SYSTEM DYNAMICS AND CIRCULATORY ANALYSIS: PROPOSALS FOR AN ALLIANCE

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ABSTRACT

Our purpose is to set up a dialogue, a scientific exchange, between CIRCULATORY ANALYSIS and SYSTEMS DYNAMICS, since we belive the two disciplines to be complementary. In fact, we would go so far as to say that S.D. represents the natural development of C.A.

We consider there are well-founded reasons to expect the cooperation between the two disciplines to be profitable in helping to subdue the system of economic circulation and to subject it to a rational control.

Circulatory Analysis can offer Systems Dynamics the conceptual rigourousness of a theory of circulatory systems developed from solid bases, and even some new concepts which may be very useful (for instance, those of Circulatory Process and Complex Circulation). On the other hand, Systems Dynamics can offer all its engineering capacity to produce working models.

In order to show more clearly what Circulatory Analysis is, we have made a small toy, a model constructed to simulate the behavior of the system of economic circulation in a commercial business. It is extremely simple (it is, after all, a toy), but the same methodology used for its design and construction can make it possible to produce machines, that is, simulator models, to any degree of complexity.

SYSTEM DYNAMICS AND CIRCULATORY ANALYSIS
PROPOSALS FOR AN ALLIANCE

The title of our paper may in some way suggest the sensational announcement of the romance between a famous film star and a humble pretender of unkonwn origins. Though, a congress of scientists is a ceremony which is not precisely frivolous, we must admit more or less humorously that our title could be explained in the following -or similar- terms:

"The small humble family of CIRCULATORY ANALYSIS (C.A.) asks from the large affluent clan of SYSTEM DYNAMICS (S.D.) -with the best of all the possible intentions, of course- formal relationships for their scientific - offsprings".

(These are stories that occasionally happen among ordinary people for the merriment of the simple minded housewives and romantic young girls- and wich make large profits for the sensational press).

Let us follow the farse.

As pretenders, we must present the terms of our claim to the family of the requested lady.

First of all we must make clear that we do not mean a monogamous relationship, since we very well know S.D.'s preferences for short intense relationship with any disciplines for they have allowed "her" an exciting - trajectory which is compatible with the enviable independence that celibacy provides. We also love our independence.

Secondly, we solemnly declare that in spite of "his" extreme youth ("he" is just over 15 years old), C.A. has exceptional qualities and pre- - sents great affinities for S.D. that make a serious pretender out of him.

Obviously, there is a huge disparity in origin between them: S.D. is of the noblest birth of contemporary science (the prestigious MIT) and - is related to the most boastful branches of present sciencie and technology (General Theory of Systems, Cibernetics, Digital Computer, Design Technology, etc.). It has been cultivated among the most advanced, refined technologies and it has been used to solve higher level problems (urban planning, world system analysis). On the contrary, C.A. was born in a humble Spanish- university (Autonomus University of Madrid) and has been developed in the - field of a discipline accounting which is still suspicious (quite reasonably, perhaps) as far as its "purity of blood" is concerned if compared to - the rest of the great scientific family.

Nevertheless, there are strong traits of affinity between S.D. - and C.A.. Among them:

1) S.D. originated as a methodology for industrial business management - (INDUSTRIAL DYNAMICS) and it is well known the important role Accountancy has that task. Many of the flows and levels that appear in the models of INDUSTRIAL DYNAMICS are accounting variables.

2) C.A. deals with CIRCULATORY SYSTEMS, their structure (circulatory - structure), behaviour and control. S.D. also deals with those systems and yet it has specialized in the design of sophisticated models to-

simulate the dynamic behaviour of circulatory systems. Something similar to "haute couture" for those systems.

3) The sort of Accounting that uses C.A. as a basic methodology to analyse the economic circulation (known as NEW ACCOUNTING) has very little in common with the conventional Accounting of business firms -- and great deal in common with S.D.

Inside the NEW ACCOUNTING the accounting models are models for circulatory systems (more concretely, models for a specific circulatory system: THE ECONOMIC CIRCULATION SYSTEM). In them, the system of the circulatory structure is defined accorging to flows and levels. They are models of a very simple mathematical structure (purely arithmetical) and of the static historical type; all S.D. models, however, include one or several accounting models which define the structure of flows and levels. That structure can be considered as the chassis in wich the motley battery of regulators (decision functions and auxiliaries) is mounted. The engine that makes the model move is, obviously, time.

S.D. models are therefore special models for circulatory systems and there is no reason to leave them off the C.A. field. Furthermore, it seems that S.D. models have a certain deficiency to design the structure of flows and levels (circulatory structure of the modelled system) compared to the exuberance that the purely accounting models -- show in this aspect (we keep referring to the language of New Accounting).

4) C.A. demonstrates that the very S.D. models <u>are circulatory systems - in their turn</u>. They are systems to produce numbers out of other numbers by means of mathematical transformations connected with one another, so that the out-puts of some transformations are in-puts for - others. Both the transformations and the in-put-out-put relationships among them may be whichsoever they are wanted.

If that is so, we can design abstract S.D. models apart from any real system and find out its purely mathematical properties. We could design standard components, similar to the CHIPS of integrated circuits, that could be used as parts to build up any S.D. models of a real - system (in fact, the delays respond to this conception). The invention of new CHIPS which simulate the laws of physical, technological, sociological or economic behaviour and so on, will only be limited - by the mathematical tools available presently and by the imagination and talent of the designer.

5) The application of C.A. to the analysis of economic circulation has revolutionarized an old discipline: ACCOUNTING and, still, threatens to introduce important changes in the economic analysis itself and - in the techniques of business management.

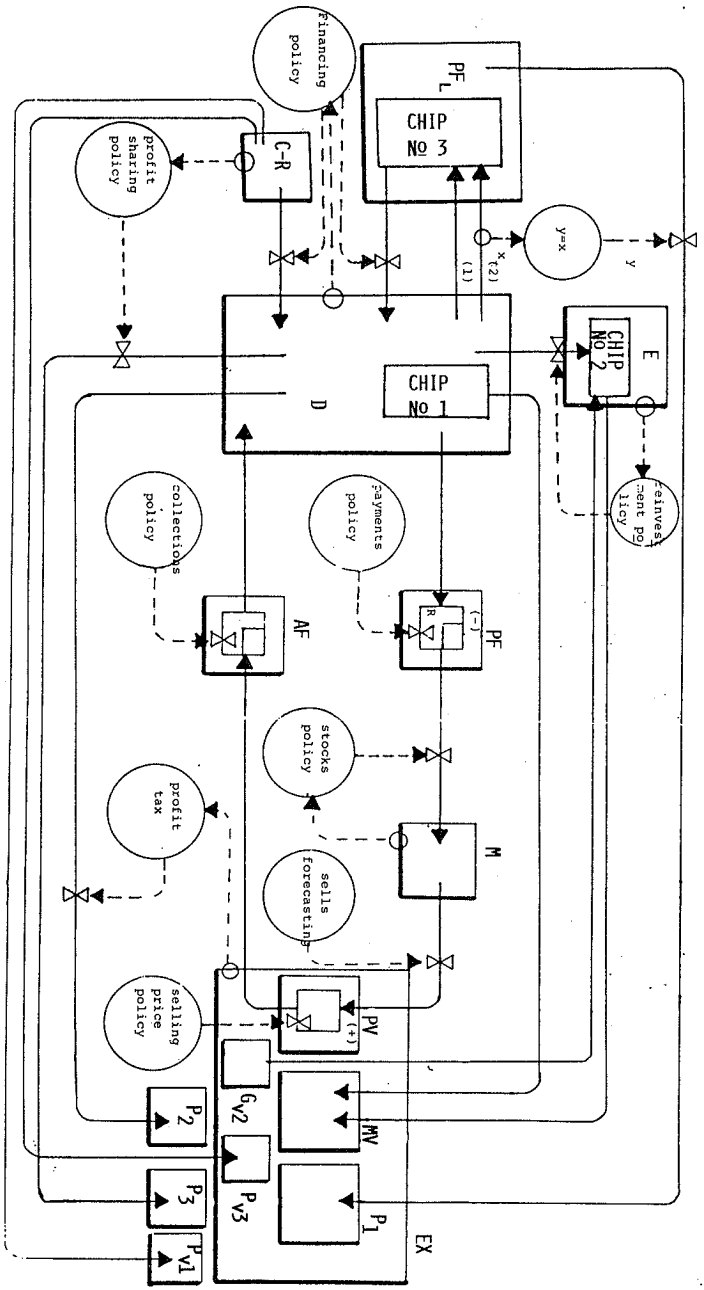
The short initial farse of our exposition has unexpectedly become a serious allegation. Unfortunately, we cannot proceed to a presentation of C.A. since even though it were as concise as it might be it would exceed - the limits of this paper. Consequently, we cannot help but direct those who are interested in this subject to available bibliography at present which,- and we also regret it, is in Spanish and is included as an appendix at the

end of this work. We shall do something we think it is more practical for - this occasion. As the old proverb says "Actions speak louder than words". - Accordingly, let us make a simple accounting model, which simulates the economic circulation of an uncomplicated business firm, move on and we shall - see that the way it works is totally similar to a S.D. model.

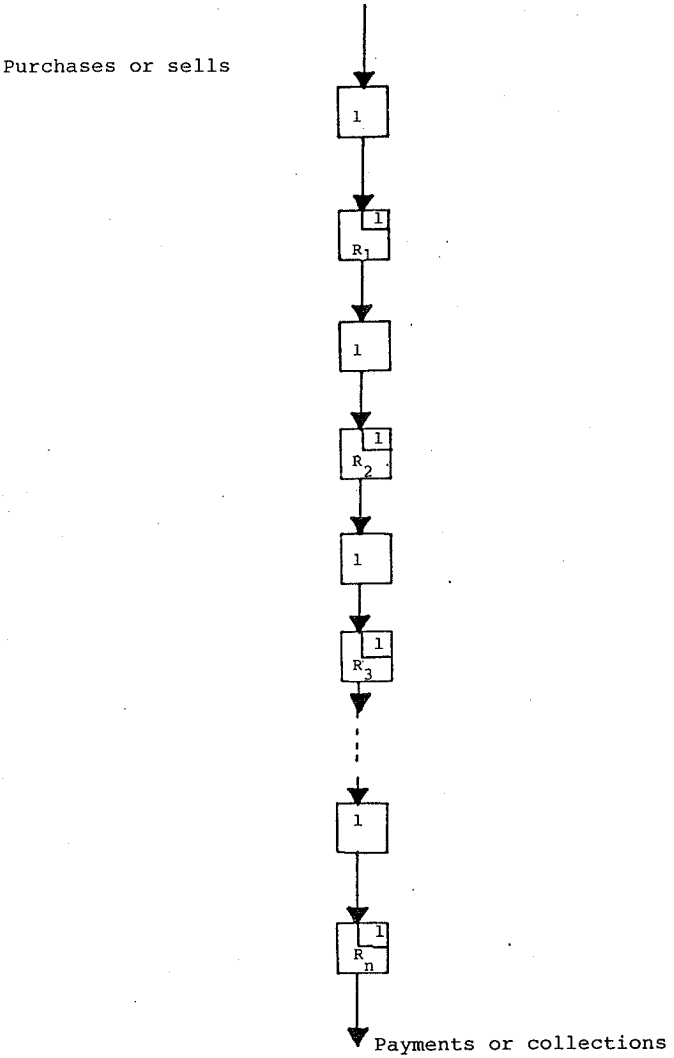
We have introduced some changes of the S.D. language in our model (we think we can and must introduce many more to make it operative). We -- shall see it is a small toy that can become a sophisticated simulator. The model has been operated by a small P.C. computer with a very modest software. Here are the results presented as accounting information for the system. Now you are to decide if the game was well played and if it shows sufficently the meaning of our initial demand but in earnest and in the austere field of the scientific discussion (1). We want finally to thank you for the attention paid to our modest work.

(1) The model has been designed by Prof. Moisés GARCIA GARCIA and implemented in the computer by Prof. Francisco SERRANO.

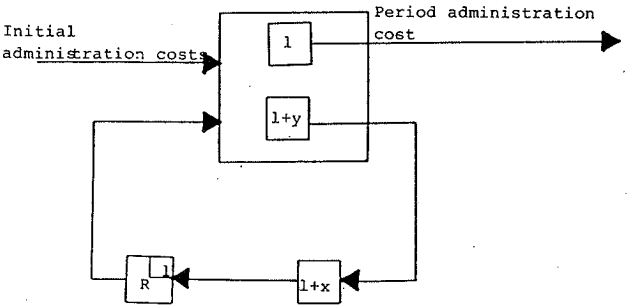
THE MODEL


financing policy
PF L
CHIP Nº 3
profit sharing policy
C-R
y=x
y
x (2)
(1)
E
CHIP Nº 2
CHIP Nº 1
D
collections policy
payments policy
reinvestment policy
AF
PF
(-)
R
stocks policy
profit tax
M
sells forecasting
selling price policy
PV
(+)
G_{V2}
MV
P_2
P_{V3}
P_3
P_1
P_{V1}
EX

OPERADOR 
n
R


Purchases or sells
1
1
R1
1
1
R2
1
1
R3
1
1
Rn
Payments or collections

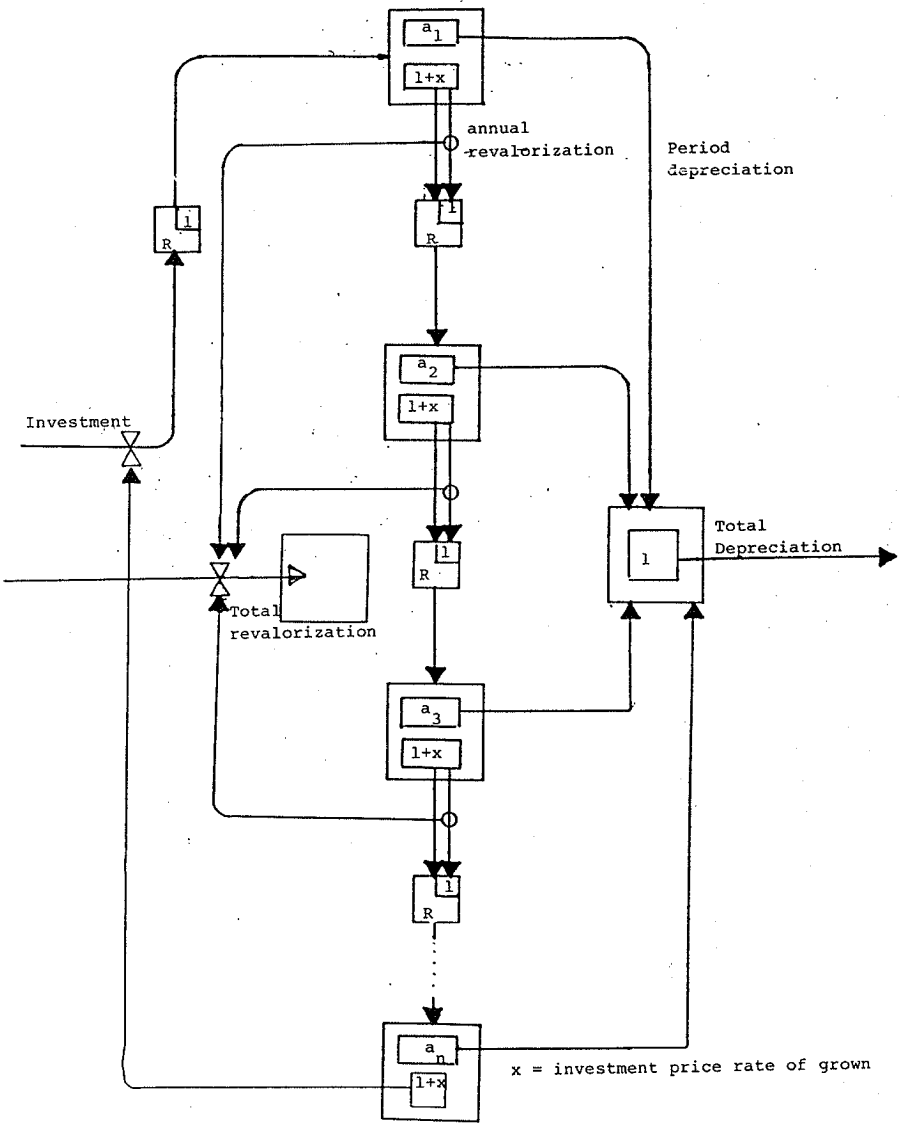
CHIP Nº 1



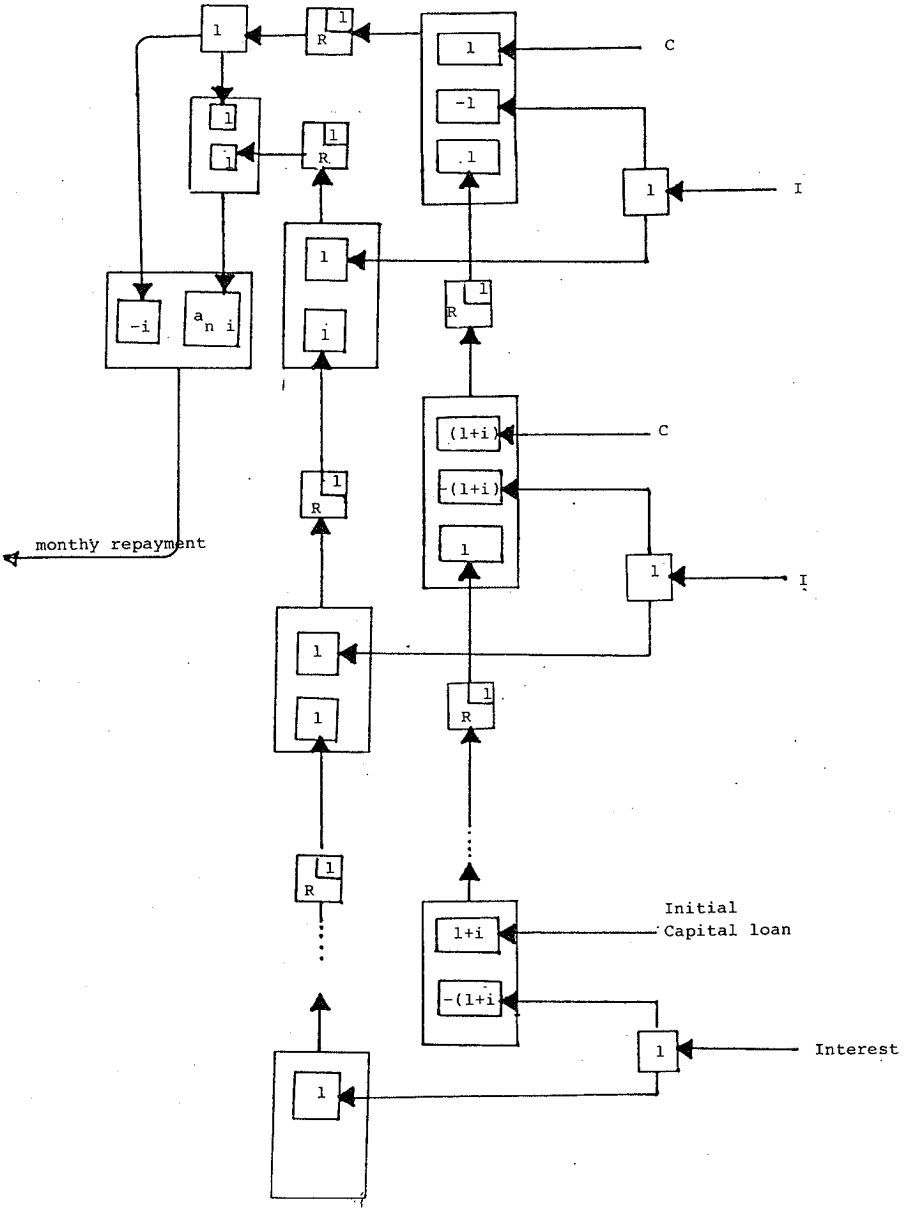
y = annual growing of administration costs

x = annual rate of grown of administration costs

"CHIP" Nº 2


a1
1+x
annual
revalorization
Period
depreciation
1
R
a2
1+x
Investment
Total
Depreciation
1
Total
revalorization
a3
1+x
an
1+x
x = investment price rate of grown

"CHIP" Nº 3


1
R
C
-1
I
-i
a n i
(1+i)
monthy repayment
Initial
Capital loan
1+i
-(1+i
Interest

MODEL CIRCULATORY VARIABLES

I. FLOW VARIABLES

C − R → D =	Monetary increases of capital by the shareholders
D → E =	Cash payment of the purchases of fixed assets
E → MV =	Amortization of fixed assets (depreciation)
D → MV =	Cash payment of the administration costs
PF → M =	Purchases with deferred payment
(PF → M.UF) =	Purchases (material units)
M → PV =	Cost of sells
(M.UF → PV) =	Sells (material units)
PV → AF =	Sells with deferred collection
AF → D =	Collections to clients
PF_L → D =	Collection of obtained long term loans (french method)
D → PF_L(1) =	Repay of loans (principal)
D → PF_L(2) =	Repay of loans (interest)
PF_L → P_1 =	Financial costs
D → P_2 =	Payment of profit taxes
D → P_3 =	Payment of dividends
C−R → P_V1 =	Retaining earnings
C−R → P_V3 =	Building up of revalorization surplus
G_V2 → E =	Assets revalorization
D → PF =	Payment of invoices to suppliers

II. FUNDS VARIABLES

D =	Cash & Banks
E =	Fixed assets
PF =	Accounts payable
M =	Inventory value

M - UF	=	Inventory (material units)
PV	=	Sells margin
AF	=	Accounts recibable
C - R	=	Capital net worth
PF_L	=	Long term loans
MV	=	Amortization and administration costs
P1	=	Financial costs
P2	=	Profit taxes
P3	=	Shareholders profits
P_V1	=	Retained earnings
G_V2	=	Revalorization surplus
P_V3	=	Assets revalorization

III. MODEL

I. FLOWS

1.- $(CR \rightarrow D) = K_1 \cdot (D \rightarrow E)$

K_1 = Part of investement financed with capital

2.- $(PF_L \rightarrow D) = (1 - K_1)(D \rightarrow E)$

3.- $CD \rightarrow PF_L(1)$
$CD \rightarrow PF_L(2) = (PF_L \rightarrow D) \times$ CHIP Nº 3.

CHIP Nº3 Simulates a repayment loan by french method

4.- $(D \rightarrow E) = (D \rightarrow E)_0 \times$ CHIP Nº 2.

CHIP Nº2 Simulates a model of depreciation and reinvestment when the fixed assets is totally amortized. The initial investment is proposed out of the model $(D \rightarrow E)_0$.

5.- $(M.UF \rightarrow PV) = (M.UF \rightarrow PV)_0 . K_3 . K_4$

K_3 = Annual rate of grown

K_4 = Rate of seasonality

$(M.UF \rightarrow PV)_0$ is a exogenous variable

6.- $(M \rightarrow PV) = (M.UF \rightarrow PV) . K_5$

K_5 = Unit value of stocks (price line)

7.- $(PF \rightarrow M.\ UF)_i = M - M_{i-1}$

M_{i-1} = Initial inventory of i period

$M = \text{Min}(K_6, \sum_{t=i+1}^{i+K7} (M.UF \rightarrow PV)_t$

K_6 = Warehouse capacity

K_7 = Stock of security (months)

8.- $(PF \rightarrow M) = (PF \rightarrow M.\ UF) . P_0 . K_8$

P_0 = Initial purchase price

K_8 = Purchase price rate of grown

9.- $(D \rightarrow PF) = (PF \rightarrow M) . R_1$

R_1 = Retard (term of purchases payments)

10.- $PV \rightarrow AF = (M \rightarrow PV) . K_9$

K_9 = (1 + sells margin)

11.- $AF \rightarrow D = PV \rightarrow AF . R_2$

R_2 = Retard (term of selling collections)

12.- $D \rightarrow MV = (D \rightarrow MV)_0 .$ CHIP Nº1

CHIP Nº1 = simulates annual grown function

13.- $E \rightarrow MV = (D \rightarrow E)_0 \times$ CHIP Nº2

14.- $PF_L \rightarrow P_1 = D \rightarrow PF_L\ (1)$

15.- $D \rightarrow P_2 = \text{Max}(0)\ K_{10} . (P_V + MV + P_1)$

K_{10} = Profit tax

16.- $D \rightarrow P_3 = K_{11} . C - R$

K_{11} = Unit dividend

17.- $CR \rightarrow P_V 1 = -(PV + MV + P_1 + P_2 + P_3)$

18.- $C - R \rightarrow P_V 3 = C . R . K_{12}$

K_{12} = Rate of annual revaluation

19.- $G_V 2 \rightarrow E = C - R \rightarrow P_V 3$

NOTE: 17, 18 and 19 are calculated at the end of every year only

DELTA TIME = 1 Month

The model calcules at first time the flow variables for each periodo according to the defined equations Later the founds are calculate as usual in accounting. This founds are emoloyed in the next iteration of the model.

The exogenous variables are defined as constants for simplify the model.

Model benefits.

1.- The model can be use as pedagogic tool for showing the system of value flows in trading company, in courses of

- Accounting
- Financing
- Management

2.- The model can be conceived as a tool for forecasting or budgetary control

3.- The model can be played handly or in a computer

A COMPUTER SIMULATION OF THE MODEL

INITIAL VALUE OF THE AUXILIARY VARIABLES

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PERIODS NUMBER	45.00	0.00	0.00	0.00
INIT.ASSETS INVEST.	100.000,00	0.00	0,00	0.00
PERCENT CAPITAL FINANCIED INVEST	0,30	0.00	0,00	0.00
RATE OF DEPRECIAT	0.10	0.00	0.00	0.00
PRICE INVEST.R.GROWN	1,10	0.00	0,00	0.00
RATE OF INTEREST	0.01	0.00	0.00	0.00
TERM OF LOANS	20,00	0.00	0,00	0.00
INIT.ADMINIST.COSTS	20.000.00	0.00	0.00	0.00
RATE OF GROWN	1,10	0,00	0,00	0,00
INIT. ANNUAL SELLS	96.000.00	0.00	0.00	0.00
RATE OF GROWN	1,20	0,00	0,00	0.00
INIT.PURCHASES PRICE	15.00	0.00	0.00	0.00
P. PRICE R.OF GROWN	1,08	0,00	0,00	0.00
KIND OF MARGIN	1.00	0.00	0.00	0.00
UNIT SELLS MARGIN	30,00	0,00	0,00	0,00
INIT.SELLING PRICE	19.50	0.00	0.00	0.00
S. PRICE R.OF GROWN	1,08	0,00	0,00	0,00
SEASONALITY	1.00	3,00	1.00	3.00
SEQUR.STOCK (MONTHS)	2,00	0,00	0,00	0,00
WAREHOUSE CAPACITY	20.000.00	0.00	0.00	0,00
TERM OF PUR.PAYMENT	3,00	0,00	0,00	0,00
TERM OF SELLS COLLEC	2.00	0.00	0.00	0.00
PROFIL TAX	0,30	0,00	0,00	0,00
UNIT DIVIDEND	0,10	0.00	0.00	0,00

SYSTEM ACTIVITY SIMULATION

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	1	2	3	4	5	6
FLOW VARIABLES						
ACTIVITY FLOWS						
CR//D (*)	30.000,00	0,00	0,00	0,00	0,00	0,00
D//E	100.000,00	0,00	0,00	0,00	0,00	0,00
E//MV	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
D//MV	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00
D//PF	0,00	0,00	0,00	180.000,00	180.000,00	120.000,00
PF//M	180.000,00	180.000,00	120.000,00	180.000,00	120.000,00	60.000,00
PF//M (U.F.)	12.000,00	12.000,00	8.000,00	12.000,00	8.000,00	4.000,00
M//PV	60.000,00	60.000,00	60.000,00	180.000,00	180.000,00	180.000,00
M//PV (U.F.)	4.000,00	4.000,00	4.000,00	12.000,00	12.000,00	12.000,00
PV//AF	78.000,00	78.000,00	78.000,00	234.000,00	234.000,00	234.000,00
AF//D	0,00	0,00	78.000,00	78.000,00	78.000,00	234.000,00
PF(L)//D	70.000,00	0,00	0,00	0,00	0,00	0,00
D//PF(L-1)	0,00	3.179,07	3.210,86	3.242,97	3.275,40	3.308,16
D//PF(L-2)	0,00	700,00	668,21	636,10	603,67	570,92
PF(L)//P1	0,00	700,00	668,21	636,10	603,67	570,92
PROFIT SHARING						
D//P2	0,00	0,00	0,00	0,00	0,00	0,00
D//P3	0,00	0,00	0,00	0,00	0,00	0,00
CR//PV1	0,00	0,00	0,00	0,00	0,00	0,00
ASSETS REVALORIZ.						
CR//PV3	0,00	0,00	0,00	0,00	0,00	0,00
GV2//E	0,00	0,00	0,00	0,00	0,00	0,00

* EXIT FOUND VAR//
ENTRY FOUND VAR

	1	2	3	4	5	6
FOUNDS VARIABLES (BALANCE SHEET)						
D	-20.000,00	-43.[illegible]79,07	10.241,86	-115.637,22	-[illegible]41.516,29	-151.395,36
E	90.000,00	80.[illegible]00,00	70.000,00	60.000,00	[illegible]0.000,00	40.000,00
FF	-180.000,00	-360.000,00	-480.000,00	-480.000,00	-4[illegible]0.000,00	-360.000,00
M	120.000,00	240.000,00	300.000,00	300.000,00	[illegible]00.000,00	120.000,00
M-U.F.	8.000,00	16.000,00	20.000,00	20.000,00	[illegible]0.000,00	8.000,00
PV	-18.000,00	-36.000,00	-54.000,00	-108.000,00	-[illegible]2.000,00	-216.000,00
AF	78.000,00	156.000,00	156.000,00	312.000,00	[illegible]00.000,00	468.000,00
CR	-30.000,00	-30.000,00	-30.000,00	-30.000,00	-[illegible]0.000,00	-30.000,00
PF-L	-70.000,00	-66.826,93	-63.610,07	-60.367,09	-[illegible]1.091,69	-53.783,54
MV	30.000,00	60.000,00	90.000,00	120.000,00	[illegible]0.000,00	180.000,00
P.1	0,00	700,00	1.368,21	2.004,31	[illegible].607,98	3.178,90
P.2	0,00	0,00	0,00	0,00	0,00	0,00
P.3	0,00	0,00	0,00	0,00	0,00	0,00
P VIRT.1	0,00	0,00	0,00	0,00	0,00	0,00
P VIRT.3	0,00	0,00	0,00	0,00	0,00	0,00
G VIRT.2	0,00	0,00	0,00	0,00	0,00	0,00
FIXED ASSETS AUX.V.						
DENOMINATION.VALUE	100.000,00	100.000,00	100.000,00	100.000,00	[illegible]00.000,00	100.000,00
ACCUMUL. AMORTIZAT.	10.000,00	20.000,00	30.000,00	40.000,00	[illegible]0.000,00	60.000,00
NET BOOK VALUE	90.000,00	80.000,00	70.000,00	60.000,00	[illegible]0.000,00	40.000,00

	1	2	3	4	5	6
LOANS REPAIMENT						
LOAN 1						
PRINCIPAL	70.000,00	66.820,93	63.610,07	60.367,09	57.091,69	53.783,54
PAYMENT	3.879,07	3.879,07	3.879,07	3.879,07	3.879,07	3.879,07
INTEREST TO PAY	0,00	700,00	668,21	636,10	603,67	570,92
PRINCIP. TO PAY	0,00	3.179,07	3.210,86	3.242,97	3.275,40	3.308,16
LOAN 2						
PRINCIPAL	0,00	0,00	0,00	0,00	0,00	0,00
PAYMENT	0,00	0,00	0,00	0,00	0,00	0,00
INTEREST TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
PRINCIP. TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
LOAN 3						
PRINCIPAL	0,00	0,00	0,00	0,00	0,00	0,00
PAYMENT	0,00	0,00	0,00	0,00	0,00	0,00
INTEREST TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
PRINCIPAL TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
LOAN 4						
PRINCIPAL	0,00	0,00	0,00	0,00	0,00	0,00
PAYMENT	0,00	0,00	0,00	0,00	0,00	0,00
INTEREST TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
PRINCIPAL TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
LOAN 5						
PRINCIPAL	0,00	0,00	0,00	0,00	0,00	0,00
PAYMENT	0,00	0,00	0,00	0,00	0,00	0,00
INTEREST TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
PRINCIPAL TO PAY	0,00	0,00	0,00	0,00	0,00	0,00

	1	2	3	4	5	6
PURCHASES						
INIT.INVENTORY	0,00	8.000,00	16.000,00	20.000,00	20.000,00	16.000,00
SEQURITY STOCK	12.000,00	20.000,00	28.000,00	36.000,00	28.000,00	20.000,00
NEEDS	12.000,00	12.000,00	12.000,00	16.000,00	8.000,00	4.000,00
SELLS	4.000,00	4.000,00	4.000,00	12.000,00	12.000,00	12.000,00
FINAL INVENTORY	8.000,00	16.000,00	24.000,00	24.000,00	16.000,00	8.000,00
WAREHOUSE CAPACITY	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00
OVERCAPACITY	0,00	0,00	4.000,00	4.000,00	0,00	0,00
PURCHASES TO DO	12.000,00	12.000,00	8.000,00	12.000,00	8.000,00	4.000,00
UNIT PRICES						
PURCHASE PRICE	15,00	15,00	15,00	15,00	15,00	15,00
SELLING PRICE	19,50	19,50	19,50	19,50	19,50	19,50
UNIT.VALUE STOCKS	15,00	15,00	15,00	15,00	15,00	15,00

	1	2	3	4	5	6
PROFIT & LOSS ACC. (MONTHLY)						
SELLS	-78.000,00	-78.000,00	-78.000,00	-234.000,00	-234.000,00	-234.000,00
SELLING COST	60.000,00	60.000,00	60.000,00	180.000,00	180.000,00	180.000,00
AMORTIZATION	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
ADMINISTRATION	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00
FINANCIAL COST	0,00	700,00	668,21	636,10	603,67	570,92
OPERATING RESULTS	12.000,00	12.700,00	12.668,21	-23.363,90	-23.396,33	-23.429,08
ASSETS REVALORIZ	0,00	0,00	0,00	0,00	0,00	0,00
REVALORIZ.SURPLUS	0,00	0,00	0,00	0,00	0,00	0,00
PROFIT & LOSS ACC. (ACCUMULATED)						
SELLS	-78.000,00	-156.000,00	-234.000,00	-468.000,00	-702.000,00	-936.000,00
SELLING COST	60.000,00	120.000,00	180.000,00	360.000,00	540.000,00	720.000,00
SELLS MARGIN	-18.000,00	-36.000,00	-54.000,00	-108.000,00	-162.000,00	-216.000,00
AMORTIZATION	10.000,00	20.000,00	30.000,00	40.000,00	50.000,00	60.000,00
ADMINISTRATION	20.000,00	40.000,00	60.000,00	80.000,00	100.000,00	120.000,00
FINANCIAL COST	0,00	700,00	1.368,21	2.004,31	2.607,98	3.178,90
OPERATING RESULT	12.000,00	24.700,00	37.368,21	14.004,31	-9.392,02	-32.821,10
ASSETS REVALORIZ	0,00	0,00	0,00	0,00	0,00	0,00
REVALORIZ SURPLUS	0,00	0,00	0,00	0,00	0,00	0,00
PROFIT AND LOSS	12.000,00	24.700,00	37.368,21	14.004,31	-9.392,02	-32.821,10
TAXES	0,00	0,00	0,00	0,00	0,00	0,00
PROFIT AFTER TAX.	0,00	0,00	0,00	0,00	0,00	0,00
EARNINGS PER SHARE	0,00	0,00	0,00	0,00	0,00	0,00
RETAINED EARNINGS	0,00	0,00	0,00	0,00	0,00	0,00

CASH-FLOW	1	2	3	4	5	6
-INIT.MONET. FOUNDS	0,00	-20.000,00	-43.879,07	10.241,86	-115.637,22	-241.516,29
-OPER. COLLECTIONS						
TO CLIENTS	0,00	0,00	78.000,00	78.000,00	78.000,00	234.000,00
-OPER. PAYMENTS						
TO OPER.SUPPLIERS	0,00	0,00	0,00	180.000,00	180.000,00	120.000,00
TO OTHER SUPPLIERS ADMINIST.	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00
FINANC.EXPENSES.	0,00	700,00	668,21	636,10	603,67	570,92
TAXES	0,00	0,00	0,00	0,00	0,00	0,00
DIVIDENDS	0,00	0,00	0,00	0,00	0,00	0,00
-FINANC.COLLECTIONS						
CAPIT.INCREASES	30.000,00	0,00	0,00	0,00	0,00	0,00
LOAN OBTAINED	70.000,00	0,00	0,00	0,00	0,00	0,00
-FINANC.PAYMENTS						
ASSETS PURCHASES	100.000,00	0,00	0,00	0,00	0,00	0,00
LOAN REPAYED	0,00	3.179,07	3.210,86	3.242,97	3.275,40	3.308,16
FINAL MONET.FUNDS	-20.000,00	-43.879,07	10.241,86	-115.637,22	-241.516,29	-151.395,36

SOURCE & APPLICATION OF FUND STATEMENT	1	2	3	4	5	6
D	-20.000,00	-23.879,07	54.120,93	-125.879,07	-125.879,07	90.120,93
E	90.000,00	-10.000,00	-10.000,00	-10.000,00	-10.000,00	-10.000,00
FF	-180.000,00	-180.000,00	-120.000,00	-0,00	60.000,00	60.000,00
M	120.000,00	120.000,00	60.000,00	0,00	-60.000,00	-120.000,00
M-U.F.	8.000,00	8.000,00	4.000,00	0,00	-4.000,00	-8.000,00
PV	-18.000,00	-18.000,00	-18.000,00	-54.000,00	-54.000,00	-54.000,00
AF	78.000,00	78.000,00	0,00	156.000,00	156.000,00	0,00
CR	-30.000,00	0,00	0,00	0,00	0,00	0,00
FF-L	-70.000,00	3.179,07	3.210,86	3.242,97	3.275,40	3.308,16
MV	30.000,00	30.000,00	30.000,00	30.000,00	30.000,00	30.000,00
F.1	0,00	700,00	668,21	636,10	603,67	570,92
F.2	0,00	0,00	0,00	0,00	0,00	0,00
F.3	0,00	0,00	0,00	0,00	0,00	0,00
F VIRT.1	0,00	0,00	0,00	0,00	0,00	0,00
F VIRT.3	0,00	0,00	0,00	0,00	0,00	0,00
G VIRT.2	0,00	0,00	0,00	0,00	0,00	0,00

	1	2	3	4	5	6
FINANCIAL RATIOS						
OPERATING ASSETS	178.000,00	352.120,93	466.241,86	496.362,78	466.483,71	436.604,64
CURRENT LIABILITIES	-180.000,00	-360.000,00	-480.000,00	-480.000,00	-420.000,00	-360.000,00
WORKING CAPITAL	-2.000,00	-7.879,07	-13.758,14	16.362,78	46.483,71	76.604,64
LIAB/OWNER'S EQ	8,33	14,23	18,12	18,01	15,90	13,79
LIQUIDITY RAT.	-0,11	-0,12	0,02	-0,24	-0,58	-0,42
QUICK ASSET RAT	0,32	0,31	0,35	0,41	0,54	0,88
CURRENT RATIO	0,99	0,98	0,97	1,03	1,11	1,21
SELF FINANCING	0,00	0,00	0,00	0,00	0,00	0,00
GROSS VALUE ADDED	0,00	0,00	0,00	0,00	0,00	0,00
NET VALUE ADDED	0,00	0,00	0,00	0,00	0,00	0,00
GROSS GENER.RENT	0,00	0,00	0,00	0,00	0,00	0,00
NET GENERATED RENT	0,00	0,00	0,00	0,00	0,00	0,00
SELLS MARGIN	0,00	0,00	0,00	0,00	0,00	0,00
TOTAL ASS.TURNOVER	0,00	0,00	0,00	0,00	0,00	0,00
RATE OF RETURN	0,00	0,00	0,00	0,00	0,00	0,00

SYSTEM ACTIVITY SIMULATION

86/07/02

UNIV.AUTONOMA MADRID
DPTO.T. CONTABILIDAD

M.GARCIA GARCIA &
FCO.SERRANO MORACHO

	7	8	9	10	11	12
FLOW VARIABLES						
ACTIVITY FLOWS						
CR//D (*)	0,00	0,00	0,00	30.000,00	0,00	0,00
D//E	0,00	0,00	0,00	100.000,00	0,00	0,00
E//MV	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
D//MV	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00
D//PF	180.000,00	120.000,00	60.000,00	60.000,00	180.000,00	120.000,00
PF//M	60.000,00	180.000,00	120.000,00	180.000,00	132.000,00	72.000,00
PF//M (U.F.)	4.000,00	12.000,00	8.000,00	12.000,00	8.800,00	4.800,00
M//PV	60.000,00	60.000,00	60.000,00	180.000,00	180.000,00	180.000,00
M//PV (U.F.)	4.000,00	4.000,00	4.000,00	12.000,00	12.000,00	12.000,00
PV//AF	78.000,00	78.000,00	78.000,00	234.000,00	234.000,00	234.000,00
AF//D	234.000,00	234.000,00	78.000,00	78.000,00	78.000,00	234.000,00
PF(L)//D	0,00	0,00	0,00	70.000,00	0,00	0,00
D//PF(L-1)	3.341,24	3.374,65	3.408,40	3.442,48	6.655,98	6.722,54
D//PF(L-2)	537,84	504,42	470,68	436,59	1.102,17	1.035,61
PF(L)//P1	537,84	504,42	470,68	436,59	1.102,17	1.035,61
PROFIT SHARING						
D//P2	0,00	0,00	0,00	0,00	0,00	19.420,14
D//P3	0,00	0,00	0,00	0,00	0,00	6.000,00
CR//PV1	0,00	0,00	0,00	0,00	0,00	39.313,66
ASSETS REVALORIZ.						
CR//PV3	0,00	0,00	0,00	0,00	0,00	8.000,00
GV2//E	0,00	0,00	0,00	0,00	0,00	8.000,00

* EXIT FOUND VAR//
ENTRY FOUND VAR

	7	8	9	10	11	12
FOUNDS VARIABLES (BALANCE SHEET)						
D	-121.274,43	-31.153,50	-37.032,58	-42.911,65	-172.669,79	-111.848,08
E	30.000,00	20.000,00	10.000,00	100.000,00	90.000,00	88.000,00
PF	-240.000,00	-300.000,00	-360.000,00	-480.000,00	-432.000,00	-384.000,00
M	120.000,00	240.000,00	300.000,00	300.000,00	252.000,00	144.000,00
M-U.F.	8.000,00	16.000,00	20.000,00	20.000,00	16.800,00	9.600,00
PV	-234.000,00	-252.000,00	-270.000,00	-324.000,00	-378.000,00	-432.000,00
AF	312.000,00	156.000,00	156.000,00	312.000,00	468.000,00	468.000,00
CR	-30.000,00	-30.000,00	-30.000,00	-60.000,00	-60.000,00	-107.313,66
PF-L	-50.442,30	-47.067,65	-43.659,26	-110.216,78	-103.560,80	-96.838,26
MV	210.000,00	240.000,00	270.000,00	300.000,00	330.000,00	360.000,00
P.1	3.716,73	4.221,16	4.691,83	5.128,43	6.230,59	7.266,20
P.2	0,00	0,00	0,00	0,00	0,00	19.420,14
P.3	0,00	0,00	0,00	0,00	0,00	6.000,00
P VIRT.1	0,00	0,00	0,00	0,00	0,00	39.313,66
P VIRT.3	0,00	0,00	0,00	0,00	0,00	8.000,00
G VIRT.2	0,00	0,00	0,00	0,00	0,00	-8.000,00
FIXED ASSETS AUX.V.						
DENOMINATION.VALUE	100.000,00	100.000,00	100.000,00	200.000,00	200.000,00	220.000,00
ACCUMUL. AMORTIZAT.	70.000,00	80.000,00	90.000,00	100.000,00	110.000,00	132.000,00
NET BOOK VALUE	30.000,00	20.000,00	10.000,00	100.000,00	90.000,00	88.000,00

	7	8	9	10	11	12
LOANS REPAYMENT						
LOAN 1						
PRINCIPAL	50.442,30	47.067,65	43.659,26	40.216,78	36.739,87	33.228,20
PAYMENT	3.879,07	3.879,07	3.879,07	3.879,07	3.879,07	3.879,07
INTEREST TO PAY	537,84	504,42	470,68	436,59	402,17	367,40
PRINCIP. TO PAY	3.341,24	3.374,65	3.408,40	3.442,48	3.476,90	3.511,67
LOAN 2						
PRINCIPAL	0,00	0,00	0,00	70.000,00	66.820,93	63.610,07
PAYMENT	0,00	0,00	0,00	3.879,07	3.879,07	3.879,07
INTEREST TO PAY	0,00	0,00	0,00	0,00	700,00	668,21
PRINCIP. TO PAY	0,00	0,00	0,00	0,00	3.179,07	3.210,86
LOAN 3						
PRINCIPAL	0,00	0,00	0,00	0,00	0,00	0,00
PAYMENT	0,00	0,00	0,00	0,00	0,00	0,00
INTEREST TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
PRINCIPAL TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
LOAN 4						
PRINCIPAL	0,00	0,00	0,00	0,00	0,00	0,00
PAYMENT	0,00	0,00	0,00	0,00	0,00	0,00
INTEREST TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
PRINCIPAL TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
LOAN 5						
PRINCIPAL	0,00	0,00	0,00	0,00	0,00	0,00
PAYMENT	0,00	0,00	0,00	0,00	0,00	0,00
INTEREST TO PAY	0,00	0,00	0,00	0,00	0,00	0,00
PRINCIPAL TO PAY	0,00	0,00	0,00	0,00	0,00	0,00

	7	8	9	10	11	12
PURCHASES						
INIT.INVENTORY	8.000,00	8.000,00	16.000,00	20.000,00	20.000,00	16.800,00
SEQURITY STOCK	12.000,00	20.000,00	28.000,00	36.000,00	28.800,00	21.600,00
NEEDS	4.000,00	12.000,00	12.000,00	16.000,00	8.800,00	4.800,00
SELLS	4.000,00	4.000,00	4.000,00	12.000,00	12.000,00	12.000,00
FINAL INVENTORY	8.000,00	16.000,00	24.000,00	24.000,00	16.800,00	9.600,00
WAREHOUSE CAPACITY	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00
OVERCAPACITY	0,00	0,00	4.000,00	4.000,00	0,00	0,00
PURCHASES TO DO	4.000,00	12.000,00	8.000,00	12.000,00	8.800,00	4.800,00
UNIT PRICES						
PURCHASE PRICE	15,00	15,00	15,00	15,00	15,00	15,00
SELLING PRICE	19,50	19,50	19,50	19,50	19,50	19,50
UNIT.VALUE STOCKS	15,00	15,00	15,00	15,00	15,00	15,00

	7	8	9	10	11	12
PROFIT & LOSS ACC. (MONTHLY)						
SELLS	-78.000,00	-78.000,00	-78.000,00	-234.000,00	-234.000,00	-234.000,00
SELLING COST	60.000,00	60.000,00	60.000,00	180.000,00	180.000,00	180.000,00
AMORTIZATION	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00	10.000,00
ADMINISTRATION	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00
FINANCIAL COST	537,84	504,42	470,68	436,59	1.102,17	1.035,61
OPERATING RESULTS	12.537,84	12.504,42	12.470,68	-23.563,41	-22.897,83	-22.964,39
ASSETS REVALORIZ	0,00	0,00	0,00	0,00	0,00	8.000,00
REVALORIZ.SURPLUS	0,00	0,00	0,00	0,00	0,00	-8.000,00
PROFIT & LOSS ACC. (ACCUMULATED)						
SELLS	-1.014.000,00	-1.092.000,00	-1.170.000,00	-1.404.000,00	-1.638.000,00	-1.872.000,00
SELLING COST	780.000,00	840.000,00	900.000,00	1.080.000,00	1.260.000,00	1.440.000,00
SELLS MARGIN	-234.000,00	-252.000,00	-270.000,00	-324.000,00	-378.000,00	-432.000,00
AMORTIZATION	70.000,00	80.000,00	90.000,00	100.000,00	110.000,00	120.000,00
ADMINISTRATION	140.000,00	160.000,00	180.000,00	200.000,00	220.000,00	240.000,00
FINANCIAL COST	3.716,73	4.221,16	4.691,83	5.128,43	6.230,59	7.266,20
OPERATING RESULT	-20.283,27	-7.778,84	4.691,83	-18.871,57	-41.769,41	-64.733,80
ASSETS REVALORIZ	0,00	0,00	0,00	0,00	0,00	8.000,00
REVALORIZ SURPLUS	0,00	0,00	0,00	0,00	0,00	-8.000,00
PROFIT AND LOSS	-20.283,27	-7.778,84	4.691,83	-18.871,57	-41.769,41	-64.733,80
TAXES	0,00	0,00	0,00	0,00	0,00	19.420,14
PROFIT AFTER TAX.	0,00	0,00	0,00	0,00	0,00	-45.313,66
EARNINGS PER SHARE	0,00	0,00	0,00	0,00	0,00	6.000,00
RETAINED EARNINGS	0,00	0,00	0,00	0,00	0,00	39.313,66

CASH-FLOW						
-INIT.MONET. FOUNDS	-151.395,36	-121.274,43	-31.153,50	-37.032,58	-42.911,65	-172.669,79
-OPER. COLLECTIONS						
TO CLIENTS	234.000,00	234.000,00	78.000,00	78.000,00	78.000,00	234.000,00
-OPER. PAYMENTS						
TO OPER.SUPPLIERS	180.000,00	120.000,00	60.000,00	60.000,00	180.000,00	120.000,00
TO OTHER SUPPLIERS						
ADMINIST.	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00	20.000,00
FINANC.EXPENSES.	537,84	504,42	470,68	436,59	1.102,17	1.035,61
TAXES	0,00	0,00	0,00	0,00	0,00	19.420,14
DIVIDENDS	0,00	0,00	0,00	0,00	0,00	6.000,00
-FINANC.COLLECTIONS						
CAPIT.INCREASES	0,00	0,00	0,00	30.000,00	0,00	0,00
LOAN OBTAINED	0,00	0,00	0,00	70.000,00	0,00	0,00
-FINANC.PAYMENTS						
ASSETS PURCHASES	0,00	0,00	0,00	100.000,00	0,00	0,00
LOAN REPAYED	3.341,24	3.374,65	3.408,40	3.442,48	6.655,98	6.722,54
FINAL MONET.FUNDS	-121.274,43	-31.153,50	-37.032,58	-42.911,65	-172.669,79	-111.846,08

SOURCE & APPLICATION OF FUND STATEMENT						
D	30.120,93	90.120,93	-5.879,07	-5.879,07	-129.758,14	60.821,72
E	-10.000,00	-10.000,00	-10.000,00	90.000,00	-10.000,00	-2.000,00
PF	120.000,00	-60.000,00	-60.000,00	-120.000,00	48.000,00	48.000,00
M	-0,00	120.000,00	60.000,00	0,00	-48.000,00	-108.000,00
M-U.F.	0,00	8.000,00	4.000,00	0,00	-3.200,00	-7.200,00
PV	-18.000,00	-18.000,00	-18.000,00	-54.000,00	-54.000,00	-54.000,00
AF	-156.000,00	-156.000,00	0,00	156.000,00	156.000,00	0,00
CR	0,00	0,00	0,00	-30.000,00	0,00	-47.313,66
PF-L	3.341,24	3.374,65	3.408,40	-66.557,52	6.655,98	6.722,54
MV	30.000,00	30.000,00	30.000,00	30.000,00	30.000,00	30.000,00
F.1	537,84	504,42	470,68	436,59	1.102,17	1.035,61
F.2	0,00	0,00	0,00	0,00	0,00	19.420,14
F.3	0,00	0,00	0,00	0,00	0,00	6.000,00
F VIRT.1	0,00	0,00	0,00	0,00	0,00	39.313,66
F VIRT.3	0,00	0,00	0,00	0,00	0,00	8.000,00
G VIRT.2	0,00	0,00	0,00	0,00	0,00	-8.000,00

	7	8	9	10	11	12
FINANCIAL RATIOS						
OPERATING ASSETS	310.725,57	364.846,50	418.967,42	569.088,35	547.330,21	500.151,92
CURRENT LIABILITIES	-240.000,00	-300.000,00	-360.000,00	-480.000,00	-432.000,00	-384.000,00
WORKING CAPITAL	70.725,57	64.846,50	58.967,42	89.088,35	115.330,21	116.151,92
LIAB/OWNER'S EQ	9,68	11,57	13,46	9,84	8,93	4,48
LIQUIDITY RAT.	-0,51	-0,10	-0,10	-0,09	-0,40	-0,29
QUICK ASSET RAT	0,79	0,42	0,33	0,56	0,68	0,93
CURRENT RATIO	1,29	1,22	1,16	1,19	1,27	1,30
SELF FINANCING	0,00	0,00	0,00	0,00	0,00	184.733,80
GROSS VALUE ADDED	0,00	0,00	0,00	0,00	0,00	212.000,00
NET VALUE ADDED	0,00	0,00	0,00	0,00	0,00	92.000,00
GROSS GENER.RENT	0,00	0,00	0,00	0,00	0,00	192.000,00
NET GENERATED RENT	0,00	0,00	0,00	0,00	0,00	72.000,00
SELLS MARGIN	0,00	0,00	0,00	0,00	0,00	0,03
TOTAL ASS.TURNOVER	0,00	0,00	0,00	0,00	0,00	5,54
RATE OF RETURN	0,00	0,00	0,00	0,00	0,00	0,17

BIBLIOGRAPHY
related to
CIRCULATORY ANALYSIS

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