

## DYNAMIC MANAGEMENT OF MANUFACTURING ORDERS

Assoc. Prof. Ghelase Daniela  
 Assoc. Prof. Daschievici Luiza  
 "Dunarea de Jos" University of Galati

### ABSTRACT

*A key requirement for the make-to-order (MTO) manufacturing companies to remain competitive is the ability to assess incoming orders in terms of performance and to determine the best orders that they should accept.*

*In this paper, we propose a method to control the entire production process, from customer enquiry up to product delivery, for the MTO manufacturing systems. In practice, decisions on order acceptance and on production planning are often made separately. Sales department is responsible for accepting orders, while the production department is in charge of production planning for implementation of accepted orders.*

*The system environment provides on-line data on the actions undertaken which, properly analyzed and correlated, will further generate solutions in order to develop said system and make it competitive.*

KEYWORDS: competitiveness, manufacturing system, dynamic management

### 1. INTRODUCTION

Order acceptance problem is usually treated in the literature considering the single resource case with deterministic processing time [1,2]. The acceptance criterion is based mostly on capacity-driven approach. We cannot take into consideration that company performance is essentially dependent on the manner in which accepted orders are appropriate to all characteristic elements of the manufacturing system. In accordance with the method proposed in this paper, order acceptance is Earning Power-driven, while work-load, due-date and price are considered as restrictions.

In present, machine control is made independently to of order features, such as price. This is why, although the local control of the machine is optimal, the order performance level is not maximum. The method presented in this paper removes the disadvantage in that the machine control is based on simultaneous optimization of all manufacturing processes caused by order fulfillment.

Finally, in the present order acceptance, planning and scheduling of the production

process, and machine control can be solved separately. In this paper, we propose an integrated control method for the three aspects where Earning Power is used as decision criterion when accepting or rejecting the order.

One customer's order can include several jobs.

Knowing the price  $P_j$  (2), the cost  $c_{ijk}$ , the asset  $A_{ijk}$  and the time  $t_{ijk}$ , we can build the order modeling, meaning the  $EP$  for each order (1).

$$EP_i = \frac{P_i - \sum_j \sum_k c_{ijk}(p_{jkn})}{\sum_j \sum_k A_{ijk} \cdot t_{ijk}(p_{jkn})} \left[ \frac{\text{Euro}}{\text{Euro} \cdot \text{min}} \right] \quad (1)$$

The price of order,  $P_i$ , (2) can be distributed on each job,  $j$ , then each operation that composes the job.

$$P_i = \sum_j \sum_k P_{ijk} \quad (2)$$

Based on  $EP_i$  determined for each order, the order can be accepted or rejected the order.

Therefore, there are going to be accepted only those orders that can bring significant profit and can increase the market share. This modeling can provide a better order management and increase the company’s competitiveness.

**2. CASE STUDY**

We consider that we have to manufacture the part in Fig. 1 and the manager must decide whether to accept this order. The technological process needed to process the part consists of the following operations: turning, drilling and welding.

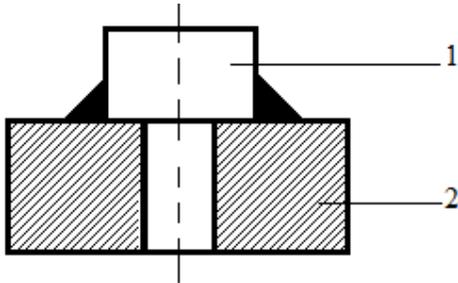


Fig. 1. Manufacturing part  
1- rod, 2- plate

In order to evaluate the order EP we have to calculate job EP and operation EP. To do this, the order will be divided in job 1 (rod 1, Fig. 1) and job 2 (plate 2, Fig. 1). To perform job 1 it is necessary to use the turning operation. For job 2 we need drilling and welding operations.

In order to evaluate the order EP we will use the relation (1) and if this is adapted to order *i* it becomes:

$$EP_i = \frac{P_i - \sum_j \sum_k c_{ijk} (p_{jkn})}{\sum_j \sum_k A_{ijk} \cdot t_{ijk} (p_{jkn})} = \frac{(P_{i11} + P_{i21} + P_{i22}) - (c_{i11} + c_{i21} + c_{i22})}{A_{i11} \cdot t_{i11} + A_{i21} \cdot t_{i21} + A_{i22} \cdot t_{i22}} \left[ \frac{\text{Euro}}{\text{Euro} \cdot \text{min}} \right]$$

where:

$P_{i11}$  - is the price of turning operation;

$c_{i11}$  - the cost of turning operation;  
 $A_{i11}$  - the asset of turning operation;  
 $t_{i11}$  - is the time to perform a turning operation;

$P_{i21}$  - is the price of welding operation;  
 $c_{i21}$  - the cost of welding operation;  
 $A_{i21}$  - the asset of welding operation;  
 $t_{i21}$  - is the time to perform a welding operation;

$P_{i22}$  - is the price of drilling operation;  
 $c_{i22}$  - the cost of drilling operation;  
 $A_{i22}$  - the asset of drilling operation;  
 $t_{i22}$  - the asset of drilling operation.

These data are given in Fig.2 and Fig.3.

By numerical simulations (Fig.2, Fig. 3), for the cases of 14 cutting speed values, 11 drilling speed values and 13 rate of welding values were obtained 2002 EP’s values of order *i*. Maximum value for EP was obtained for a turning speed,  $v=50$  m/min, drilling speed,  $v=200$  rev/min and welding speed,  $v=5.2$  mm/s. Maximum value for EP is

$$7.25 \cdot 10^{-8} \left[ \frac{\text{Euro}}{\text{Euro} \cdot \text{min}} \right].$$

We can calculate the EP for the other orders in the order entry pool in a similar manner. In the end, all EP values of all orders are ordered in a decreasing sequence.

The orders with a maximum calculated EP that brings economical effect to the company would be kept.

The other orders will be outsourced to other manufacturing companies.

It results that the manager will have an overview of the order EP to make an order acceptance. Order acceptance will be made after evaluation of maximal EP values and after selecting only those orders that may bring profit to the company.

Analyzing data in table 1 according to the maximum value of EP, the manager can decide whether or not to perform all jobs necessary to achieve order in the company.

Table 1. Order EP maximum

Order price [Euro]	Operation order			Order EP max [Euro/Euro·min]
	turning	drilling	welding	
150	x	x	x	$7.256 \cdot 10^{-8}$
136.25	x		x	$6.11 \cdot 10^{-8}$
22.5	x	x		$14 \cdot 10^{-8}$
141.25		x	x	$7.4 \cdot 10^{-8}$
127.5			x	$6.09 \cdot 10^{-8}$
8.75	x			$6.26 \cdot 10^{-8}$
13.75		x		$57.5 \cdot 10^{-8}$

The screenshot shows a Microsoft Excel spreadsheet titled "Modelare job". The table contains 49 rows of data. The columns are labeled A through R. The first column (A) contains a sequence of numbers from 1 to 49. The second column (B) contains a sequence of numbers from 10 to 150. The third column (C) contains a sequence of numbers from 200 to 300. The fourth column (D) contains a sequence of numbers from 2.0 to 2.5. The fifth column (E) contains a sequence of numbers from 5.2 to 5.7. The sixth column (F) contains a sequence of numbers from 7.125 to 7.875. The seventh column (G) contains a sequence of numbers from 9.275 to 10.35. The eighth column (H) contains a sequence of numbers from 11.5913 to 11.9171. The ninth column (I) contains a sequence of numbers from 14.291 to 14.861. The tenth column (J) contains a sequence of numbers from 17.133 to 17.839. The eleventh column (K) contains a sequence of numbers from 20.106 to 21.191. The twelfth column (L) contains a sequence of numbers from 23.113 to 24.191. The thirteenth column (M) contains a sequence of numbers from 26.156 to 27.191. The fourteenth column (N) contains a sequence of numbers from 29.236 to 30.191. The fifteenth column (O) contains a sequence of numbers from 32.359 to 33.191. The sixteenth column (P) contains a sequence of numbers from 35.525 to 36.191. The seventeenth column (Q) contains a sequence of numbers from 38.736 to 39.191. The eighteenth column (R) contains a sequence of numbers from 41.991 to 42.191. The nineteenth column (S) contains a sequence of numbers from 45.291 to 46.191. The twentieth column (T) contains a sequence of numbers from 48.636 to 49.191. The twenty-first column (U) contains a sequence of numbers from 52.031 to 53.191. The twenty-second column (V) contains a sequence of numbers from 55.476 to 56.191. The twenty-third column (W) contains a sequence of numbers from 58.971 to 59.191. The twenty-fourth column (X) contains a sequence of numbers from 62.516 to 63.191. The twenty-fifth column (Y) contains a sequence of numbers from 66.111 to 67.191. The twenty-sixth column (Z) contains a sequence of numbers from 69.756 to 70.191. The twenty-seventh column (AA) contains a sequence of numbers from 73.451 to 74.191. The twenty-eighth column (AB) contains a sequence of numbers from 77.196 to 78.191. The twenty-ninth column (AC) contains a sequence of numbers from 80.991 to 81.191. The thirtieth column (AD) contains a sequence of numbers from 84.836 to 85.191. The thirty-first column (AE) contains a sequence of numbers from 88.731 to 89.191. The thirty-second column (AF) contains a sequence of numbers from 92.676 to 93.191. The thirty-third column (AG) contains a sequence of numbers from 96.671 to 97.191. The thirty-fourth column (AH) contains a sequence of numbers from 100.716 to 101.191. The thirty-fifth column (AI) contains a sequence of numbers from 104.811 to 105.191. The thirty-sixth column (AJ) contains a sequence of numbers from 108.956 to 109.191. The thirty-seventh column (AK) contains a sequence of numbers from 113.151 to 114.191. The thirty-eighth column (AL) contains a sequence of numbers from 117.396 to 118.191. The thirty-ninth column (AM) contains a sequence of numbers from 121.691 to 122.191. The fortieth column (AN) contains a sequence of numbers from 126.036 to 127.191. The forty-first column (AO) contains a sequence of numbers from 130.431 to 131.191. The forty-second column (AP) contains a sequence of numbers from 134.876 to 135.191. The forty-third column (AQ) contains a sequence of numbers from 139.371 to 140.191. The forty-fourth column (AR) contains a sequence of numbers from 143.916 to 144.191. The forty-fifth column (AS) contains a sequence of numbers from 148.511 to 149.191. The forty-sixth column (AT) contains a sequence of numbers from 153.156 to 154.191. The forty-seventh column (AU) contains a sequence of numbers from 157.851 to 158.191. The forty-eighth column (AV) contains a sequence of numbers from 162.596 to 163.191. The forty-ninth column (AW) contains a sequence of numbers from 167.391 to 168.191. The fiftieth column (AX) contains a sequence of numbers from 172.236 to 173.191. The fifty-first column (AY) contains a sequence of numbers from 177.131 to 178.191. The fifty-second column (AZ) contains a sequence of numbers from 182.076 to 183.191. The fifty-third column (BA) contains a sequence of numbers from 187.071 to 188.191. The fifty-fourth column (BB) contains a sequence of numbers from 192.116 to 193.191. The fifty-fifth column (BC) contains a sequence of numbers from 197.211 to 198.191. The fifty-sixth column (BD) contains a sequence of numbers from 202.356 to 203.191. The fifty-seventh column (BE) contains a sequence of numbers from 207.551 to 208.191. The fifty-eighth column (BF) contains a sequence of numbers from 212.796 to 213.191. The fifty-ninth column (BG) contains a sequence of numbers from 218.091 to 219.191. The sixtieth column (BH) contains a sequence of numbers from 223.436 to 224.191. The sixty-first column (BI) contains a sequence of numbers from 228.831 to 229.191. The sixty-second column (BJ) contains a sequence of numbers from 234.276 to 235.191. The sixty-third column (BK) contains a sequence of numbers from 239.771 to 240.191. The sixty-fourth column (BL) contains a sequence of numbers from 245.316 to 246.191. The sixty-fifth column (BM) contains a sequence of numbers from 250.911 to 251.191. The sixty-sixth column (BN) contains a sequence of numbers from 256.556 to 257.191. The sixty-seventh column (BO) contains a sequence of numbers from 262.251 to 263.191. The sixty-eighth column (BP) contains a sequence of numbers from 268.046 to 269.191. The sixty-ninth column (BQ) contains a sequence of numbers from 273.841 to 274.191. The seventieth column (BR) contains a sequence of numbers from 279.686 to 280.191. The seventy-first column (BS) contains a sequence of numbers from 285.581 to 286.191. The seventy-second column (BT) contains a sequence of numbers from 291.526 to 292.191. The seventy-third column (BU) contains a sequence of numbers from 297.521 to 298.191. The seventy-fourth column (BV) contains a sequence of numbers from 303.566 to 304.191. The seventy-fifth column (BW) contains a sequence of numbers from 309.661 to 310.191. The seventy-sixth column (BX) contains a sequence of numbers from 315.806 to 316.191. The seventy-seventh column (BY) contains a sequence of numbers from 322.001 to 323.191. The seventy-eighth column (BZ) contains a sequence of numbers from 328.246 to 329.191. The seventy-ninth column (CA) contains a sequence of numbers from 334.541 to 335.191. The eightieth column (CB) contains a sequence of numbers from 340.886 to 341.191. The eighty-first column (CC) contains a sequence of numbers from 347.281 to 348.191. The eighty-second column (CD) contains a sequence of numbers from 353.726 to 354.191. The eighty-third column (CE) contains a sequence of numbers from 360.221 to 361.191. The eighty-fourth column (CF) contains a sequence of numbers from 366.766 to 367.191. The eighty-fifth column (CG) contains a sequence of numbers from 373.361 to 374.191. The eighty-sixth column (CH) contains a sequence of numbers from 380.006 to 381.191. The eighty-seventh column (CI) contains a sequence of numbers from 386.701 to 387.191. The eighty-eighth column (CJ) contains a sequence of numbers from 393.446 to 394.191. The eighty-ninth column (CK) contains a sequence of numbers from 400.241 to 401.191. The ninetieth column (CL) contains a sequence of numbers from 407.086 to 408.191. The hundredth column (CM) contains a sequence of numbers from 414.031 to 415.191. The hundred-first column (CN) contains a sequence of numbers from 421.076 to 422.191. The hundred-second column (CO) contains a sequence of numbers from 428.221 to 429.191. The hundred-third column (CP) contains a sequence of numbers from 435.466 to 436.191. The hundred-fourth column (CQ) contains a sequence of numbers from 442.811 to 443.191. The hundred-fifth column (CR) contains a sequence of numbers from 450.256 to 451.191. The hundred-sixth column (CS) contains a sequence of numbers from 457.801 to 458.191. The hundred-seventh column (CT) contains a sequence of numbers from 465.446 to 466.191. The hundred-eighth column (CU) contains a sequence of numbers from 473.191 to 474.191. The hundred-ninth column (CV) contains a sequence of numbers from 481.036 to 482.191. The hundred-tenth column (CW) contains a sequence of numbers from 488.981 to 489.191. The hundred-eleventh column (CX) contains a sequence of numbers from 497.026 to 498.191. The hundred-twelfth column (CY) contains a sequence of numbers from 505.171 to 506.191. The hundred-thirteenth column (CZ) contains a sequence of numbers from 513.416 to 514.191. The hundred-fourteenth column (CA) contains a sequence of numbers from 521.761 to 522.191. The hundred-fifteenth column (CB) contains a sequence of numbers from 530.206 to 531.191. The hundred-sixteenth column (CC) contains a sequence of numbers from 538.751 to 539.191. The hundred-seventeenth column (CD) contains a sequence of numbers from 547.396 to 548.191. The hundred-eighteenth column (CE) contains a sequence of numbers from 556.141 to 557.191. The hundred-nineteenth column (CF) contains a sequence of numbers from 565.086 to 566.191. The hundred-twentieth column (CG) contains a sequence of numbers from 574.231 to 575.191. The hundred-twenty-first column (CH) contains a sequence of numbers from 583.576 to 584.191. The hundred-twenty-second column (CI) contains a sequence of numbers from 593.121 to 594.191. The hundred-twenty-third column (CJ) contains a sequence of numbers from 602.866 to 603.191. The hundred-twenty-fourth column (CK) contains a sequence of numbers from 612.811 to 613.191. The hundred-twenty-fifth column (CL) contains a sequence of numbers from 622.956 to 623.191. The hundred-twenty-sixth column (CM) contains a sequence of numbers from 633.301 to 634.191. The hundred-twenty-seventh column (CN) contains a sequence of numbers from 643.846 to 644.191. The hundred-twenty-eighth column (CO) contains a sequence of numbers from 654.591 to 655.191. The hundred-twenty-ninth column (CP) contains a sequence of numbers from 665.536 to 666.191. The hundred-thirtieth column (CQ) contains a sequence of numbers from 676.681 to 677.191. The hundred-thirty-first column (CR) contains a sequence of numbers from 688.026 to 689.191. The hundred-thirty-second column (CS) contains a sequence of numbers from 699.571 to 700.191. The hundred-thirty-third column (CT) contains a sequence of numbers from 711.316 to 712.191. The hundred-thirty-fourth column (CU) contains a sequence of numbers from 723.261 to 724.191. The hundred-thirty-fifth column (CV) contains a sequence of numbers from 735.406 to 736.191. The hundred-thirty-sixth column (CW) contains a sequence of numbers from 747.751 to 748.191. The hundred-thirty-seventh column (CX) contains a sequence of numbers from 760.296 to 761.191. The hundred-thirty-eighth column (CY) contains a sequence of numbers from 773.041 to 774.191. The hundred-thirty-ninth column (CZ) contains a sequence of numbers from 785.986 to 786.191. The hundred-fortieth column (CA) contains a sequence of numbers from 799.131 to 800.191. The hundred-forty-first column (CB) contains a sequence of numbers from 812.476 to 813.191. The hundred-forty-second column (CC) contains a sequence of numbers from 826.021 to 827.191. The hundred-forty-third column (CD) contains a sequence of numbers from 839.766 to 840.191. The hundred-forty-fourth column (CE) contains a sequence of numbers from 853.711 to 854.191. The hundred-forty-fifth column (CF) contains a sequence of numbers from 867.856 to 868.191. The hundred-forty-sixth column (CG) contains a sequence of numbers from 882.201 to 883.191. The hundred-forty-seventh column (CH) contains a sequence of numbers from 896.846 to 897.191. The hundred-forty-eighth column (CI) contains a sequence of numbers from 911.691 to 912.191. The hundred-forty-ninth column (CJ) contains a sequence of numbers from 926.736 to 927.191. The hundred-fiftieth column (CK) contains a sequence of numbers from 942.081 to 943.191. The hundred-fifty-first column (CL) contains a sequence of numbers from 957.726 to 958.191. The hundred-fifty-second column (CM) contains a sequence of numbers from 973.671 to 974.191. The hundred-fifty-third column (CN) contains a sequence of numbers from 989.916 to 990.191. The hundred-fifty-fourth column (CO) contains a sequence of numbers from 1006.461 to 1007.191. The hundred-fifty-fifth column (CP) contains a sequence of numbers from 1023.306 to 1024.191. The hundred-fifty-sixth column (CQ) contains a sequence of numbers from 1040.451 to 1041.191. The hundred-fifty-seventh column (CR) contains a sequence of numbers from 1057.896 to 1058.191. The hundred-fifty-eighth column (CS) contains a sequence of numbers from 1075.641 to 1076.191. The hundred-fifty-ninth column (CT) contains a sequence of numbers from 1093.686 to 1094.191. The hundred-sixtieth column (CU) contains a sequence of numbers from 1112.031 to 1113.191. The hundred-sixty-first column (CV) contains a sequence of numbers from 1130.676 to 1131.191. The hundred-sixty-second column (CW) contains a sequence of numbers from 1149.621 to 1150.191. The hundred-sixty-third column (CX) contains a sequence of numbers from 1168.866 to 1169.191. The hundred-sixty-fourth column (CY) contains a sequence of numbers from 1188.411 to 1189.191. The hundred-sixty-fifth column (CZ) contains a sequence of numbers from 1208.256 to 1209.191. The hundred-sixty-sixth column (CA) contains a sequence of numbers from 1228.401 to 1229.191. The hundred-sixty-seventh column (CB) contains a sequence of numbers from 1248.846 to 1249.191. The hundred-sixty-eighth column (CC) contains a sequence of numbers from 1269.591 to 1270.191. The hundred-sixty-ninth column (CD) contains a sequence of numbers from 1290.636 to 1291.191. The hundred-seventieth column (CE) contains a sequence of numbers from 1312.081 to 1313.191. The hundred-seventy-first column (CF) contains a sequence of numbers from 1333.926 to 1334.191. The hundred-seventy-second column (CG) contains a sequence of numbers from 1356.171 to 1357.191. The hundred-seventy-third column (CH) contains a sequence of numbers from 1378.816 to 1379.191. The hundred-seventy-fourth column (CI) contains a sequence of numbers from 1401.861 to 1402.191. The hundred-seventy-fifth column (CJ) contains a sequence of numbers from 1425.306 to 1426.191. The hundred-seventy-sixth column (CK) contains a sequence of numbers from 1449.151 to 1450.191. The hundred-seventy-seventh column (CL) contains a sequence of numbers from 1473.396 to 1474.191. The hundred-seventy-eighth column (CM) contains a sequence of numbers from 1497.941 to 1498.191. The hundred-seventy-ninth column (CN) contains a sequence of numbers from 1522.886 to 1523.191. The hundred-eightieth column (CO) contains a sequence of numbers from 1548.131 to 1549.191. The hundred-eighty-first column (CP) contains a sequence of numbers from 1573.676 to 1574.191. The hundred-eighty-second column (CQ) contains a sequence of numbers from 1600.521 to 1601.191. The hundred-eighty-third column (CR) contains a sequence of numbers from 1627.666 to 1628.191. The hundred-eighty-fourth column (CS) contains a sequence of numbers from 1655.111 to 1656.191. The hundred-eighty-fifth column (CT) contains a sequence of numbers from 1682.856 to 1683.191. The hundred-eighty-sixth column (CU) contains a sequence of numbers from 1710.901 to 1711.191. The hundred-eighty-seventh column (CV) contains a sequence of numbers from 1739.246 to 1740.191. The hundred-eighty-eighth column (CW) contains a sequence of numbers from 1767.891 to 1768.191. The hundred-eighty-ninth column (CX) contains a sequence of numbers from 1796.836 to 1797.191. The hundred-ninetyth column (CY) contains a sequence of numbers from 1826.081 to 1827.191. The hundred-ninety-first column (CZ) contains a sequence of numbers from 1855.626 to 1856.191. The hundred-ninety-second column (CA) contains a sequence of numbers from 1885.471 to 1886.191. The hundred-ninety-third column (CB) contains a sequence of numbers from 1915.616 to 1916.191. The hundred-ninety-fourth column (CC) contains a sequence of numbers from 1946.061 to 1947.191. The hundred-ninety-fifth column (CD) contains a sequence of numbers from 1976.806 to 1977.191. The hundred-ninety-sixth column (CE) contains a sequence of numbers from 2007.851 to 2008.191. The hundred-ninety-seventh column (CF) contains a sequence of numbers from 2039.196 to 2040.191. The hundred-ninety-eighth column (CG) contains a sequence of numbers from 2070.841 to 2071.191. The hundred-ninety-ninth column (CH) contains a sequence of numbers from 2102.786 to 2103.191. The two-hundredth column (CI) contains a sequence of numbers from 2135.031 to 2136.191. The two-hundred-first column (CJ) contains a sequence of numbers from 2167.576 to 2168.191. The two-hundred-second column (CK) contains a sequence of numbers from 2200.421 to 2201.191. The two-hundred-third column (CL) contains a sequence of numbers from 2233.666 to 2234.191. The two-hundred-fourth column (CM) contains a sequence of numbers from 2267.311 to 2268.191. The two-hundred-fifth column (CN) contains a sequence of numbers from 2301.356 to 2302.191. The two-hundred-sixth column (CO) contains a sequence of numbers from 2335.801 to 2336.191. The two-hundred-seventh column (CP) contains a sequence of numbers from 2370.646 to 2371.191. The two-hundred-eighth column (CQ) contains a sequence of numbers from 2405.891 to 2406.191. The two-hundred-ninth column (CR) contains a sequence of numbers from 2441.536 to 2442.191. The two-hundred-tenth column (CS) contains a sequence of numbers from 2477.581 to 2478.191. The two-hundred-eleventh column (CT) contains a sequence of numbers from 2514.026 to 2515.191. The two-hundred-twelfth column (CU) contains a sequence of numbers from 2550.871 to 2551.191. The two-hundred-thirteenth column (CV) contains a sequence of numbers from 2588.116 to 2589.191. The two-hundred-fourth column (CW) contains a sequence of numbers from 2625.761 to 2626.191. The two-hundred-fifth column (CX) contains a sequence of numbers from 2663.806 to 2664.191. The two-hundred-sixth column (CY) contains a sequence of numbers from 2702.251 to 2703.191. The two-hundred-seventh column (CZ) contains a sequence of numbers from 2741.096 to 2742.191. The two-hundred-eighth column (CA) contains a sequence of numbers from 2780.341 to 2781.191. The two-hundred-ninth column (CB) contains a sequence of numbers from 2820.086 to 2821.191. The two-hundred-tenth column (CC) contains a sequence of numbers from 2860.231 to 2861.191. The two-hundred-eleventh column (CD) contains a sequence of numbers from 2900.776 to 2901.191. The two-hundred-twelfth column (CE) contains a sequence of numbers from 2941.721 to 2942.191. The two-hundred-thirteenth column (CF) contains a sequence of numbers from 2983.066 to 2984.191. The two-hundred-fourth column (CG) contains a sequence of numbers from 3024.811 to 3025.191. The two-hundred-fifth column (CH) contains a sequence of numbers from 3066.956 to 3067.191. The two-hundred-sixth column (CI) contains a sequence of numbers from 3109.501 to 3110.191. The two-hundred-seventh column (CJ) contains a sequence of numbers from 3152.446 to 3153.191. The two-hundred-eighth column (CK) contains a sequence of numbers from 3195.791 to 3196.191. The two-hundred-ninth column (CL) contains a sequence of numbers from 3239.536 to 3240.191. The two-hundred-tenth column (CM) contains a sequence of numbers from 3283.681 to 3284.191. The two-hundred-eleventh column (CN) contains a sequence of numbers from 3328.226 to 3329.191. The two-hundred-twelfth column (CO) contains a sequence of numbers from 3373.171 to 3374.191. The two-hundred-thirteenth column (CP) contains a sequence of numbers from 3418.516 to 3419.191. The two-hundred-fourth column (CQ) contains a sequence of numbers from 3464.261 to 3465.191. The two-hundred-fifth column (CR) contains a sequence of numbers from 3510.406 to 3511.191. The two-hundred-sixth column (CS) contains a sequence of numbers from 3556.951 to 3557.191. The two-hundred-seventh column (CT) contains a sequence of numbers from 3603.896 to 3604.191. The two-hundred-eighth column (CU) contains a sequence of numbers from 3651.241 to 3652.191. The two-hundred-ninth column (CV) contains a sequence of numbers from 3699.086 to 3700.191. The two-hundred-tenth column (CW) contains a sequence of numbers from 3747.431 to 3748.191. The two-hundred-eleventh column (CX) contains a sequence of numbers from 3796.276 to 3797.191. The two-hundred-twelfth column (CY) contains a sequence of numbers from 3845.621 to 3846.191. The two-hundred-thirteenth column (CZ) contains a sequence of numbers from 3895.466 to 3896.191. The two-hundred-fourth column (CA) contains a sequence of numbers from 3945.811 to 3946.191. The two-hundred-fifth column (CB) contains a sequence of numbers from 3996.656 to 3997.191. The two-hundred-sixth column (CC) contains a sequence of numbers from 4047.901 to 4048.191. The two-hundred-seventh column (CD) contains a sequence of numbers from 4099.646 to 4100.191. The two-hundred-eighth column (CE) contains a sequence of numbers from 4151.891 to 4152.191. The two-hundred-ninth column (CF) contains a sequence of numbers from 4204.636 to 4205.191. The two-hundred-tenth column (CG) contains a sequence of numbers from 4257.881 to 4258.191. The two-hundred-eleventh column (CH) contains a sequence of numbers from 4311.626 to 4312.191. The two-hundred-twelfth column (CI) contains a sequence of numbers from 4365.871 to 4366.191. The two-hundred-thirteenth column (CJ) contains a sequence of numbers from 4420.616 to 4421.191. The two-hundred-fourth column (CK) contains a sequence of numbers from 4475.861 to 4476.191. The two-hundred-fifth column (CL) contains a sequence of numbers from 4531.606 to 4532.191. The two-hundred-sixth column (CM) contains a sequence of numbers from 4587.851 to 4588.191. The two-hundred-seventh column (CN) contains a sequence of numbers from 4644.596 to 4645.191. The two-hundred-eighth column (CO) contains a sequence of numbers from 4701.841 to 4702.191. The two-hundred-ninth column (CP) contains a sequence of numbers from 4759.586 to 4760.191. The two-hundred-tenth column (CQ) contains a sequence of numbers from 4817.831 to 4818.191. The two-hundred-eleventh column (CR) contains a sequence of numbers from 4876.576 to 4877.191. The two-hundred-twelfth column (CS) contains a sequence of numbers from 4935.821 to 4936.191. The two-hundred-thirteenth column (CT) contains a sequence of numbers from 4995.566 to 4996.191. The two-hundred-fourth column (CU) contains a sequence of numbers from 5055.811 to 5056.191. The two-hundred-fifth column (CV) contains a sequence of numbers from 5116.556 to 5117.191. The two-hundred-sixth column (CW) contains a sequence of numbers from 5177.801 to 5178.191. The two-hundred-seventh column (CX) contains a sequence of numbers from 5239.546 to 5240.191. The two-hundred-eighth column (CY) contains a sequence of numbers from 5301.791 to 5302.191. The two-hundred-ninth column (CZ) contains a sequence of numbers from 5364.536 to 5365.191. The two-hundred-tenth column (CA) contains a sequence of numbers from 5427.781 to 5428.191. The two-hundred-eleventh column (CB) contains a sequence of numbers from 5491.526 to 5492.191. The two-hundred-twelfth column (CC) contains a sequence of numbers from 5555.771 to 5556.191. The two-hundred-thirteenth column (CD) contains a sequence of numbers from 5620.516 to 5621.191. The two-hundred-fourth column (CE) contains a sequence of numbers from 5685.761 to 5686.191. The two-hundred-fifth column (CF) contains a sequence of numbers from 5751.506 to 5752.191. The two-hundred-sixth column (CG) contains a sequence of numbers from 5817.751 to 5818.191. The two-hundred-seventh column (CH) contains a sequence of numbers from 5884.496 to 5885.191. The two-hundred-eighth column (CI) contains a sequence of numbers from 5951.741 to 5952.191. The two-hundred-ninth column (CJ) contains a sequence of numbers from 6019.486 to 6020.191. The two-hundred-tenth column (CK) contains a sequence of numbers from 6087.731 to 6088.191. The two-hundred-eleventh column (CL) contains a sequence of numbers from 6156.476 to 6157.191. The two-hundred-twelfth column (CM) contains a sequence of numbers from 6225.721 to 6226.191. The two-hundred-thirteenth column (CN) contains a sequence of numbers from 6295.466 to 6296.191. The two-hundred-fourth column (CO) contains a sequence of numbers from 6365.711 to 6366.191. The two-hundred-fifth column (CP) contains a sequence of numbers from 6436.456 to 6437.191. The two-hundred-sixth column (CQ) contains a sequence of numbers from 6507.701 to 6508.191. The two-hundred-seventh column (CR) contains a sequence of numbers from 6579.446 to 6580.191. The two-hundred-eighth column (CS) contains a sequence of numbers from 6651.691 to 6652.191. The two-hundred-ninth column (CT) contains a sequence of numbers from 6724.436 to 6725.191. The two-hundred-tenth column (CU) contains a sequence of numbers from 6797.681 to 6798.191. The two-hundred-eleventh column (CV) contains a sequence of numbers from 6871.426 to 6872.191. The two-hundred-twelfth column (CW) contains a sequence of numbers from 6945.671 to 6946.191. The two-hundred-thirteenth column (CX) contains a sequence of numbers from 7020.416 to 7021.191. The two-hundred-fourth column (CY) contains a sequence of numbers from 7095.661 to 7096.191. The two-hundred-fifth column (CZ) contains a sequence of numbers from 7171.406 to 7172.191. The two-hundred-sixth column (CA) contains a sequence of numbers from 7247.651 to 7248.191. The two-hundred-seventh column (CB) contains a sequence of numbers from 7324.396 to 7325.191. The two-hundred-eighth column (CC) contains a sequence of numbers from 7401.641 to 7402.191. The two-hundred-ninth column (CD) contains a sequence of numbers from 7479.386 to 7480.191. The two-hundred-tenth column (CE) contains a sequence of numbers from 7557.631 to 7558.191. The two-hundred-eleventh column (CF) contains a sequence of numbers from 7636.376 to 7637.191. The two-hundred-twelfth column (CG) contains a sequence of numbers from 7715.621 to 7716.191. The two-hundred-thirteenth column (CH) contains a sequence of numbers from 7795.366 to 7796.191. The two-hundred-fourth column (CI) contains a sequence of numbers from 7875.611 to 7876.191. The two-hundred-fifth column (CJ) contains a sequence of numbers from 7956.356 to 7957.191. The two-hundred-sixth column (CK) contains a sequence of numbers from 8037.601 to 8038.191. The two-hundred-seventh column (CL) contains a sequence of numbers from 8119.346 to 8120.191. The two-hundred-eighth column (CM) contains a sequence of numbers from 8201.591 to 8202.191. The two-hundred-ninth column (CN) contains a sequence of numbers from 8284.336 to 8285.191. The two-hundred-tenth column (CO) contains a sequence of numbers from 8367.581 to 8368.191. The two-hundred-eleventh column (CP) contains a sequence of numbers from 8451.326 to 8452.191. The two-hundred-twelfth column (CQ) contains a sequence of numbers from 8535.571 to 8536.191. The two-hundred-thirteenth column (CR) contains a sequence of numbers from 8620.316 to 8621.191. The two-hundred-fourth column (CS) contains a sequence of numbers from 8705.561 to 8706.191. The two-hundred-fifth column (CT) contains a sequence of numbers from 8791.306 to 8792.191. The two-hundred-sixth column (CU) contains a sequence of numbers from 8877.551 to 8878.191. The two-hundred-seventh column (CV) contains a sequence of numbers from 8964.296 to 8965.191. The two-hundred-eighth column (CW) contains a sequence of numbers from 9051.541 to 9052.191. The two-hundred-ninth column (CX) contains a sequence of numbers from 9139.286 to 9140.191. The two-hundred-tenth column (CY) contains a sequence of numbers from 9227.531 to 9228.191. The two-hundred-eleventh column (CZ) contains a sequence of numbers from 9316.276 to 9317.191. The two-hundred-twelfth column (CA) contains a sequence of numbers from 9405.521 to 9406.191. The two-hundred-thirteenth column (CB) contains a sequence of numbers from 9495.266 to 9496.191. The two-hundred-fourth column (CC) contains a sequence of numbers from 9585.511 to 9586.191. The two-hundred-fifth column (CD) contains a sequence of numbers from 9676.256 to 9677.191. The two-hundred-sixth column (CE) contains a sequence of numbers from 9767.501 to 9768.191. The two-hundred-seventh column (CF) contains a sequence of numbers from 9859.246 to 9860.191. The two-hundred-eighth column (CG) contains a sequence of numbers from 9951.491 to 9952.191. The two-hundred-ninth column (CH) contains a sequence of numbers from 10044.236 to 10045.191. The two-hundred-tenth column (CI) contains a sequence of numbers from 10137.481 to 10138.191. The two-hundred-eleventh column (CJ) contains a sequence of numbers from 10231.226 to 10232.191. The two-hundred-twelfth column (CK) contains a sequence of numbers from 10325.471 to 10326.191. The two-hundred-thirteenth column (CL) contains a sequence of numbers from 10420.216 to 10421.191. The two-hundred-fourth column (CM) contains a sequence of numbers from 10515.461 to 10516.191. The two-hundred-fifth column (CN) contains a sequence of numbers from 10611.206 to 10612.191. The two-hundred-sixth column (CO) contains a sequence of numbers from 10707.451 to 10708.191. The two-hundred-seventh column (CP) contains a sequence of numbers from 10804.196 to 10805.191. The two-hundred-eighth column (CQ) contains a sequence of numbers from 10901.441 to 10902.191. The two-hundred-ninth column (CR) contains a sequence of numbers from 10999.186 to 11000.191. The two-hundred-tenth column (CS) contains a sequence of numbers from 11097.431 to 11098.191. The two-hundred-eleventh column (CT) contains a sequence of numbers from 11196.176 to 11197.191. The two-hundred-twelfth column (CU) contains a sequence of numbers from 11295.421 to 11296.191. The two-hundred-thirteenth column (CV) contains a sequence of numbers from 11395.166 to 11396.191. The two-hundred-fourth column (CW) contains a sequence of numbers from 11495.411 to 11496.191. The two-hundred-fifth column (CX) contains a sequence of numbers from 11596.156 to 11597.191. The two-hundred-sixth column (CY) contains a sequence of numbers from 11697.401 to 11698.191. The two-hundred-seventh column (CZ) contains a sequence of numbers from 11799.146 to 11800.191. The two-hundred-eighth column (CA) contains a sequence of numbers from 11901.391 to 11902.191. The two-hundred-ninth column (CB) contains a sequence of numbers from 12004.136 to 12005.191. The two-hundred-tenth column (CC) contains a sequence of numbers from 12107.381 to 12108.191. The two-hundred-eleventh column (CD) contains a sequence of numbers from 12211.126 to 12212.191. The two-hundred-twelfth column (CE) contains a sequence of numbers from 12315.371 to 12316.191. The two-hundred-thirteenth column (CF) contains a sequence of numbers from 12420.116 to 12421.191. The two-hundred-fourth column (CG) contains a sequence of numbers from 12525.361 to 12526.191. The two-hundred-fifth column (CH) contains a sequence of numbers from 12631.106 to 12632.191. The two-hundred-sixth column (CI) contains a sequence of numbers from 12737.351 to 12738.191. The two-hundred-seventh column (CJ) contains a sequence of numbers from 12844.096 to 12845.191. The two-hundred-eighth column (CK) contains a sequence of numbers from 12951.341 to 12952.191. The two-hundred-ninth column (CL) contains a sequence of numbers from 13059.086 to 13060.191. The two-hundred-tenth column (CM) contains a sequence of numbers from 13167.331 to 13168.191. The two-hundred-eleventh column (CN) contains a sequence of numbers from 13276.076 to 13277.191. The two-hundred-twelfth column (CO) contains a sequence of numbers from 13385.321 to 13386.191. The two-hundred-thirteenth column (CP) contains a sequence of numbers from 13495.066 to

If obtaining an unsatisfactory value of EP for the company, the manager may choose to outsource those operations. Thus, if the company run only drilling and outsourced the other two operations, it would be observed that this case is the most profitable ( $EP=57.5 \cdot 10^{-8}$  Euro/Euro·min).

If they perform the welding operation, the worst EP ( $EP=6.09 \cdot 10^{-8}$  Euro/Euro·min) is obtained.

### 3. CONCLUSION

Order acceptance will be made only after evaluating the maximal values of EP and selecting those orders-that could be positive for the company.

As far as the order is concerned, if the company only performed the drilling operation and outsourced the other two operations, the effect on the company would be a positive one ( $EP=57.5 \cdot 10^{-8}$  Euro/Euro·min). If the company would only performed the welding operation it would have the worst EP ( $EP=6.09 \cdot 10^{-8}$  Euro/Euro·min). Therefore, the manager will have an overview of the order EP in order to perform the order acceptance.

This analysis will help the manager of a make-to-order companies, on one hand, to accept an order, and on the other hand, to perform an optimal control of the processing system.

In other words, the paper suggests a method for integrated control for a make-to-order manufacturing system where EP is used as a decision making criterion.

### REFERENCES

- [1] **M. Ebadian, M. Rabbani, F. Jolai, S.A. Torabi, R. Tavakkoli-Moghaddam**, A new decision-making structure for the order entry stage in make-to-order environments, *Int. J. Production Economics* 111 351–367, 2008.
- [2] **Ebben, M.J.R., E.W. Hans, and F.M. Olde Weghuis**, Workload Based Order Acceptance in Job Shop Environments, *OR Spectrum* 27: 107–122, DOI: 10.1007/s00291-004-0171-9, 2005.
- [3] **Ghaeli M, Bahri P., Lee P** - *Scheduling of a mixed batch/continuous sugar milling plant using Petri nets*, in *Computers & Chemical Engineering*, Volume 32, Issue 3, 24 March 2008, 580-589
- [4] **Wang M., Wang H.** - *From process logic to business logic- A cognitive approach to business management*, in *Information & Management*, 43,2008, 179-193.
- [5] **Linderman K., McKone-Sweet**- *An integrated system to process control and maintenance*, in *European Journal of Operational Research*, 164(2), 2005, 324-340.
- [6] **Francisco Restivo** - *An Agile and Adaptive Holonic Architecture for Manufacturing Control*, Ph. D. thesis, University of Porto, student: Paulo Leitão, supervisor: **2001-2004**.
- [7] **Paulo Leitão and Francisco Restivo** - *ADACOR: A Holonic Architecture for Agile and Adaptive Manufacturing Control*, in *Computers in Industry*, Vol.57, n° 2, 2006, 121-130.
- [8] **Babiceanu R.F and Frank C.F** - *Development and applications of holonic manufacturing system: a survey*, in *Journal of Intelligent Manufacturing* 17, **2006**, 111-131.
- [9] **Koren Y., Heisel U.** - *Reconfigurable Manufacturing Systems*, *Annals of the CIRP*, vol. 48/2/1999, 1999, 527-536
- [10] **Gi-Tae Yeo, Roe M.and Dinwoodie J.** - *Evaluating the competitiveness of container ports in Korea and China Transportation Research Part A: Policy and Practice*, In Press, Corrected Proof, Available online 14 February 2008
- [11] **Seong Kon Lee, Gento Mogi and Jong Wook Kim** - *The competitiveness of Korea as a developer of hydrogen energy technology: The AHP approach Energy Policy*, In Press, Corrected Proof, Available online 28 January, 2008.
- [12] **George F. Georgakopoulos** - *Chain-splay trees, or, how to achieve and prove loglogN-competitiveness by splaying*, in *Information Processing Letters*, Volume 106, Issue 1, 31 March 2008, 37-43.