DIPARTIMENTO DI INGEGNERIA INFORMATICA, GESTIONALE E DELL'AUTOMAZIONE
UNIVERSITA' POLITECNICA DELLE MARCHE
"Maurizio Panti"

ASSOCIAZIONE ITALIANA DI RICERCA OPERATIVA

UNIVERSITA' POLITECNICA DELLE MARCHE

XXXVIII ANNUAL CONFERENCE OF THE ITALIAN OPERATIONS RESEARCH SOCIETY

GENOVA, ITALY, SEPTEMBER 5-8, 2007

Industrial Investment Planning: Effects on Firm Performance and Profitability

Marcello Falasco
Marco Cardinali
Enrico Guzzini

M. Falasco (falasco@diiga.univpm.it)
M. Cardinali (marco.cardinali@tiscali.it)
E. Guzzini (guzzini@diiga.univpm.it)

Dipartimento di Ingegneria Informatica, Gestionale e dell'Automazione (D.I.I.G.A.) Università Politecnica delle Marche - Ancona, Italy.

Abstract
Long-term industrial investment decisions are a very important aspect of business strategy and give a fundamental contribution to its success and to its capability to compete in markets.
Following one of our previous works and taking the results there obtained as starting point (optimisation of production and purchasing planning), we will focus our attention on the investment analysis planning. In particular we will examine, by applying suitable methodologies of evaluation (Net Present Value, Internal Rate of Return, Payback Period), the feasibility and the economic and financial convenience of the investment plan. We will analyse, further to the optimisation of production processes and layout, the benefits concerning: reduction of operating costs, improvement of product quality, increase in efficiency and production capacity.

Keywords: Industrial Investment, Net Present Value, Pay Back Period.

1. PRESENTATION OF CASE STUDY

The case study considered in this paper is a manufacturing concern with about 100 employees. The situation at the end of 2006 is the following:

BALANCE SHEET

ASSETS	2006	2005	LIABILITIES	2006	2005
Non current assets	9.380.613	7.569.522	Equity	2.867.948	3.056.063
Current assets			Non current liabilities	5.540.424	4.621.286
Inventories	5.198.778	3.979.088	Current liabilities	19.387.707	12.769.138
Accounts Receivables	13.172.977	8.844.176			
Cash and cash equivalent	43.711	53.701			
	27.796.079	**20.446.487**		**27.796.079**	**20.446.487**

We may note a strong financial fragility of the firm with a ratio between Debt and Equity greater than 8. Furthermore, at the same time, the conditions of liquidity and solvability are very weak: the ratio between Current Assets and Current Liabilities is less than 1 (0,94), the quick ratio is about 0,68.
The Income Statement shows a negative profit of € 188.117. The main reason depends on an increase in variable costs during 2006 (especially in the cost of raw materials) and in a reduction of

sale prices, in order to catch more customers. This situation can be seen in the reduction of operating profit. The financial weakness of the firms is reflected in the increase of interest costs (+€ 231.502). Therefore pre tax profit decreases of about € 270.786.

INCOME STATEMENT

	2006	2005
Sales	22.461.182	17.017.933
Operating Costs	-21.567.223	- 15.949.862
Operating Profit	893.959	1.068.071
Financial Costs and Revenue		
Interest Costs	- 921.217	- 689.715
Interest Revenues	139.023	9.909
Non Operating Cost and Revenues	33.575	27.861
Pre tax Profit	145.340	416.126
Taxes	- 333.457	- 360.260
Net Profit	**- 188.117**	**55.866**

2. BENEFITS OF PREVIOUS MODEL

In Falasco, Cardinali, Guzzini (2006) we introduced a pilot model in the manufacturing concern. The starting point of this model concerns the demand forecast, in order to esteem monthly demand and to plan the corresponding need of resources. The introduction of the forecast model made possible a reorganization of the whole planning production process. According to this reorganization at the end of the year the marketing department draws up the annual sales budget. At the same time, the planning production department esteems the sales for the following three month (e.g. January-March) according to past sales. Then the estimates are monthly updated with reference to market conditions, marketing policies, ecc. Capitalising on this revision of monthly sales the planning production department draws up the production planning of the following months. The aim of the production planning is to minimize resources tied up in inventories (work in progress, finished products) and to rationalize purchasing activities in order to decrease transaction costs (e.g. delivery costs, etc.).

Although the Balance Sheet shows an increase in inventories from 2005 to 2006 (+ € 1.219.690), the model introduced, according to available data, gave raise, however to some benefits.

Concerning the increase in inventories in the period 2005-2006, we may highlight:

- A "strategic" increase in raw materials because of an expected increase in the price of lead in 2008;
- The assessment of inventories in 2006 had been made at an higher values than 2005;
- The increase in turnover in 2006 was possible, given the limits of productive capacity, thanks to an increase in commercialization of goods bought from other producers (China). Given the longer lead time (for these goods), it was necessary to increase the amount of goods in stock in order to avoid stock-out.

At the end of 2005, before the introduction of the pilot model, inventories in stock concerning to the internal production were:

- Work in progress (semi-finished products; WIP or SF): about 330.000 items in stock;
- Finished products (batteries for vehicles): about 62.000 items in stock.

At the end of 2006, one year after the introduction of the pilot model, the firm achieved the following results:

- Work in progress (semi-finished products): about 260.000 items in stock;
- Finished products: about 49.000 items in stock.

The reduction of semi-finished products in stock involved a subsequent decrease in financial resources of about € 80.000[1] which can be determined in the following way:

Decrease in financial resources tied up in SF = (330.000-260.000) · 1,16 = € 81.200

The reduction of finished products (FP) in stock involved a subsequent decrease in financial resources of about € 390.000[2] which can be determined in the following way:

Average variable cost determined according to the production mix (of 2006)[3] = € 28,50

Decrease in financial resources tied up in FP = (62.000-49.000)· 28,50 = € 370.500

3. INVESTMENT PLAN

Given the need of an increase in the productive capacity and given also according to the commercial department, an expected increase in sales of future years (6, 7 years) of about 50.000 units, we focus in the present paper on the investment analysis planning.

The increase in sales (forecasted by the commercial department) concerns, according to the marketing policies developed by the firm, mainly the product of kind III, with a higher contribution margin (see § 5.4).

In the following analysis we will try to assess the feasibility of the new investments in three fields:

- Reduction of operating costs;
- Increase of productive capacity;
- Improvement of product quality.

In particular we will consider three kinds of machinery:

- **Industrial handling system**
- **Cast on straps**
- **Assembly line**

[1] The decrease in financial resources tied up in work in progress is valued at 2005 variable cost (€ 1,16).
[2] Also this reduction is valued at 2005 variable cost.
[3] In 2005 the average variable cost according to production mix was €27,07. See Falasco, Cardinali, Guzzini (2006). The 2006 average variable cost (even if calculated at 2005's values) is higher since the production mix of 2006 is different from the 2005 one.

3.1. Industrial handling system

Description

This machinery takes the finished products coming from the Assembly line and prepares pallets[4] to be put in warehouse and/or to be sold to customers. The quantity of goods in each pallet and its scheme of composition[5] are determined automatically according to the first setting made during its installation. The introduction of this machinery allows a saving of one worker during the day, since this task is developed at present manually.

Economic information

Cost of machinery = € 90.000
Economic life = 10 years
Organization benefits = saving of ½ worker for each shift (work time = 2 shifts)
Economic benefits = reduction of operating costs of € 30.000 per year, since the cost of one worker per year is about € 30.000.
Increasing in the productive capacity = none if it is bought alone
Improvement in the products quality = none

3.2. Cast on straps

Description

This machinery takes as input semi-finished products (positive and negative plates) and gives as output another work in progress (an element[6]) of 2 volts. Furthermore, Cast on straps (COS) puts the elements in the corresponding cells of the box. This is the input for the Assembly line. The number of plates for each element depends on the battery capacity. With the increase of the capacity we have to add more plates. With respect to the previous one (completely depreciated), in the new COS:

- The stations of charging (unstrapped plates) and discharging (elements) are completely automatic. The old one is manual (and needs 2 workers);
- The new COS is faster than the previous one;
- The new COS needs only one person with supervision tasks.

Economic information

Cost of machinery = € 450.000
Economic life = 10 years
Organization benefits = saving of 1 worker for each shift (work time = 2 shifts)
Economic benefits = reduction of operating costs of € 60.000 per year, since the cost of one worker per year is about € 30.000.
Increasing in the productive capacity = only if the Cast on straps is purchased with the Assembly line.
Improvement in the products quality = none

[4] A pallet is a transport structure which supports goods in a stable fashion while being lifted or moved by a forklift.
[5] The number of goods for each pallet depends on the dimension of each typology of finished product
[6] An element consists of an amount of positive and negative plates mechanically strapped (joint) all together.

3.3. Assembly line

Description

This machinery allows to make finished product (batteries) and to make all the quality controls regarding short circuits. In other words, this machinery takes as input the output of COS, assembles all the raw materials and semi-finished products and makes the finished product. During each phase of the assembly process, this machinery makes the quality controls. This fact allows improving the product's quality. With respect to the previous one (completely depreciated), the new Assembly line executes automatically some operations previously manual.

Economic information

Cost of machinery = € 350.000
Economic life = 10 years
Organization benefits = saving of ½ worker for each shift (work time = 2 shifts)
Economic benefits = reduction of operating costs of € 30.000 per year, since the cost of one worker per year is about € 30.000.
Increasing in the productive capacity = only if the Assembly line is purchased with the Cast on straps.
Improvement in the product quality = yes

In order to assess the economic feasibility of the above mentioned investments we will determine three kinds of indicators[7]:

- ***Payback Period*** (*PBP*): Payback period represents the period of time it takes in order to repay the initial cash outflow of the investment.
- ***Net Present Value*** (*NPV*): Net Present Value is the sum of the (expected) discounted cash inflows minus the initial outflow for the investment.
- ***Internal Rate of Return*** (*IRR*): Internal Rate of Return is the discounted rate which equals the sum of discounted cash inflows with the initial outflow for the investment.

Before analysing cash flows of the different investments and the relating methodologies of investment assessment, we focus on the discount rate, whose determination is necessary for the *NPV*.

4. DETERMINATION OF DISCOUNT RATE

In order to assess the discounted cash flows, we have to determine the discounted rate. As discount rate we will use the WACC (*Weighted Average Cost of Capital*). WACC represents the opportunity cost of capital of the firm:

$$i = WACC = r_E \frac{E}{E+D} + r_D \frac{D}{E+D},$$

[7] For details (pro and cons of each method, ecc.) see, among others, Brealey, Myers, Allen (2006), Seitz, Ellison (2004), Shapiro (2004), Pavarani, Tagliavini (2006), Falasco, Baldoni (2001).

Where E indicates the amount of Equity; D stands for the amount firm's financial debts[8]; r_E represents the rate of return investors (shareholders) would expect by investing in other projects with the same level of risk of the firm[9]; r_D represents the rate of return creditors would expect by lending money to other firms with the same level of risk. In our analysis the values of E and D are the following:

E = € 2.867.948

D = € 15.323.051

$D/E \cong 5{,}343$

In order to determine WACC, we have to estimate the values of r_E and r_D.

4.1 Determination of r_E

In determining r_E we will use the CAPM (*Capital Asset Pricing Model*).[10]

According to this model, r_E is defined as follows:

$$r_E = R_F + \beta_A \cdot (R_M - R_F)$$

where R_F is the nominal free risk rate, i.e. the return the investor could earn investing in a certain activity without any risk. $(R_M - R_F)$ is the MRP (*market risk premium*) which is the difference between the expected return on market portfolio (R_M) and the risk free rate; the parameter β_A measures the sensitivity of the expected returns of firm "A" (or of A's project) to market portfolio returns. In other words beta is a measure of the return volatility of A's project. Therefore $\beta_A \cdot (R_M - R_F)$ measures the risk premium of A's project[11]. Thus the (rate of) return investors would expect by investing in A's projects (r_E) is the sum of risk premium of A's projects and the risk free rate (R_F).

In our analysis we will use the following parameters:

R_F = interest rate of 10 years BTP (July 2007) = 4,76%[12]

MRP = 6,645%[13]

In order to estimate β_A we will consider two kinds of indicators:

- Rate of return of "Ultimo MIBtel" from February 2003 to July 2007, monthly data
- Rate of return of "MIB Settoriale Elettronici-Elettrici" from February 2003 to July 2007, monthly data[14]

The index "Ultimo MIBtel" is considered as a proxy of R_M, while, because of unavailability of firm's data (at a monthly level), we use the index "MIB Settoriale Elettronici-Elettrici" as a proxy of the firm's returns, since the firm operates in this sector.

By running the following linear regression:

$$\text{MIB Settoriale Elettronici-Elettrici}_t = \alpha + \beta \cdot \text{Ultimo MIBtel}_t + \varepsilon_t$$

[8] Therefore we do not include Accounts payable, tax debts, ecc.

[9] We suppose that the firm's level of risk and the project's level of risk (we are analysing) are the same.

[10] Sharpe (1964), Lintner (1965). Although there are many doubts about the CAPM, it is still widely used. See Graham and Harvey (2002).

[11] $\beta_{AU} = \sigma_{AM} \Big/ \sigma_M^2$, where the numerator is the covariance between the expected return of A and M; the denominator is the variance of expected return of M. If $\text{beta}_A = 1$ it means that the volatility of A's return equals the market one. If $\text{beta}_A > 1$, the A's risk premium is higher than MRP. The converse holds if $\text{beta}_A < 1$.

[12] See Banca d'Italia (2007).

[13] We considered the average values of estimates made by Dimson, Marsh, Staunton (2002) and Panetta, Violi (1999); quoted in Pavarani, Tagliavini (2006, p.312).

[14] These data can be found in www.borsaitaliana.it. We calculate the rate of return as the percentage variation in the value of the monthly indicators, without considering the distribution of dividend, i.e. we consider only capital gains (losses).

we obtain the following estimation for β: $\hat{\beta} \cong 0{,}99158$ In our analysis $\hat{\beta} \cong 0{,}99158 = \beta_{AU}$ [15]. Since β_{AU} is the unleverage value of *A*'s beta, we have to leverage it (β_A).

We use the following equation[16]:

$$\beta_A = \beta_{AU} \cdot [1 + (1\text{-}t) \cdot (D/E)] = 0{,}99158 \cdot [1 + 0{,}67 \cdot 5{,}343] \cong 4{,}541$$

(D/E) is the debt equity ratio as defined above, (1-t) is the so called *tax-shield*, depending on the fact that the costs of debts (interest expenses) are tax deductible[17]. Given R_F and MRP, we may determine r_E.

$$r_E = R_F + \beta_{AL} \cdot (R_M - R_F) = 4{,}76\% + 4{,}541 \cdot 6{,}645\% \cong 34{,}94\%$$

4.2. Determination of r_D

In order to determine the value of r_D we will assume that the following relation holds:

$$r_D = [\, R^D{}_F + CS \,] \cdot (1\text{-}t)$$

where $R^D{}_F$ is the free risk interest rate (on debt); *CS* is the *Credit spread* i.e. a measure of the firm's risk and (1-t) is the tax shield. In our analysis we will use:

$R^D{}_F$ = six months Euribor (interest rate), July 2007[18] = 4,36%

In order to estimate the *credit spread* we consider the ratio Ebit[19]/ Interest expenses ≅ 0,97 as an indicator of firm's risk. We consider the *credit spread* calculated by rating agencies corresponding to the value of this indicator for little and medium firms. This value is about 12,50%[20]. Given a value of $R^D{}_F$ = 4,36%, we obtain:

$$r_D = [R^D{}_F + CS\,] \cdot (1\text{-}t) = [\, 4{,}36\% + 12{,}50\% \,] \cdot 0{,}67 \cong 11{,}30\%$$

We can finally calculate the value of *WACC*

$$i = WACC = r_E \frac{E}{E+D} + r_D \frac{D}{E+D} \cong 15\%$$

[15] R^2 = 0,59061; Student's t value = 8,57763, therefore beta is statistically significative. The procedure we follow is not completely correct, since $\hat{\beta}$ is an estimation of the average β for leveraged firms belonging to the sector "Elettronici-Elettrici". This value should be unleveradged according to their financial structure. Since the unleveraged β is lower than the leveraged one, we overestimate the value of beta, i.e. we will discount with a higher discount rate and therefore we will calculate more conservative values.

[16] See, among others, Damodaran (2006, p.121).

[17] More precisely interest expenses are tax deductible from IRES (with a tax rate of 33%).

[18] See European Central Bank (2007).

[19] It corresponds substantially to the Operating profit.

[20] For details, see Damodaran (2006, p.143) and www.bondsonline.com. See also Pavarani, Tagliavini (2006, p.326).

5. INVESTMENT ANALYSIS

In following analysis we will make the assumption that the purchase of these machineries will be financed both by debt and by equity: in particular we will assume that the ratio between Debt and Equity (D/E = 5,343) is not modified by the financing decision.

5.1. Industrial handling system

The initial outflow is C_0 = € 90.000. The stream of future cash flows is:

Reduction in operative costs	€	30.000
Depreciation[21]	€	-9.000
Increase in EBIT	€	21.000
Corporate income taxes[22]	€	-8.400
Net Profit	€	12.600
Cash flow (Fl_j)	€	**21.600**

Fl_j are calculated as difference between the total inflows (increase in Ebit) and the total outflows (Taxes) of the year.

We can calculate the following indicators:

Industrial handling system	*Payback period*	*Net present value*	*Internal rate of return*
	4 years, 2 months	€ 18.405	20,18%

PBP is determined by considering the sum of future cash flows:

1	2	3	4	5	6	7	8	9	10
21.600	**43.200**	**64.800**	**86.400**	**108.000**	**129.600**	**151.200**	**172.800**	**194.400**	**216.000**

NPV and *IRR* are so calculated:

$$NPV = \sum_{j=1}^{10} \frac{FL_j}{1.15^j} - 90.000 \cong € \ 18.405$$

IRR corresponds to i^* such that $NPV = 0$

Given the values of *PBP*, *NPV* and *IRR*, the investment is convenient.

[21] For simplicity we assume a straight line depreciation.
[22] They are calculated by using an average tax rate of 40%.

5.2. Cast on straps

The initial outflow is C_0 = € 450.000. The stream of future cash flows is:

Reduction in operative costs	€	60.000
Depreciation	€	-45.000
Increase in EBIT	€	15.000
Corporate income taxes	€	-6.000
Net Profit	€	9.000
Cash flow (Fl_j)	€	**54.000**

The stream of cumulative cash flow is:

1	2	3	4	5	6	7	8	9	10
54.000	108.000	162.000	216.000	270.000	324.000	378.000	432.000	486.000	540.000

Cast on straps	*Payback period*	*Net present value*	*Internal rate of return*
	8 years, 4 months	€ -178.986	3,46%

Given the previous values, the benefit of reduction in operating costs is not sufficient to justify the purchase of this machinery.

5.3. Assembly line

The initial outflow is C_0 = € 350.000. The stream of future cash flows is:

Reduction in operative costs	€	30.000
Depreciation	€	-35.000
Increase in EBIT	€	-5.000
Corporate income taxes	€	2.000
Net Profit	€	-3.000
Cash flow (Fl_j)	€	**32.000**

The stream of cumulative cash flow is:

1	2	3	4	5	6	7	8	9	10
32.000	64.000	96.000	128.000	160.000	192.000	224.000	256.000	288.000	320.000

The economic life of the machinery is not sufficient to repay its cost.

Assembly line	*Payback period*	*Net present value*	*Internal rate of return*
	> 10 years	€ -189.399	There not exists

Therefore PBP is greater than the project's economic life and there not exist any positive discount rate such that NPV is zero. For these reasons the investment should not be made.

5.4. Assembly line and Cast on straps

If Assembly line and Cast on Strups are bought together, the firm will have the possibility to increase its sales of about 50.000 units. In particular, for the three typologies of products, the expected sales are so distributed:

Typology	Price	Average Variable cost	Average Contr Margin	Quantity	Increase in Sales	Increase in Variable costs	Increase in Contr. Margin
I	21,20	19,50	1,70	12.500	€ 265.000	243.750	21.250
II	23,10	20,50	2,60	12.500	€ 288.750	256.250	32.500
III	69,00	48,50	20,50	25.000	€ 1.725.000	1.212.500	512.500
				50.000	**€ 2.278.750**	**€ 1.712.500**	**€ 566.250**

As a matter of prudence, we assumed that the increase in sales will be limited for the first five years. Always for the same reasons we assumed that in these years there will be an increase in period costs of about € 100.000 (for logistics, maintenance, and commercial department).

At the same time, however, the firm will need some financial resources tied up in working capital (inventories, accounts receivables ecc.). We have to estimate the need of these resources.

1) Inventories. As we saw before, the amount of finished products in stock at the same period is 49.000 units. The total production in 2006 was about 300.000 units of finished products (I, II, III). We assess the need of inventories by assuming the same proportion.

- For the finished products we will have: Increase of number of finished products in stock = 50.000/6,122 = 8.167[23], which is valued at his average cost of € 34,25 according to the production mix. The total value is about € 279.720.
- About semi works, we know that at the end of 2006 the quantity held in stock was 260.000 units. We estimate the increase in inventories by 20% (ΔQ = 52.000). The average cost of one unit of semi work is € 1,72 (cost of 2006). Therefore the incremental value of semi works amounts to about € 89.440.

At the end, we have about € 369.160 of financial resources to be tied up in inventories[24].

2) Secondly, not all the sales will be collected in the year. Given an average collection period of about 190 days, we have also to compute an increase in Accounts receivables which is about 190/365 = 0,52 of the sales. Since the increase in sales is € 2.278.750, we estimate an amount in sales not collected in the year of about € 1.184.950.

3) About the increase of costs, we consider an average payable period of about 122 days. The increase in variable costs is € 1.712.500. The part of this cost concerning the labor-cost (which is paid without any extension) is about 20%. Therefore the amount of about € 1.370.000 refers to costs for which the firm has an average payable period of about 122 days (1/3 of the year). The part of these costs which will not be paid in the year will be of about € 456.667.

Therefore in the first year we have an increase in working capital which is:
369.160 +1.184.950 - 456.667 = € 1.097.443

We are able to calculate the cash flow for the first year. The initial cash flow is C_0 = € 800.000. As we can see, the need of financial resources is not limited to the initial cash outflow for the purchase of the machines, but concerns also the **first** year of economic life of the project.

[23] 6,122 is obtained by subdividing 300.000 by 49.000.

[24] We do consider raw materials since the increase in raw materials in stock at the end of 2006 (see §2) is considered sufficient to support the increase in sales.

Increase in contribution margin	€	566.250
Increase in period costs	€	-100.000
Reduction in operating costs	€	90.000
Depreciation	€	-80.000
Increase in EBIT	€	476.250
Corporate income taxes (40%)	€	-190.500
Net Profit	€	285.750
Increase in Working Capital	€	-1.097.443
Cash flow (Fl_1)	€	**-731.693**

For the **second, third, fourth and fifth year** we have:

Increase in contribution margin	€	566.250
Increase in period costs	€	-100.000
Reduction in operating costs	€	90.000
Depreciation	€	-80.000
Increase in EBIT	€	476.250
Corporate income taxes (40%)	€	-190.500
Net Profit	€	285.750
Cash flow (Fl_2 ,Fl_5)	€	**365.750**

In this situation we do not have to add the item "Increase in working capital", since, e.g, the sales not collected in the year are balanced by the collection of sales of previous year[25].

In the **sixth** year we have:

- the decrease in operating costs;
- the reduction in inventories because of the reduction in sales;
- the collection of sales not collected in the previous year;
- the payment of costs not paid in the previous year

Reduction in operating costs	€	90.000
Depreciation	€	-80.000
Increase in EBIT	€	10.000
Corporate income taxes	€	-4.000
Net Profit	€	6.000
Decrease in working capital	€	1.097.443
Cash flow (Fl_6)	€	**1.183.443**

In the last years (**eighth-ninth- tenth**) cash flows amount to:

Reduction in operating costs	€	90.000
Depreciation	€	-80.000
Increase in EBIT	€	10.000
Corporate income taxes	€	-4.000
Net Profit	€	6.000
Cash flow (Fl_7, $Fl_{10,}$)	€	**86.000**

[25] The same consideration holds for costs.

The stream of cumulative cash flows is:

1	2	3	4	5
- 731.693	- 365.943	- 193	365.557	731.307

6	7	8	9	10
1.914.750	2.000.750	2.086.750	2.172.750	2.258.750

	Payback period	*Net present value*	*Internal rate of return*
Cast on strups and Assembly line	5 years, 1 month	€ 89.536	16,71%

Given the above assumptions and the values of *PBP*, *NPV* and *IRR*, the investment is convenient.

6. CONCLUSIONS

The analysis of economic feasibility of the investments highlighted the following results:

- **Industrial handling system:** the introduction of this machinery is considered convenient irrespective of the increase of the production capacity: the reduction of operating costs is so high to justify its purchase.
- **Cast on straps and Assembly line:** the introduction of these machiners is considered convenient only if both are introduced at the same time because of the increase in productive capacity. The simply reduction of operating costs is not sufficient to justify the introduction of the single machinery. In particular, in order to be convenient the joint introduction of Assembly line and Cast on straps, there is the need for the firm to increase the sales according to the assumed turnover mix. Secondly it results that the need of financial resources is not limited to the outflow for the purchasing of machines. Indeed a great amount of resources concerns the financing of working capital. It would be wise for the firm to decrease the average collection period, to increase the average payable period and to continue to control inventories in stock (according to the previous model). Thanks to such improvements, the firm would experience better performances (in terms of *PBP*, *NPV*, *IRR*). Lastly, it should be considered that an assumption of our analysis was an increase of period costs of € 100.000. It would be sufficient an increase in period costs of € 150.000 to transform the investment in a non convenient one.

7. REFERENCES

Banca d'Italia (2007) *Supplementi al Bollettino Statistico. Mercato Finanziario*, Anno XVII, Numero 48, Agosto.
Brealey R.A., Myers S.C., Allen F. (2006) *Corporate Finance*. McGraw-Hill, 8th Edition.
European Central Bank (2007) *Monthly Bulletin*, August.
Damodaran A. (2006) *Finanza Aziendale*. Apogeo, 2° edizione.

Dimson E., Marsh P., Staunton M. (2002) *Triumph of the Optimists: 101 Years of Global Investments Returns*. Princeton University, Princeton.
Falasco M., Baldoni F. (2001) *La Pianificazione degli Investimenti Produttivi*, Pitagora Editrice, Bologna.
Falasco M., Cardinali M., Guzzini E. (2006) *Ottimizzazione dei Flussi Finanziari nella Pianificazione della Produzione e degli Approvvigionamenti*. XXXVII Conferenza Internazionale A.I.R.O., Settembre 2006, Cesena.
Graham J., Harvey C., (2002) *How Do CFOs Make Capital Budgeting and Capital Structure Decisions?* Journal of Applied Corporate Finance, Spring, 8-23.
Lintner J. (1965) *The valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets*, Review of Economics and Statistics, 47:13-37.
Panetta F., Violi R. (1999) *Is there an Equity Premium Puzzle in Italy? A look at Asset Returns, Consumption and Financial Structure Data over the Last Century*. Banca d'Italia, Temi di Discussione N. 353, June.
Pavarani E., Tagliavini G. (2006) *Pianificazione finanziaria*. Mc Graw-Hill Editore, Milano.
Seitz N., Ellison M. (2004) *Capital Budgeting and Long-Term Financing Decisions*. South Western College Publications, 4th Edition.
Sharpe W.F. (1964) *Capital Asset Pricing: a Theory of Market Equilibrium under Conditions of Risk*, Journal of Finance, 19: 425-442.
Shapiro A.C. (2004) Capital Budgeting and Investment Analysis, Prentice Hall.