Title	System Dynamics Market Model with Aspects of Economic Policy
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Citation	
Issue Date	2005-11
Type	Conference Paper
Text version	publisher
URL	http://hdl.handle.net/10119/3968
Rights	2005 JAIST Press
Description	The original publication is available at JAIST Press http://www.jaist.ac.jp/library/jaist-press/index.html, IFSR 2005 : Proceedings of the First World Congress of the International Federation for Systems Research : The New Roles of Systems Sciences For a Knowledge-based Society : Nov. 14-17, 2178, Kobe, Japan, Workshop, Session 3 : he New Roles of Systems Sciences for a Knowledge-based Society

System Dynamics Market Model with Aspects of Economic Policy

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ABSTRACT

This paper studies the possibility of the use of the principles, knowledge and tools of System Dynamics. The authors discuss creation of a general system dynamics behavioral market model with interferences to government economic policy.

The problem is specified as a creation of a general system dynamics behavioral market model respecting some tools of governmental economic policy application. It is a part of a broader research on general characteristics common for various dynamic market structures determining the customers' behavior and consecutive processing of general system dynamics behavioral market model from the company's viewpoint.

The paper is one of the results of a project supported by the Czech Science Foundation grant "System Dynamics Theory and Market Structures," GACR 402/05/0502.

Keywords: system dynamics, market, model, economic policy

1. DEFINING THE PROBLEM AND REASONS FOR THE CHOICE OF THE METHOD

The weaknesses and strengths of the system dynamics approach [2] have been evaluated and compared with other approaches in economic theory. Dynamics methodology is used as a practically orientated discipline, which can help in solving concrete problem situations [5]. The System Dynamics has been chosen because it allows the user to work through specific problems in a system with dynamics complexity [4]. With the aid of causal loops it is possible to describe and analyze complex feed-back systems and predict how the systems will behave. The feed-backs are recognized as the main descriptors of the problem defined below [1].

Coming from this point of view the problem mentioned seems to be just a partial subsystem connected with its environment by a high number of relations. It is a comprehensive social system with a highly detailed and dynamic complexity: a system with a number of feed-backs among its elements, where the main elements are people with all their inscrutable characteristics. The satisfactions, expectations and meanings of the consumers - are so called soft variables and an important part of the system. Soft data is hard to control and the model constructors usually ignore them. The avoiding of these soft variables here would result not only to lower validity of the model but would attack the fundamentals of the model itself.

The growing complexity of problems solved in today's world forces us to change our views of the system, if we want to begin to understand and analyze problems in a systematic manner, we must move from an analysis of separate events and their causes and start to look at a system as a system of mutually connected parts. This means seeking closed feedback loops.

2. BEHAVIORAL MARKET MODEL WITH GOVERNMENTAL POLICY FACTORS

Theoretical background for the consumer's behavior side has been the Bass Diffusion Model [4].

If we want to understand the behavior of the system in time, we have to learn its structure. It includes a defining of the elements of the system and marking their mutual relations. There are two approaches to describe the structure of the system following the principles of the system dynamic methodology in fact: with a Causal Loop Diagram (CLD) or with a Stock and Flow Diagram (SFD). the descriptive ability of CLD indeed hinders a precise understanding of the dynamic consequences of relationships. And this is the reason why the authors decided to use predominantly SFDs.

Start of the discussion has been an experience of a number of product oriented sub-models describing markets from the producing company's point of view and from the consumers´ point of view. Behavior at a consumer market must be simplified for a model description. Incorporation of all the possible relations and subjects will lead to confusion and we shall not be able to recognize the characteristics of its behavior.

SD is used for understanding the problem in its dynamic, frequently trans-disciplinary context. If we want to understand the behavior of the system in time, we have to learn its structure. Understanding based on learning the structure of the system and its implicit formulation is the beginning of innovative thinking and detecting the proper reasons of the problems.

Governmental economic policy is a very large area [3]. Effects of particular policies are quite hard to recognize and they are often mixed with market effects and market failures. In our case we consider only those policies and tools directly focused on consumer markets. The issue for this purpose is a segmentation of the markets (product segmentation or a vintage segmentation reflecting the age of consumers). Evaluating of mutual interdependencies among the different policies is very important. Especially important are contradictory, multiplicative or compensatative relations.

Non-linearity will be typical for the system - the reaction will not be proportional to the starting action and timelags.

The results of governmental economic policy and its regulative tools are almost indefinite from company point of view. When examining such a complex system we have to define exactly the abstraction layer and system's composition, and subsequently identify main elements that determine customers' behavior.

The basic elements of the model are customers. They can be categorized as potential customers, actual customers (point of view of our company) and customers of our competitors. Their entrance into and their exit from the model are affected by demographic factors that are not under direct influence of the market itself.

Their moving (migration) from one state to another depends on the decisions of themselves, the decisions of individual producers (companies) at the market and on the governmental policy activities in this area. The customers´ personal decisions on buying the particular product is affected by factors of brand integrity (like reasonable price, quality, good advertising, attractive image, fashion trends, planned obsolescence, good word-of month, reputation, victory in competition or niche product, history, tradition, good services).

The government can affect all of these brand integrity factors. The government can use tools such as advertisement limitations, rising excise duties, consumer taxes or VAT, support of education of consumers etc. (used widely in tobacco and alcoholic beverages markets) and creates a special social environment. Questions of public goods or merit goods have also been under examination. Situation is illustrated in the following chart.

Scheme: Influence of governmental policy (regulation)
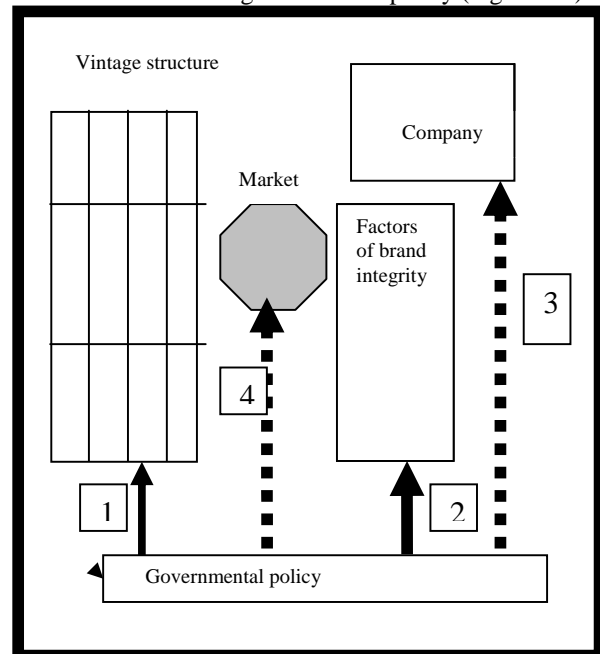
1 Relation of the direct influence on the side of customers. (Example: Alcohol must not been sold to people under 18/21 years old.)

2 Relation of both direct and indirect influence on different factors of the brand integrity of the product.

3 Influence relations on the company exist, both direct and indirect but are not considered in our approach. All the influences are expected to manifest within the factors of the brand integrity of the product. (Example: Governmental limits on air pollution influence the costs of

production and these are manifested in the price of the product.)

4 Relation of a direct influence on the market is seen as a direct regulation of the market le.g. antitrust policy, policy protecting competition on the market, policy protecting consumers etc. At present the discussion of the possibilities of manifesting such a regulation within the factors of product integrity change, or within a group of consumer characteristics. Accepting this "transferred manifestation" approach the governmental policy might be concentrated and simplified in affecting the product and consumers only.

Analyzing the problem and observing a course of parameter values in the available data (sales, cash flow, turnover, stock, market share, adoption, market saturation etc.) during the time period, we can see what type of behavior is behind the problem. Behind a number of different problems is the same type of behavior. This is the main advantage of the system dynamics as an instrument for solving problems. We plan to progress in the following way:

- description of common characteristics of various market structures determining the customers' behavior from the system dynamics point of view (this is about to be undertaken),
- discussion of governmental economic policy influence
- creation of a general system of dynamics behavioral market model from the company's viewpoint, optionally – creation of various models, respecting the basic characteristics of different market types,
- formulation of governmental policy influence relations
- setting the purpose and scale,
- dynamic hypotheses definition,
- simulation model definition,
- model testing and evaluation,
- explanation of the model's dynamic behavior, usual policies consequences evaluation, solution of consecutive problems,
- user interface design (building of interactive learning environment), incl. reference help and usage scenarios,
- weaknesses and strengths of system dynamics approach (comparison with other approaches – economic theory, etc.),

3. FINAL DISPUTATION ON USE OF THE MODEL RESULTS

We have finally got a dynamic system, where the structure might change at different levels within the time factor and is able to generate a very complicated behavior pattern. The total understanding is possible only if we know all the relevant elements of the feed-back spiral (composed from individual feed-back elements). We also expect some hidden feed-backs.

The results of a general system dynamics behavioral market model may contribute to a deeper knowledge and understanding of the system and assist to discover key hidden relations. It is possible to use the model for finding policies that can solve problematic behavior and help us to explain why markets behave in such ways. The model could also work as a framework for an easier thematic simulation model creation in both academic and practical spheres, for a real market behavior analysis and finding policies and decisions successful the long-run.

Although the primary model issue is a view of a company, the model can also be used for "what-if" analyses - simulating the governmental economic policy - its consequences and expected and unexpected effects. It is possible to formulate hypotheses and test them using the model - to test the potential efficiency of the governmental economic policies affecting the particular market.

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