SYSTEM DYNAMICS AND INDUSTRIAL CHANNELS ANALYSIS
Example : French timber channel

Marcel OVIDE-ETIENNE
Docteur ès Sciences Economiques
Assistant à l'Université de CAEN
Institut des Sciences de la Décision
Université de Caen
14000 CAEN

ABSTRACT

In our thesis (5) we show the advantage of using D.S. methods for the modelling of economic processes. Some practioners of econometry have already seen the D.S. as a preliminary to the formalisation of a model economy subject (3).

In a recent article, (6) we showed how the optimum of production may sometimes not be given primacy in a sector, in a grouping of firms, or a firm and it is sometimes profitable to analyse the weaknesses which can be found in a whole industrial network in order to understand the lack of competitiveness in national products.

The aim of this paper is to apply methods of the system dynamics to the analysis and modelling of the process of pricing certain products in the French timber industry.

We shall do this in the following way :

- presentation of the results of a statistical survey which revealed the products in the French timber industry responsible for deficits.

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- a general presentation will lead us to distinguish between four sub-systems in the industrial network :
  - the yield of French forests
  - the activities related to the first transformation of timber : cutting - peeling - sawing - grinding
  - the assembly of the timber
  - the distribution of the products
- the stage of presentation and of analysis will supply the significant data and lead to a modelling according to Forrester's method (1,2).

I. - Study and results of a statistical survey of competition carried out in the field of the products in the French timber channels.

The concept of competition generally concerns firms, industries and national economy. In comparing countries with each other, national and foreign products can be studied with regard to competition. It may then be envisaged as a study of rival products.

In this case, sale price is seen as one of the must significant criteria of competition (criteria that we may class according to advantages and disadvantages for the buyer).

Differences between goods which are linked to this criterium arise from their components as differentiated by various individual national data : costs in raw material, capital, and work etc... ; these distinctions may also arise from efficiency gaps between firms. This, it seems, is what economic theory would have us recognize : a production optimum must be aimed at in terms of the cost of production factors and the efficacity of production schemes in the market when considered apart from these production factors.

However, the vertical process organisation for the fabrication of products certainly influences the price level involved. Thus, we must analyse be channels of the particular product.

a/- The industrial channel concept. The timber channel.

According to A. Staffaes : "an industrial channel includes all the various stages in the production process ranging from the raw materials to the satisfaction of the consumer's ultimate needs, whether these needs in fact concern material goods (food, lodging, etc...) or a service (transport, communications, health, leisure).

The raw material generally supplies the channel (metallugical network, from the iron and steel industry to engineering industries ; agro-chemical network ; timber network, etc...).

Within the same channel, and according to the various stages, we can also include diverse concepts and means, the essential being to analyse the operation procedures as far as each element is concerned (economic agents, recognized places of economic transaction, significant variables) which will bring us from a particular raw material to the utilisable end product.

In particular, the fabrication process in timber products can be presented in terms of channel. Michel Besson and Jean Reymond give a global view of the production flow in this French timber channel. The chart they use to illustrate it raises the following comments :

- French forests produce both constructional timber and timber for trituration,
- triturational timber contributes to the sectors fabricating wood panels and to the pulp industries.
- the cutting, peeling and sawing of timber constitute the principal bases in the intermediary consumption of wood for furnishing and building.

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One can also envisage four important stages in the channel :

- the production of constructional timber and timber for trituration,
- all operations linked to cutting, peeling, sawing, or trituration,
- all assembly operations (on intermediary consumption of cut, peeled, sawn or triturated timber),
- distribution of products.

b/- The aims of our research.

The aim of the study was to identify the French timber products responsible for a foreign deficit ; to estimate the behaviour of products in the market with regard to their national or foreign substitutes and their foreign rival products -(Here we have taken only one competitive criterium into account : price)- ; and finally, to reveal the influence of the French timber channel on the competition of the products in question.

c/- The method.

The end products used as a basis for research have been selected from a list of a hundred products in the French channel, and which had featured in an S.T.I.S.I. survey (Department for the data processing of industrial information and statistics - Centre for stastical surveys - Caen - Ministry for Industry). In order to be retained, these products had to come under three criteria :

- rival products, especially with regard to price (a national product is similar to a foreign product according to other criteria of competition),
- products which are likely to cause a deficit or surplus in foreign trade,
- products suitable for a continuous study, and thus rendering an analytical accountancy analysis possible for each phase of the channel.

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The chosen products have been the subject of a regional statistical survey (Lower Normandy) based on a questionnaire concerning : price and the prices of rival products -the components of this price and other variables contributing to it within each four timber subsidiary channels.

d/- Results.

Before applying criteria for the selection of products, those which need to be noted belong to the following categories :

- furniture,
- constructional and joinery timber material,
- flooring, moulding and profiling,
- panelling, plywood, worked and processed wood,
- packing articles in wood,
- cooperage articles,
- light prefabricated units.

α/ Products chosen after the application of concomitant criteria on French foreign trade :

The importance of the deficit or the surplus in French foreign trade caused us to choose, first of all, the furnishing industry. This trade has a general tendency to be in deficit. Three categories of products (joinery and frame members -cooperage articles -woodfibre panelling) give rise to a surplus for France.

We have selected only joinery articles and frame members because of the importance of the surplus in question.

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Statistics concerning the French timber imports and exports (These products bring about a deficit or surplus significant in value for the French balance of payments :

In Franc thousands

PRODUCTS	IMPORTS	EXPORTS	DEFICITS	SURPLUS
Wood furniture				
- for bedrooms	591.775	232.850	358.925	
- for diningrooms & sittingrooms	1,143.531	324.301	819.230	
- for kitchens	377.498	133.333	244.165	
Other wood furniture or furniture parts	706.098	262.727	443.371	
Joinery work and frame members (including light prefabricated units)	355/743	477.367		121.624

β/ Influence of the two other criteria

The selection of products according to the first criterium (rival products in particular with regard to price) was carried out when products were at the distribution stage. The criterium of the products suitability for continuous study in order to realise an analytical accountancy was sometimes evaded. It was in fact possible to consider average accountancy data.

γ/ Findings concerning the presence and price of studied products

Let us now summarize what we have been able to establish

- French products are strong in the market as regards luxury-class furniture and solid wood (dining-rooms, bedrooms). One product would seem to remain an exception : country-style salons, (solid oak and cushions) France is particularly rivalled by Belgium.

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For average range furniture products, (Furniture doors or a whole front in solid wood, the rest in plywood) foreign competition is strong both in price and quality. Italy (livingrooms for example), Germany also has an important position in the market.

- When the furniture is made entirely of plywood, the foreign product seems to be the only one of its kind in the market, the national product being inexistent.

- Joinery articles remain competitive because they come from the transformation of low-cost exotic wood (in this field, French industry often has the management of tropical forests and practises a vertical concentration).

δ/ Analytical accountancy of products.

Interested by the problem of deficit products, we noted the various aspects contributing to their cost price in relation to the phases of their fabrication.

In the majority of cases, it seems that the distributor realises a gross profit of 100 %.

- The cost price of the product leaving the assembly factory includes a margin/direct cost of production of 43 % on an average, the cost of timber purchase apparently oscillating in percentage between 30 % and 50 %.

- The total purchase cost of the assembly work ranges from furnishing (8 %), mechanical wood work (19 %) agricultural products (16 %). The mechanical work here covers plywood sheets (14 %) panels of "particules" (58 %) fibrewood panels (3 %) plywood panels (25 %) (Sawn timber is not included within this category). The agricultural purchases are subdivided into standing timber (5 %) rough timber (30 %), sawn timber (65 %).

The square meter of sawn timber includes between 40 % and 50 % of its price in the cost of standing timber. This analytical accountancy underlines the contribution of each subsidiary channel to the final state of the products concerned. It remains for us to establish the particular operations of each stage in the fabrication process.

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II. - Description of the channel in order to explain the situation of French products in the market.

In order to define the French situation, two variables must be underlined and explained : the price of each product and its share in the market. If we try to explain these two factors we should establish at least one list of explanatory variables, and study the links of causality between them, so as to suggest a total comprehensive model which permits the transition from the explanatory variables to the two variables under study.

The concept of the channel permits a detailed analysis of the operations linked to the fabrication of products and the formation of their prices. However the division into subsidiary channels and the apparent causality links, of the upstream-downstream type, should not prevent us from taking other kinds of links into account. But as for aspects such as the information between agents involved, their role in decision-making, the applied choice, they bring other causal links to light. Thus, the distributors of furniture do not always consider the price of the merchandise they order from the suppliers as a data. The purchase price is only a component of the distributor's own sale price. But the distributor plays a role in the formation of this purchase price ; simply the role of client.

These remarks lead us to an analysis in terms of subsidiary channels and sometimes in terms of more classical structure, (market structures -firm structures). If we take market structure into account we can then situate the analysis between two subsidiary channels. The distributor of the furniture belongs to the subsidiary channels distribution, and get it is his supplier's partner who belongs to the assembly subsidiary channels.

What is more, causality does not always intervene between two associated subsidiary channels. A forest cultivator can well change his strategy when informed of the state of the market regarding a piece of furniture in pinewood, in oak or in elm. Also the furniture distributor may well make certain decisions according to the possibilities revealed by such and such a subsidiary channel of the downstream.

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Thus, all along the four stages of the channel, it is necessary to underline categories of significant variables (in order to explain the price formation of the products) :

- those which characterise the intermediary consumer market ofthe subsidiary channel.

III. - Presentation of the analysis in terms of the system dynamics, first stage towards a model

In a general diagram we place the four subsidiary channels which become the sub-systems of the general system (the channel). We characterise them by the most representative economic agent. We can feature the offer and demand structures which classes the agents of the sub-systems into pairs.

In order to explain this general diagram, let us go from downstream towards upstream.

The forest is implied in two "offer and demand" markets. But he remains as an element of the timber sub-system.

The first timber processor is in contact with a national forester and (or) with a foreign forester.

These commercial relations feature right up to the end product client. Thus, in this general diagram a same agent sometimes appears in several markets.

a/- The causal diagram of the forest sub-system.

This diagram proposes the links of causality conforming to economic theory : when the offer of goods rises in a market, the price diminishes, everything otherwise equal, when the price rises, the offer increases everything otherwise equal ; when the demand of goods rises, its price rises - but when the price of these goods rises, its demand diminishes, everything otherwise remaining equal.

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The forest sub-system is characterized by an economic structure : the forest surface (total volume of standing timber) -number of foresters -size of forests- These first three variables, which are otherwise linked between themselves, determine those which seem to us as ultimately essential for the formation of the timber price.

(Foresters' recurrent timber offer, average cost price of capital integrated within the production of unprocessed timber, average salary given, income expected by the forester etc...).The list of variables is not exhaustive. Certainly, we only retain a small number of endogenous variables ; in the diagram we do not feature the auxiliary variables (in Forester's sense) nor the exogenous variables to the sub-system. But they will be taken into account for the definitive elaboration of the model.

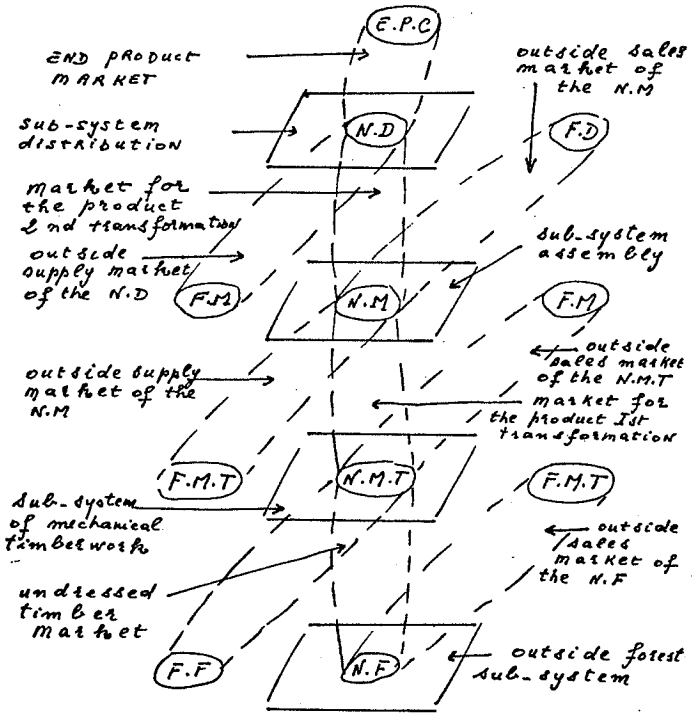
b/- The causal diagram of the mechanical timberwork sub-system.

We bring in links of causality similar to the preceding ones. The national volume of processed timber is the physical relay between the forest sub-system and the "mechanical timberwork" sub-system. The timber price is the monetary relay.

c/- The causal diagram of the assembly sub-system and that of the distribution sub-system.

It is easy to interpret the last two diagrams in the light of commentaries made on the first two.

FIG 1. GENERAL DIAGRAM OF THE CHANNEL



GENERAL DIAGRAM OF THE CHANNEL

E.P.C. : End product client

N.D. : National distributor

F.D. : Foreign distributor

N.M. : National manufacturer

F.M. : Foreign manufacturer

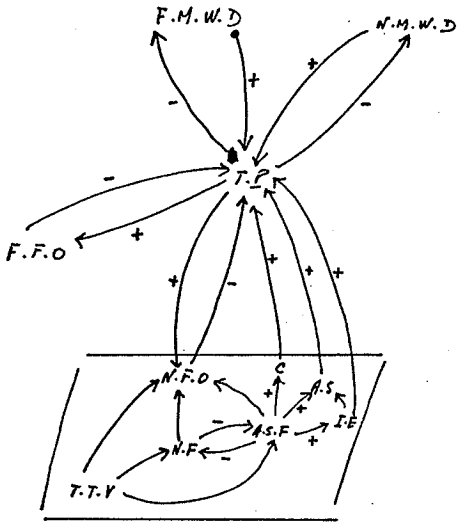
N.M.T. : National mechanical timberworker

F.M.T. : Foreign mechanical timberworker

N.F. : National forester

F.F. : Foreign forester

FIG 2. CAUSAL DIAGRAM OF THE FOREST SUB-SYSTEM



CAUSAL DIAGRAM OF THE FOREST SUB-SYSTEM

N.M.W.D. : National mechanical work demand

F.M.W.D. : Foreign mechanical work demand

T.P. : Timber price

F.F.O. : Foreign foresters' offer

N.F.O. : National foresters' offer

T.T.V. : Total timber volume

N.F. : Number of foresters

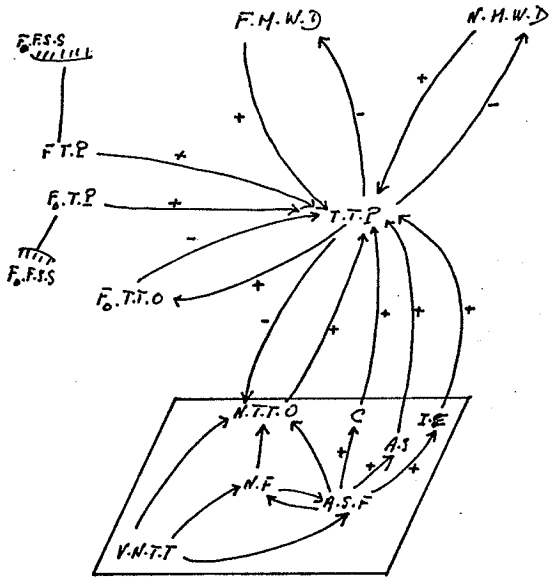
A.S.F. : Average size of forests

A.S. : Average salary

C. : Capital

I.E. : Income expected

FIG 3. CAUSAL DIAGRAM OF THE MECHANICAL TIMBERWORK SUB-SYSTEM



CAUSAL DIAGRAM OF THE MECHANICAL TIMBERWORK SUB-SYSTEM

N.M.W.D. : National mechanical work demand

F.M.W.D. : Foreign mechanical work demand

T.T.P. : Treated timber price

F.T.P. : French timber price

Fo.T.P. : Foreign timber price

Fo.T.T.O. : Foreign treated timber offer

N.T.T.O. : National treated timber offer

V.N.T.T. : Volume national treated timber

N.F. : Number of firms

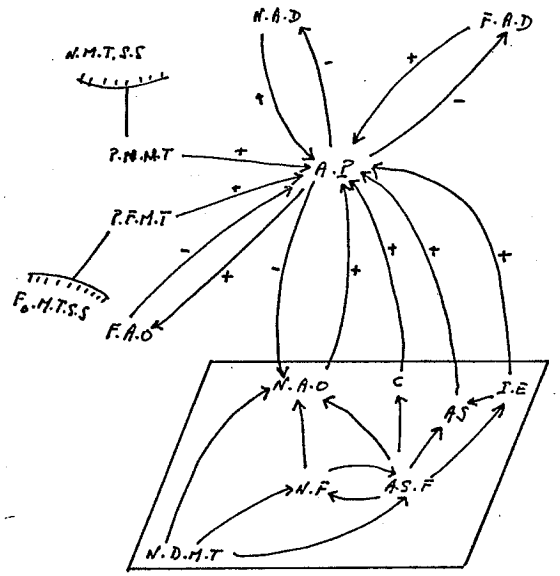
A.S.F. : Average size of firms

C. : Capital

A.S. : Average salary

I.E. : Income expected

FIG 4. CAUSAL DIAGRAM OF THE ASSEMBLY SUB-SYSTEM



CAUSAL DIAGRAM OF THE ASSEMBLY SUB-SYSTEM

N.A.D. : National assembly demand

F.A.D. : Foreign assembly demand

A.P. : Assembly price

P.N.M.T.: Price of national mechanical timberwork

P.F.M.T.: Price of foreign mechanical timberwork

F.A.O. : Foreign assembly offer

N.A.O. : National assembly offer

N.D.M.T.: National demand for mechanical timberwork

N.F. : Number of firms

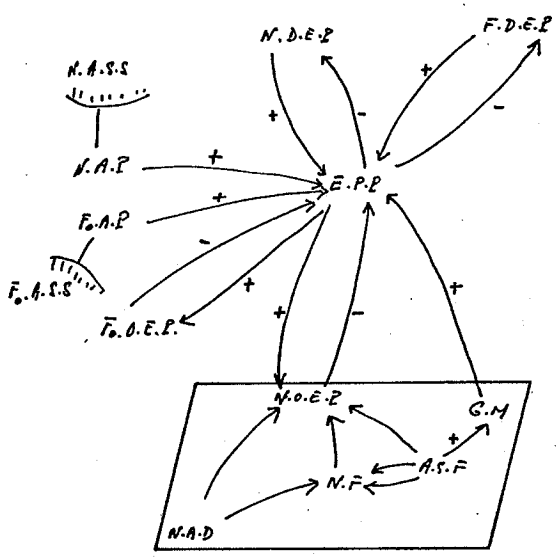
S.F. : Size of forests

C. : Capital

A.S.F. : Average size of firms

I.E. : Income expected

FIG 5. CAUSAL DIAGRAM OF THE DISTRIBUTION SUB-SYSTEM



CAUSAL DIAGRAM OF THE DISTRIBUTION SUB-SYSTEM

N.D.E.P. : National demand for end product

F.D.E.P. : Foreign demand for end product

E.P.P. : End product price

N.O.E.P. : National offer for end product

G.M. : Gross marqin

IV. Conclusion

The preceding developments demonstrate first of all that a channel analysis gains by being presented in terms of a causal diagram. This presentation allows us to reintegrate the essential aspects of economic theory within the mechanisms under study (market structure, etc...).

All the significant variables of the French timber channel do not figure in it. The links of causality are not given. But we may imagine how this modelisation must be realised ; selection of variables under various headings (variables of state, auxiliary variables ; level and flux ;...) -definition of relations by methods which have become familiar in econometry (which demands a lot of statistical work all along the channel).

The final modelisation will thus furnish a basis of simulation, of explanation and of estimates concerning the price level of products and market shares. But it will indicate above all the variables which play a major role in the deterioration of the French trade situation as regards the products selected for study.

BIBLIOGRAPHIE

(1) Jaw w. Forrester : World Dynamics -second edition- Wright -Allen Press, Cambridge, Massachusetts, 1971,1973

(2) Jaw w. Forrester : Urban Dynamics, the MIT Press, Cambridge, Massachusetts, and London, England, 1969

(3) Bernard Piganiol : The roles of the system dynamic in the elaboration of economic models -Paper presented at the A.F.C.E.T. congress -Mons-Belgique, 1979

(4) Jacques Popper : System dynamic -Les Editions d'organisation, Paris, 1973

(5) Marcel Ovide-Etienne : The role of mathematical programming in the control of economic processes by stages, Doctorat d'Etat Thesis in Economy Caen University, France 1980

(6) Marcel Ovide-Etienne : Competitiveness of products and network organisation -example of the French timber industry- Paper presented at the I.A.E. colloquium- Lyon -17/18/19 Novembre 1982

(7) C. Stoffaes : Industrial and network policy- Revue d'économie industrielle, n° 13, 3ème trimestre 1980

DYNAMIC MODELS FOR PLANNING TOURIST COMPLEXES

Habib Sedehi
ENIDATA
Via Marconi 29/1
40122 Bologna Italy

Paola Valli, Paolo Verrecchia
TEMA
Via Marconi 29/1
40122 Bologna Italy

ABSTRACT

Planning tourist facilities is a highly complex task. It is necessary to evaluate carefully, with an interdisciplinary approach, all the variables of a technical, architectural, commercial, economical and financial nature that may be involved in a given project, without however ignoring the natural resources of the environment where the facilities are to be set up.

For a correct evaluation, these resources must be considered limited and seen as a wealth that can be exploited but not wasted, used but not destroyed.

The approach outlined above is all the more important in countries like Italy, for instance, where there is a risk of overexploiting the natural resources of the environment.

In all but exceptional cases, an evaluation that does not take the above principles into account will result in a tourist enterprise that is ultimately a failure, as it degrades, often irreparably, the natural environment until it ceases to be an adequate source of revenue.

This paper describes an integrated approach which provides, by means of simulation techniques, tools for a proper implementation of tourist facilities taking into due account all the variables and constraints involved, and likewise for the assessment by the Public Administration authorities of the wisdom and soundness