production Systems[1]

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*Abstract*

*In an economic environment where more and more emphasis is being placed on increasing company's performance and on the continuous improvement of business processes, companies face new challenges. On one hand they must address the existing market demand strictly observing the requirements of customers and the conditions imposed by competitors, on the other hand they should use the resources available in an effective manner in terms of lowest incurred costs and highest efficiency level. From this perspective, the article outlines the need to introduce systems of priority management in order to ensure the balance between the decisions in company's internal environment and the external environment's restrictions. The approach of priorities by companies' management has an overwhelming role in the process of correlating the available resources and capacity with the set objectives. Considering these aspects, the present article aims at defining a coordinate system as a reference point for identifying and managing companies' priorities.*

**Keywords:** *priority management, priority axes and rules, long-term thinking, the goal of the business*

**JEL Classification System: M10, M11**

## Introduction

Priorities are governing our society and our lives. They are amplifying due to age and life experience, which may explain why establishing a limited number of priorities and focusing on them are some of the most difficult challenges managers are facing nowadays. Many of them think that everything is important and cannot give up anything without suffering serious consequences. But if everything becomes a priority, then nothing is a priority. What is worse is that staff at lower levels, faced with the (impossible) task to meet all requirements, gets to decide what is most important based on their narrower perception of company's strategy and on their ability to solve problems. Leaving those few key priorities

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unsolved, team leaders and teams in general delegate the prioritization task unintentionally to others. People have to try to forecast, prepare, improve and be prepared for reacting in the most efficient way possible for them and for the ones depending on them. (Năstase, Barbu, 2011)

Most companies communicate their set priorities as part of their strategic plan. In time, however, the clarity of these priorities is lost. From this perspective, the need for a common framework for priority setting is more and more visible, starting from the overall objective of the company, what the management has in view be obtain, crossing the organizational ladder to the molecular level and making the connection with what can be achieved given the limitations of each structure and each individual.

This paper considers the priority from the business perspective, as an activity, an objective and a policy which, by its degree of importance, is entitled to have a relative right to the allocation of the organization's scarce resources. This necessity is explained through the fact that if resources were unlimited, there would be no need to weight decisions and to rank priorities. One could have it all.

The article starts with the hypothesis that in the current economy, a balance between the continuously diversifying needs and the organization's resources becoming increasingly scarce is essential. The article develops this hypothesis, however, proposing an approach of priority management in organizations through an integrated system on three axes of analysis: time horizon, hierarchical levels, and insight, bringing the company closer to the set objectives.

## 1. Literature review

In this section we will describe some of the most significant and utilized priority management tools.

### *1.1 Scheduling*

It deals with the coordination of operations. There are a number of decisions that affect scheduling. Planning decisions are based on capacity planning, which includes all facilities and equipments available. Plans related to capacity are usually made annually or quarterly as new equipment or building acquisitions are made, or as these equipments are disposed of. (Jacobs et al., 2009)

The scheduling task is one that refers to the allocation and prioritization according to the demand taking into account the available resources. Two significant factors in achieving this allocation and in determining priorities are: the type of planning (forward and backward) and the criteria used for priorities.

### *1.2 Aggregate Planning*

Also known as aggregate scheduling, it deals with the determination of quantities and the coordination of production for the near future, usually with 3 to 18 months before. Operational management is trying to determine the best way to meet forecasted demand by adjusting production indices, work levels, inventory levels, overtime work, subcontracting rates and other variables that can be controlled. Usually aggregate planning's objective is to minimize the cost for the planning period. (Bărbulescu, Bâgu, 2002) However, other aspects of strategic relevance may be more important than minimizing costs. These strategies may also consider the homogenization of employment levels, the reduction of inventory levels or the rendering of high level services. For producers, aggregate planning creates a link between the strategic objectives and the production plans.

### *1.3 Goldratt's 99/1 rule*

It is based on the TOC principle that every system has a governing element dictating its functioning and uses the DBR methodology to emphasize the importance of the dependence between systems's compounding elements and the acknowledgement of a certain degree of variation. (Goldratt, Cox, 2004).

The 99/1 rule is a derivative of the 80/20 principle with the difference that Goldratt (2004) insists on the impact the constraint resource has on the overall performance of the system; he observed that if all the elements are interrelated, then it is enough to have one factor in the system to influence the major part of the outcome, not necessarily 20%. In our situation, the execution of one operation might depend on finishing others; or the final product to be delivered to the client is the result of several operations performed at many work centers simultaneously.

### *1.4 Pareto Principle or the 80/20 rule*

The principle, proposed for the first time by the Italian economist Vilfredo Pareto was originally a mathematical algorithm of non equal distribution which could be applied to most things. It underlines the basic idea that a major part of the results of a process, activity and so on is determined by a minority of inputs. Therefore the principle can be a very useful tool to help managers focus their time, resources and the efforts on those factors that contribute most to the outcome of their businesses. In other words, this principle gives the same arguments as the effectiveness and efficiency theory: working smart on everything is an unnecessary consumption of energy; instead the priority should be given to those activities that are worth working smart on.

## 2. Priorities in the production processes – time axis and hierarchical axis

The planning process and by default, the setting of priorities begins with demand forecast. It can address problems in the short, medium and long term. Long-term projections help managers solve strategic problems related to capacity and they are the responsibility of senior management. Figure 1 illustrates the time horizon and the characteristics of the planning process.

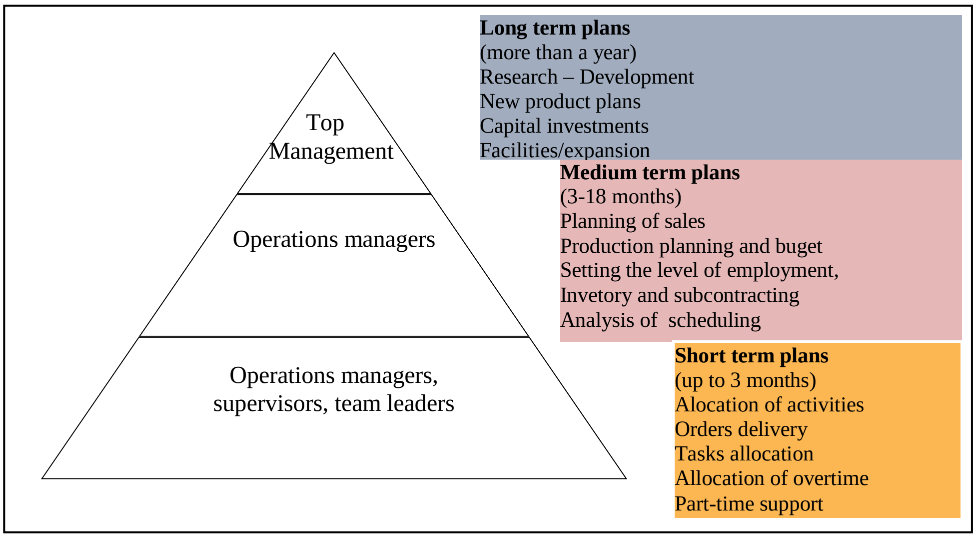


**Figure 1 Managerial planning process on hierarchical levels**
**Source**: Heizer, J., Render, B. 2008, *Operations Management*, Prentice Hall, Upper Saddle River, p. 519

Medium-term planning starts when planning decisions related to capacity for the long-term were already made. Planning decisions address issues of correlating productivity with the fluctuating demand. These plans must be consistent with the long-term strategy of senior management and must be deployed within the resources allocated by previous strategic decisions.

Short-term planning can be extended up to one year, but usually it is designed for periods up to three months. The plan is also the task of operational staff, working together with supervisors and team leaders to "disaggregate" intermediate plan into weekly programs, daily and hourly. (Heizer, Render, 2008) Some techniques of approaching scheduling are loading, sequencing (Hicks, Pongcharoen, 2006), dispatching and allocation.

A study undertaken by Roland Berger Strategy Consultants Company and International Association of Controllers, called "Operational Efficiency Radar" indicates that the main priorities of European companies in 2010 will refocus from restructuring to efficiency, focusing on the product portfolio, the production process, the working capital management, innovation and development (Roland Berger, 2010). From the findings of the study a fundamental idea can be drawn: there is compatibility in terms of setting priorities on the time axis on all levels in an organization. In terms of deadlines, all the employees of a company, from the lowest to the highest level have a common frame of reference in identifying priorities, so that the criteria identification may often coincide. Often malfunctions and failures arise in the analysis of priorities for each hierarchical level and the integration of priorities across organizations.

As previously mentioned, we propose the application of three priority rules: EDD rule, Pareto rule and 99/1 rule. We will compare the results of each of them and give the conclusions according to the objectives the manufacturing companies usually have in mind when setting priorities. The aim is to identify the best rule that corresponds to the necessities of the business in terms of costs, customer satisfaction and effectiveness.

We furthermore begin with the application and the results of production scheduling (short term planning), based on the model of Heizer and Render (2008)

The company A&G Manufacturing has a couple of orders that need to be processed in the work center. The orders entered the system on different dates and were assigned certain deadlines, in order to comply with the requests of the clients. Since the company receives many orders periodically and only one operation can be processed at a time, the personnel has to prioritize the work in the center. The person in charge with fixing the production schedules every week is the machine center scheduler. On a given day he schedules the operations for the next work period. Let us consider that at the current moment the company is on day 75 on the timetable of the machine center. The operations listed in Table 1 represent clients and the record number corresponding to their orders.

**Table 1 Information about 5 operations to be processed at A&G Manufacturing**

| Operation | Receipt date | Due date | Processing time (days) | Due date (days) |
|---|---|---|---|---|
| **IP 225** | 68 | 134 | 15 | 59 |
| **AC 57** | 65 | 104 | 25 | 29 |
| **VM 901** | 70 | 154 | 35 | 79 |
| **BL 773** | 73 | 194 | 40 | 119 |
| **NT 505** | 71 | 144 | 30 | 69 |

Observation: the due date (days) for each operation is computed taking into account the day when the scheduling is performed, which is day 75. For operation IP 225 the due date (days) is: due date – scheduling date = 134 – 75 = 59 days.

According to this rule, the scheduler orders the operations by earliest due date first, focusing the production process on those operations that need to be finished first in order to deliver the batches to the customers on time. Thus, the order in which operations should be processed through the work center is:

AC 57 – IP 225 – NT 505 – VM 901 – BL 773

The results obtained are the following:

**Table 2 Sequencing results according to EDD rule**

| Operation sequence | Processing time (days) | Total time spent in the work center | Due date (days) | Days delay |
|---|---|---|---|---|
| **AC 57** | 25 | 25 | 29 | 0 |
| **IP 225** | 15 | 40 | 59 | 0 |
| **NT 505** | 30 | 70 | 69 | 0 |

| Operation sequence | Processing time (days) | Total time spent in the work center | Due date (days) | Days delay |
|---|---|---|---|---|
| **VM 901** | 35 | 105 | 79 | 26 |
| **BL 773** | 40 | 145 | 119 | 26 |
| ∑ | 145 | 385 | | 52 |

When applying the Pareto principle, we will assume that the scheduler will take the operations in the order of the longest processing time. The reasoning is that the operations having to be processed for a longer time are normally the ones that signal problems with respecting the due dates. The entire procedure is performed through the means of an Excel application. He will compute the total time spent in the work center for each of them, and matching the figures obtained with the due dates, he will look forward to see the tardiness that occurs. In a new column, the scheduler puts the value of the % days delayed/operation out of the total days delay.

Next, he sorts the operations in the descending order of their delay days. Another column is added in the table to show the percentage of days delayed for each operation from the total number of days delayed. He then marks another column to underline the cumulative percentages of the days delayed per operation, in order to see which operations have the most significant impact on the total number of days delayed, in other words, which operations should be processed first so as not to affect the deadlines too much and thus to not comply with the clients expectations.

| Operation sequence | Processing time (days) | Total time spent in the work center | Due date (days) | Days delay |
|---|---|---|---|---|
| BL 773 | 40 | 40 | 29 | 11 |
| VM 901 | 35 | 75 | 59 | 16 |
| NT 505 | 30 | 105 | 69 | 36 |
| AC 57 | 25 | 130 | 79 | 51 |
| IP 225 | 15 | 145 | 119 | 26 |
| ∑ | 145 | 495 | | 140 |

| Operation | Days delayed | % days delay/operation from total days delay | Cumulative % |
|---|---|---|---|
| AC 57 | 51 | 36.43% | 36.43% |
| NT 505 | 36 | 25.71% | 62.14% |
| IP 225 | 26 | 18.57% | 80.71% |
| VM 901 | 16 | 11.43% | 92.14% |
| BL 773 | 11 | 7.86% | 100.00% |
| ∑ | 140 | 100.00% | 100.00% |

**Figure 2 Drawing the Pareto diagram to prioritize operations**

The operations with the highest level of tardiness are identified as being AC 57, NT 505 and IP 225. According to Pareto's 80/20 rule, the efforts should be focused on reducing their delay. But this effect cannot be obtained on the short run, but rather through a series of decisions enforced on the long run by top management, like for instance, hiring part-time operators to support the activity, or investing in a new piece of equipment to increase capacity. But these measures suppose a greater complexity.

Still, the other two operations having a smaller number of days delay cannot be overlooked as they might represent orders that bring about good financial benefits which might even compensate other losses that look tremendous at a first glance.

Let us suppose that we are dealing with a dynamic system whose stability varies influenced by the instability of the workforce operating the machines. Assuming that the operations listed in table 1 are planned to be processed with the time allocated at the beginning of the scheduling period, let us consider that from the first week of work at operation AC 57, instead of working 8 hours a day, the regular time, operators work only 7 hours due to a break-down of the machine that occurs periodically and whose fixing wastes an hour from the work time allotted. In a week, 5 hours are lost, from the processing time, hence the completion of the operation is delayed with 5 weeks X 5 hours = 25 hours, which in terms of work days means 25 hours : 8 hours = 3.125 days. This means that the next activity scheduled to be processed will also be delayed with almost 3 days. The dependency between operations affects the completion time of the last activity, increasing its delay. We can observe that the negative effects that arise at the work center spread throughout the entire production process. Even if the processing time is rigorously determined and break-downs happen rarely, when looking at the process on a longer period of time, all sorts of variations should be foreseen and appropriate measures should be taken in prevent undesirable situations.

## 3. Priorities in the production processes – the insight axis

Production processes are dynamic, complex and stochastic processes. From the beginning of organized production, workers, supervisors, engineers and managers have developed more practical and intelligent methods to control production activities.

The two key issues in the scheduling of the production capacity are priorities. In other words, what should be done first and how it should be done? In production there are many types of scheduling. However many companies produce goods and deliver them to customers but often use collections of independent plans that are overlooked, have regular meetings in which information is transmitted without rigour and ad-hoc decisions made by persons who do not have an overview of the whole system.

If the time axis and the hierarchical axis are concepts that do not require further explanation due to their terms, the insight axis is a very broad concept and, in order to work with a specific notion, we define our vision in this respect. The insight axis, refers to a type of priority management that took into account the dynamics of companies systems and processes, the ongoing diversification of priorities and their existence in simultaneity, the impact of the decisions made as soon as the prioritization process has ended and the action plan has been projected. This axis integrates to an extent, the previously analyzed two dimensions, time axis and organizational hierarchy and takes them into account, but requires an overview of the entire system to facilitate decision making when managers or even a single employee is faced with a great amount of priorities of which some are selected at the expense of others.

## Conclusions

The structuring of priorities on different hierarchical levels and in time is mainly determined by the implicit and explicit projection of the company's objectives.

A first conclusion of this article is that, if systems are stable and the degree of variability is low, the impact of the dependency between activities is also small, priorities can be managed easier. The example proposed provides evidence that scheduling rules are appropriate and work well enough.

Depending on the stability of the systems in question and on the degree of variability, scheduling rules and Goldratt's principles could be used alternatively, based on their appropriateness and significance for a particular manufacturing system. However, when a certain state of balance is reached, there is a need to "create" the right level of crisis to stimulate innovation as a long-term thinking on one hand, and to use a kanban system as a scheduling system on the other hand.

The question is if the rules can solve priorities for longer-term periods. At a higher level of aggregation, as processes become more and more complex and as the time span is extended, Pareto principle proved to comply with the scope of prioritization. This principle is suitable for systems where a single variable is considered at a time. Having in mind all these ideas, we can summarize and say that the transition from long-term to short-term priority rules can be accomplished through a highly flexible system.

Further debate and research can be undertaken to study the way in which the priority rules discussed in this paper can be applied when the constraint is outside the company; how affectively do they manage to respond to business' needs. Another area of future research is the integration of priority rules into information systems and the design of such systems for the management of resources, capacity and constraints of a complex business process, with low steadiness and high variation. It would also be of great interest to see how the principles and algorithms described here would work in a services oriented company or in not for-profit organizations; would these rules still deliver the best results in terms of overall performance.

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