# SD Game DOCUMENTATION

## A. ABOUT THE 3 DIFFERENT PROGRAMS

### 1. FINAL – SWITCH

This program gives the user two options. The first is to choose the random numbers (strategy followed) for each product manually. This can be done by setting the switch placed in graph #3 to the OFF position and pressing the button "TO RANDOM NUMBERS" which is placed under graph #3. Thus the user can first select the strategy of the company for each one of the 10 products and then run the simulation. The second option is to turn the switch to the ON position. Then the program stops every time a new R&D effort for a new product has begun. So, the user can change the random numbers (strategy followed) or other parameters of the model every time the program stops.

### 2. FINAL – STRATEGY1

This program gives the user two options. The first is to select a random number (with the slider under graph #3) which will be the COMMON strategy for all the products of the company. This can be done by turning the switch, in graph #3, to the OFF position. The second option is to turn the switch to the ON position. Then the program follows a pre-selected strategy. This strategy can be summarized as: "The second company cooperates only if the first company has cooperated in the previous product. Or, the second company betrays only if the first company has betrayed in the previous product."

### 3. FINAL – STRATEGY2

This program is actually the same with the previous program with one only difference. The pre-selected strategy of the program when the switch is turned ON can be summarized as: "The second company cooperates only if the first company has betrayed in the previous product. Or, the second company betrays only if the first company has cooperated in the previous product."

## B.  DOCUMENTATION OF THE PROGRAMS

The 3 programs above have the same logic and are based on the same model with slight differences only in the procedure of the selection of the strategy. Therefore, the documentation is the same for all 3 programs.

The model has 4 main sub-models for each company (the main company and the complementary company). These sub-models are:

a)  The Production & Development Process sub-model.
b)  The Market Dynamics sub-model.
c)  The Cooperation Strategy sub-model.
d)  The Operating Performance sub-model.

### a.  THE PRODUCTION & DEVELOPMENT PROCESS SUB-MODEL

The production and development process sub-model calculates the production rate and the processes R&D effort that each company dedicates for the development of the new products. The production is driven by the customer rate of the company (demand driven). The processes R&D effort is based on a sine wave function the amplitude of which is determined by the R&D intensity of the company. The time span of the sine wave is determined by the R&D capability of the company and by the time that is needed to develop the processes. The capability of the companies changes over time because of learning by doing (experience curve).

This sub-model also calculates the price of the products. The price is calculated by adding a profit markup (30%) to the unit cost. The unit cost decreases as production continues because of the experience curve. Here, we should note that the unit cost for the second company is much smaller than for the first company and that it decreases much more sharply as production continues. This is because the product of the second company (video game cassettes) can be produced rather cheaply after the production of the first product. However, it should be noted that the unit price of the cassettes does not fall as much as the unit cost falls. At first the price of the cassettes is high (€85) to cover the R&D costs, but then it falls to €55 and does not fall any further. Therefore, the profit markup of the second company increases to more than 30% after a period.

Finally, we should mention that the companies can begin the R&D effort for every new product before the previous effort has ended. Therefore the companies can "run" two or more projects simultaneously. The time when every new effort begins can be changed by the user with the slider named "TIME OF NEW EFFORT". The slider gives the percentage of the previous effort when the new effort will begin. So, if the slider is set at 80, this means that the new R&D effort will begin at 80% of the previous effort.

## b. THE MARKET DYNAMICS SUB-MODEL

The market sub-model is actually the customer rates of the two companies. The sub-model works as follows:

First, there is a flow of incoming customers. We assume that the flow is steady at 100,000 customers per month.

Then there is a customer base named "Potential Customers". These customers can either buy a product from the first company or from another competitor. The percentage of the Potential Customers that will become Customers of the first company is influenced not only by the price of the products of the company itself but also by the price of the complementary products of the second company.

The customer rate is also influenced by a factor that indicates the 'antiquity' of the products. The nature of the video game consoles and video game cassettes is such that they become outdated fairly soon after their entrance in the market. Therefore, the model takes into account this fact and actually decreases the customer rate of the products as time passes from their introduction in the market.

Another factor that influences the customer rate of the companies is the word of mouth effect. These products target mainly the market of young children and young adults (ages 6 – 20). For these ages the word of mouth effect plays a significant role as children play together, are influenced by one another and exchange video game cassettes. So, they want these cassettes to be compatible and therefore play in each others consoles. As a result they tend to be influenced by their friends and end up buying the same console and games with their friends.

Another factor that influences the customer rate is the strategy that each company follows, namely to cooperate with or to betray the other company. The logic behind the calculation of the strategic decisions of the two companies will be analyzed is the next paragraph named "The Cooperation Strategy Sub-model".

Finally, a factor that influences the customer rate of the company is the customers of the complementary company. The more the customers of the second company for products that work on a certain version of the product of the first company, the more the sales of the specific product of the first company. The magnitude of the influence between the two companies is determined by the factor in the slider named "influence of company 2 on company 1".

Therefore, according to the customer rate some Potential customers become Customers of the first company and the rest are "lost" by the company and become "Lost Customers". However, every time that the company produces and markets a new product, a percentage of the lost customers become again Potential Customers. These are the converts who decide to buy the new product and therefore are again potential customers for the company. The percentage of the

lost customers who become converts each time a new product is introduced can be determined by the user using the slider named "Percentage of converts".

Finally, a percentage of the customers of the company may decide to purchase a new product when introduced, from either the company or from a competitor. This percentage is assumed to be high at the beginning and become less as time from the introduction of the new product passes.

As far as the customer rate of the second company is concerned, it follows the customer rate of the first company and is influenced by the strategy that the second company decides to follow.

## c. THE COOPERATION STRATEGY SUB-MODEL

This sub-model implements the Prisoner's Dilemma payoff matrix. The decisions of the two potential complementors are simultaneous – i.e. both firms are faced with making decisions at the same point in time. The payoffs for each strategic decision are shown in Table 1.

| Firm A / Firm B | Cooperate with Firm B | Not cooperate with Firm B |
|---|---|---|
| **Cooperate with Firm A** | *B=2   A=2* | *B=0   A=3* |
| **Not cooperate with Firm A** | *B=3   A=0* | *B=1   A=1* |

**Table 1:** *The pay-offs of each strategic (cooperation or defection) decision*

The pay-offs are materialized, after the development effort has been completed, in the sales rate of each firm. In essence, the payoffs are the coefficients that regulate the sales rate for each firm. The values of the payoffs are diminishing as development efforts are completed (multiplied by a factor inversely proportional to the number of efforts completed). This is to model the fact that the expected gains of a firm that cooperates are greater at the beginning of the cooperation, whereas a firm that defects late has less benefits as it has already invested resources in the cooperation. Defection yields the highest outcome because the defecting firm can build on its existing market deploying more marketing resources using a different partner. Mutual defection results in other competitors

valuing the cooperation of both firms less (bargaining power is diminished and the possibility of forming a highly profitable alliance is reduced).


## d. THE OPERATING PERFORMANCE SUB-MODEL

The cost and revenue (performance) sub-model deals with the evolution of the operating profitability of each firm as the production activity is undertaken and new products are introduced into the market. The firm's revenues are a function of its sales and the unit's selling price. The unit price is variable and is based on the unit cost of the product (adding a profit markup). The operating cost of a firm includes both the cost of production and the cost of R&D effort made in order to develop and launch a new product.


*******************************************************************************

The structure of the model is shown in the figure below.
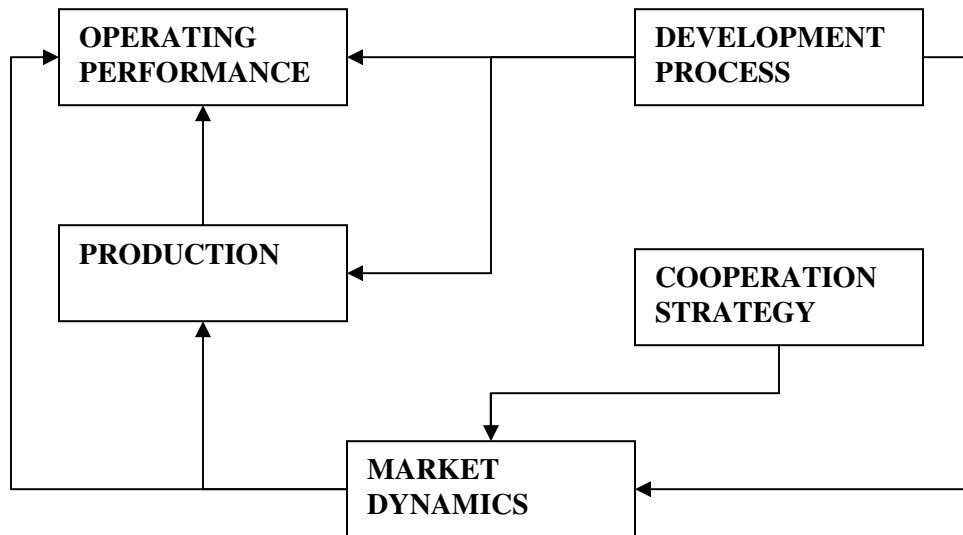
**Figure 1:** *The structure of the system dynamics model for a complementor*