CONTRIBUTION TO THE FUNCTIONAL SPECIFICATION OF MRP/MRPII. AN APPLICATION IN ERP.

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ABSTRACT

In this work we present the contribution to the **functional specification** of the systems MRP/MRPII, identifying the characteristics that such systems should present, starting from the existent literature on the theme.

Once the **functional specification** of the system MRP/MRPII was established, we verified these characteristics in ERP - Enterprise Resource Planning.

The representative ERP, SAP R/3, was selected through the uses of models established in the literature and also based in additional information and the MRP/MRPII, present in SAP R/3, the selected ERP, was analized in comparison with the **functional specification**.

The obtained results showed that SAP R/3 assists to the requirements of the **functional specification.**

LIST OF ABBREVIATIONS

APICS	American Production and Inventory Control Society
ATO	Assemble to Order
ATP	Avaliable to Promise
CRP	Capacity Requirements Planning
EOQ	Economic Order Quantity
EP	Structures of the Product.
ERP	Enterprise Resource Planning
FOQ	Fixed Order Quantity
FPR	Fixed Period Requirements
JIT	Just in Time
LFL	Lot For Lot
LT	Lead Time
MPS	Master Production Schedule
MRP	Materials Requirements Planning
MRPII	Manufacturing Resource Planning
MSEA	Medium of the Sum of the Absolute Errors.
MSEQ	Medium of the Sum of the Quadratic Errors.
MTO	Make to Order
MTS	Make to Stock
OPT	Optimized Production Technology
PPCP	Planning, Programming and Control of the Production.
RCCP	Rough Cut Capacity Planning
S&OP	Sales and Operations
IT	Information Technology
TS	Tracking Signal

1 - INTRODUCTION

The development of the system of PPCP - Planning, Programming and Control of the Production has been made through computerized information systems, as the system MRP/MRPII, presented, respectively, by Orlicky (1975) and Wight (1984) and that are found in ERP - Enterprise Resource Planning, or the Systems of Planning of the Resources of the Corporation.

This new generation of softwares, ERP, has been appearing, starting from the decade of 1990, announcing, among other aspects, its importance for the supply of information for the different needs of the companies, being included in them PPCP.

A lot of companies have been implanting ERP, for the management of its activities being important the study of present MRP/MRPII in ERP to verify if the system, presents the necessary characteristics so that it can be used to elaborate PPCP.

The relevance of ERP can be evaluated by some data.

At the end of 1997, (Business Week, 1997 apud Wood, 1999), the market of ERP was evaluated in 10 billion dollars, to the which were added other 20 billion dollars in consulting works and others supplies and softwares and more10 billion dollars in equipments and accessories.

The race to implant ERPs, on the part of the companies, was due to different factors that were told in Wood's research (1999), being, the reasons and the answers, p[resented in the Exibit 1.1.

In the same research, they were identified the advantages and the disadvantages of ERP, in agreement with the customers of the systems and that are related in the Exibit 1.2.

REASONS TO IMPLANT ERP	PERCENTAGE OF ANSWERS
Integration of processes and information	95
Follow the tendency	90
Pressure of the shareholders	45
Fear of the competitors	35
Pressure of the IT's area	25
Internal political reasons	30
Influence of the media	30
Influence of consultants and gurus	30
Pressure of customers and vendors	5

Exibit 1.1 Reasons to implant ERP. Multiples answers in percentage. (Wood, 1999)

ADVANTAGES	DISADVANTAGES
Larger integration between areas and units	Non attendance of the specific needs of the business
Larger integration of information and process	Loss of some essential functions of the business
Improvement of the quality	Superficial vision of the processes
Opportunity of rethinking processes	Dependence of an only vendor
Improvementof the level	Excess of controls

Exibit 1.2 Advantages and disadvantages in the implant of a ERP (Wood,1999)

The interest in ERP, its presence in many companies all over the world, the investment levels in the systems, as well as the subjects lifted by the executives of the companies and, specifically, the lack of a systematized analysis of the relative aspects to MRP/MRPII in ERP, they are the factors that motivated the development of this research.

The research intended to verify two hypotesis :

Hypothesis 1 : The MRP/MRPII system in SAP R/3 allows the treatment of the manufacturing environment MTS, MTO and ATO ".

Hypothesis 2 : The MRP/MRPII system, present in SAP R/3 presents the requirements identified in the **functional specification**.

2 - FUNCTIONAL SPECIFICATION OF THE SISTEMA MRP/MRPII

The system of PPCP is a system of information that should answer to the questions (Corrêa et al., 1997):

- What to produce and to buy,
- How much to produce and to buy,
- When to produce and to buy and
- With resources to produce and to buy ;

that can be answered through four different approaches (Corrêa et al., 1997; Vollman et al., 1997; Pedroso, 1996):

- the approache MRP/MRPII,
- the approache JIT,
- the aprroache OPT and
- the use of systems with finite capacity.

The present work focuses the approache MRP/MRPII.

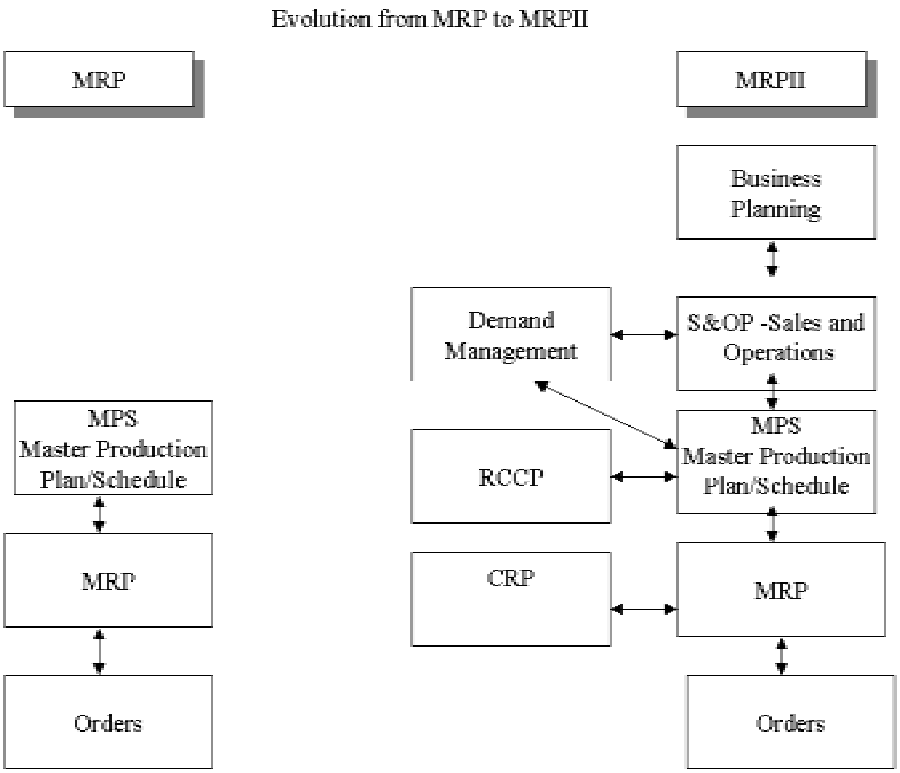
MRP was developed by Orlicky (1975), that defined it as a group of procedures through which the components could not (Sott,1994):

- to be drifted,
- to satisfy to the demand and
- to be calculated correctly

taking for base the customers' demand and the plans of previous production.

The development of MRP/II was due to Wight(1984) that increased MRP with the calculation of the capacity and with other functions that were not embraced by MRP.

The evolution of MRP for MRPII is illustrated in the Exibit 2.1



Exibit 2.1 Evolution of MRP to MRPII. (Scott,1994)

Besides the algorithm used for the calculation of the materials, Wight and the other authors presented the elements that the system MRP/MRPII should include, , as being:

- the manufacture environment,
- the structure of the products,
- the lead teams,
- the planning horizon,

- the sales forecasts,
- the master production plan,
- the production capacity,
- the determination of the replacement lots and
- additional aspects as the pegging, the processing type (net change or regenerative) and
- the calculation of safety's stocks.

In spite of this identification, the literature doesn't present a structured functional specification, so to define what is a system of MRP/MRPII, because the authors analyze each one of the characteristics of the system in an isolated way and with different depth.

The search of the literature and the developed analyses, in the work, they showed that those characteristics could be analyzed and detailed, constituting a group of items denominated the **functional specification** of the system MRP/MRPII and that is presented in the Exibit 2.2.

3 - SELECTION OF ERP TO BE ANALYZED

ERP is a system that facilitates the flow of information inside of a company, integrating the different functions which are manufacture, logistics, finances, human resources and engineering, among other (Hicks, 1997; Davenport, 1998).

Still, it presents a base of data that operates in an only platform and that consolidates all the information in an only computacional environment(Robinson, 1997).

Ideally, the objective of a ERP is to be capable to enter with the information an only time and this information to be accessed for everybody (Lieber, 1995; Davenport, 1998).

The Exibit 3.1 presents the general vision of ERP.

The ERP presents three main characteristics (Steven, 1997):

- Architecture client/server,
- Database and
- Modules and applications

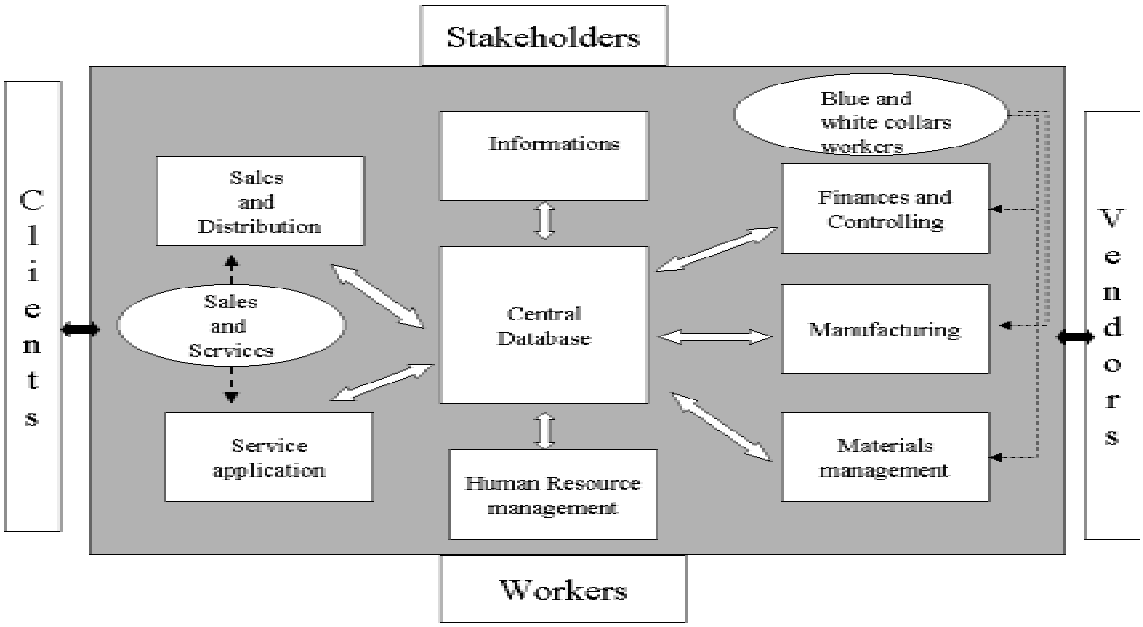
By virtue of the great number of existent ERP, we tried to identify ERP to be analyzed in agreement with models, approaches and information of companies specialized in that type of analyses.

The results are supplied by the model of the "Boston Group " and by he model of the " Magic Quadrant" and they are presented in the Exibit 3.2 and Exibit 3.3, respectively.

The analysis of these two models showed that two ERP could be analyzed: SAP R/3 and ORACLE, classified as leaders.

FUNCTIONAL SPECIFICATION OF THE SYSTEM MRP/MRPII
1 - To treat the environments MTS, MTO and ATO.
2 - To integrate S&OP with MPS.
3 - Cadaster of the items in EP.
4 - Identification of the items in EP.
5 - To allow the inclusion of different categories for the materials of EP.
6 - Each item of EP should present data that allow the tracking.
7 - To allow ghost items in EP.
8 - To allow alternative items in EP.
9 - To allow calculated Lead Times
10 - Lead Time's calculation should include the times of set-up and the other identified times.
11 - To allow the inclusion of Lead Time of safety
12 - The forecast of sales should embrace the mobile average, the pondered average, the exponential average, the adjustment of straight line, the adjustment for the seazonal effect.
13 - The methods of errors control's in the forecasts MSEQ or MSEA should be present.
14 - It should have the calculation of variable TS for control of the forecast model.
15 - MPS should treat environment MTS,MTO and ATO
16 - ATP should be calculated
17 - It should have the concept of time fences
18 - Inclusion of the capacity calculation in the two necessary levels : RCCPand CRP...
19 - The capacities RCCP and CRP should be calculated for the identified resources.
20 - Re-calculation of RCCP and of CRP, for the modifications (without recalculating the whole system)
21 - To present, at least< the models of the lots LFL, FOQ and FPR
22 - Calculation of safety's stock and its automatic inclusion in the system.
23 - Processing net change and regenerative
24 - Simple Pegging and complete Pegging
25 - Algoríthm of calculation of MRP, following the pattern.

Exibit 2.2 Functional specification of the MRP/MRPII system.



Exibit 3.1 General vision of an ERP (Davenport, 1998)

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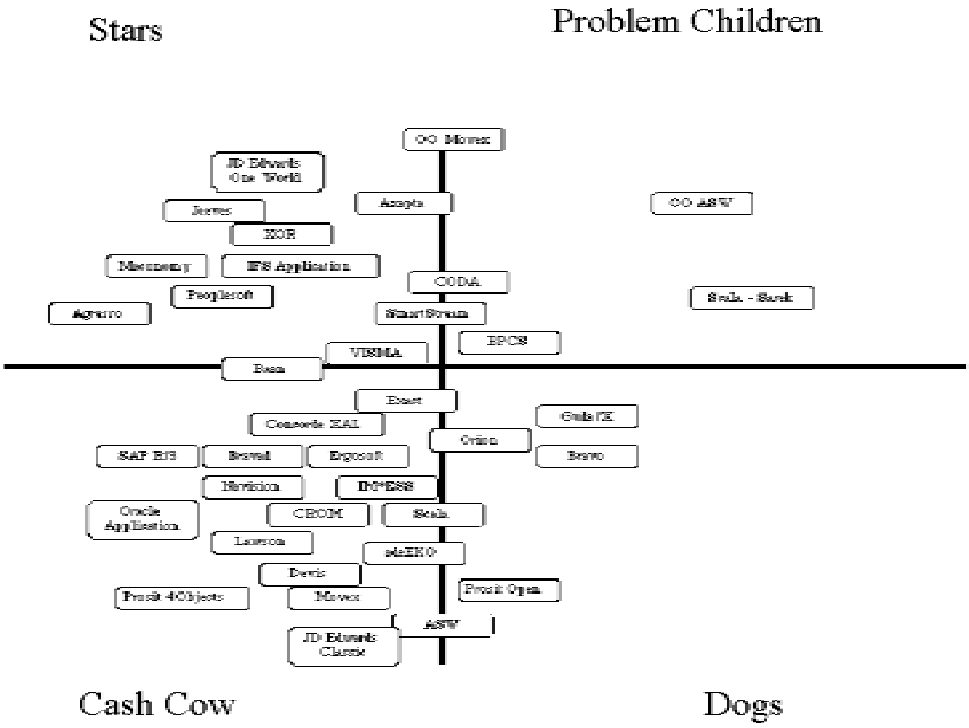
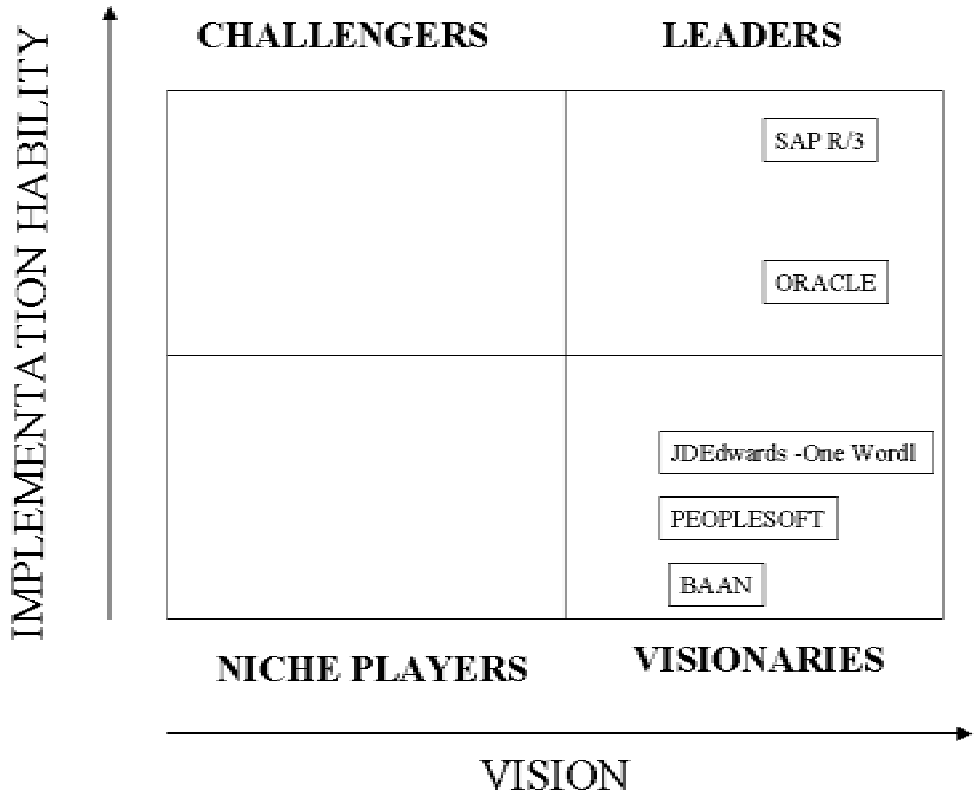


Exibit 3.2 ERP's position in the Boston Matrix (Research DPU ab, 2000)



Exibit 3.3 ERP's position in the Magic Quadrant (Gartner Group, 1999)

4 - RESULTS

Hypothesis 1 : The MRP/MRPII in SAP R/3 facilitates to treat the manufacture atmospheres MTS, MTO and ATO .

With relationship to the treatment of the manufacture environment MTS, MTO and ATO, we verified that the definitions exist in SAP R/3, but are not treated this way.

SAP R/3 consider the environments MTS and MTO, while ATO is treated as a case of these two environment. In addition,SAP R/3 presents other cases inside of the

environment MTS and MTO named as "strategies". All the strategies treated by SAP R/3 number seventeen.

Ending, the accomplished analysis, it showed that " the strategies " presented by SAP R/3, embrace all the environment MTS, MTO and ATO.

Hypothesis 2 : The MRP/MRPII system, in SAP R/3 presents the requirements identified in the **functional specification**

Besides the subject of the treatment of the manufacture environment, there are other inquiries of the **functional specification** that were analyzed.

The structure of the product that the system presents facilitates the representation of any product. That structure is quite flexible and it can be adapted to products that are integrally manufactured in the company or partial or totally manufactued aoutside the company..

The subject of the definition and the lead time calculation it is correct and complete, embracing not only the necessary times at the manufacture, as well as the times of wait of the product to be processed in the following productive center and the time of transport among the productive centers. Still, the time of process of a lot, it can be calculated starting from the unitary time of the product multiplied by the amount of the lot, what is the correct.

With relationship to the sales forecasts, SAP R/3 presents all the average models: mobile average, average with exponential adjustment, adjustment for the seazonality and the calculation of the deviations and of the TS - Tracking Signal, for the accompaniment of the selected forecast model. The only proviso that should be done is

with relationship to the inexistance of the model of adjustment of straight line, what doesn't commit the subject.

The treatment and the calculation of the master production plan MPS they are also correct.

The definition of the time fences facilitates the necessary alert to the programmer of the production when the initial date is surpassed and the system also presents the necessary blockades (to the production programmer's approach) in the emission of orders.

The capacities presented by the system are those defined in the literature, RCCP and CRP, with all its considered aspects.

The definition of the production lots is treated besides the need. The system presents all the three models of lots identified in the functional specification and, in addition, to these, five other additional models, of doubtful usefulness.

Finally all the additional characteristics of MRP are assisted, the pegging, the processings net change and regenerative, the calculation of safety's stocks and the own calculation of the algorithm of MRP is made in a correct way.

Ending, the accomplished research, it shows that present MRP/MRPII in SAP R/3 is a system that assists to the functional specification that was presented.

The Exibit 4.1 summarizes the results of the work.

FUNCTIONAL SPECIFICATION OF THE SYSTEM MRP/MRPII OF THE SAP R/3	
1 - To treat ambient MTS, MTO and ATO.	SAP R/3 treats the manufacture environments MTS, MTO and ATO
2 - To integrate S&OP with MPS.	It integrates S&OP with MPS.
3 - Cadaster of the items in EP.	SAP R/3 assists to all the requirements
4 - Identification of the items in EP.	SAP R/3 assists to all the requirements
5 - To allow the inclusion of different categories for the materials of EP.	SAP R/3 assists to all the requirements
6 - Each item of EP should present data that allow the rastreabilidade.	SAP R/3 assists to all the requirements.
7 - To allow items ghost in EP.	It allows the ghost inclusion of items
8 - To allow alternative items in EP	It allows the inclusion of alternative items
9 - To allow calculated Lead Time.	It allows to calculate the Lead Time
10 - Lead Time calculation should include the times of set-up and the other identified times. .	The Lead Time calculation includes all the necessary times.
11 - To allow the inclusion of Lead Team of safety.	A safety Lead Time can be included.
12 – The sales forecast should include the mobile average, the pondered average, the exponential average, the adjustment of straight line, the adjustment for the seasonal effects.	The forecast of sales presents all the models, with exclusion of the adjustment of straight line. It presents adjustment for the seasonal effects.
13 - The methods of errors control in the forecasts MSEQ or MSEA should be present.	It presents the methods of control of errors
14 - It should have the calculation of the TS for control of the forecast model.	It presents the calculation of TS.
15 - MPS should treat environment MTS, MTO and ATO.	MPS allows to treat environment MTS, MTO and ATO.
16 - ATP should be calculated.	It presents the calculation of ATP.
17 - it should have the concept of Time fences.	The concept of Time fences is implemented

Exibit 4.1 - The adherence of MRP/MRPII of SAP R/3 to the **functional specification**.

FUNCTIONAL SPECIFICATION OF THE SYSTEM MRP/MRPII OF THE SAP R/3	
18 - Inclusion of the capacity calculation in the two necessary levels	It includes the calculation of the two types of capacities.
19 - The capacities RCCP and CRP should be calculated for the identified resources	SAP R/3 presents the correct requirements in the calculation of the capacities RCCP and CRP.
20 - Recalculation of RCCP and of CRP, for the modifications (without recalculation of the whole system).	SAP R/3 presents this aspect.
21 - To present the models of the lots LFL, FOQ and FPR.	It presents several models for the calculation of the lots, being included LFL, FOQ and FPR.
22 - Calculation of safety's stock and its automatic inclusion in the system.	It facilitates to calculate safety's stock in agreement with the correct methodology.
23 - Processing net change and regenerative.	It presents the processings net change and regenerative.
24 - Simple Pegging and complete Pegging	Present the simple pegging and the complete pegging
25 - Algorithm of calculation of MRP, following the pattern.	It presents the algorithm of calculation of MRP, in agreement with the correct methodology.

Exibit 4.1(cont.) - The adherence of MRP/MRPII of SAP R/3 to the **functional specification**

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