

e-music business game Overview

Since 2000¹, we do not talk anymore about a single average profile of the e-consumer. In this project we decided to keep three segments which may have their own dynamics and behavior:

- profile 1 : they are using the internet in a pragmatic way. If they buy online it is mainly for convenience. Therefore they are choosing e-shoppers that could provide a (wide) range of efficient services (delivery, personalisation, security, etc.)
- profile 2 : Regarding online consumption, these clients are situated between the two first profiles. They pay attention to services but will compare prices and they are ready to change their supplier for a substantial difference.
- profile 3 : These consumers are always searching the “good deal”. They spent many hours comparing offers and prices among different e-shops and auctions sites.

Actually, player may adopt specific strategies for each segment. We chose a differentiation mechanism based on customer segmentation, but other differentiation approaches are possible, such as a product-based segmentation/differentiation or geographical segmentation/differentiation. As the game intends to develop the marketing specificities of the Internet sale channel, customer segmentation seems to be a reasonable choice.

Model structure

The game consists of two main models:

- the market model simulates the demand and computes the market shares between players;
- the player model simulates the player firm's internal processes. Each player has his own model.

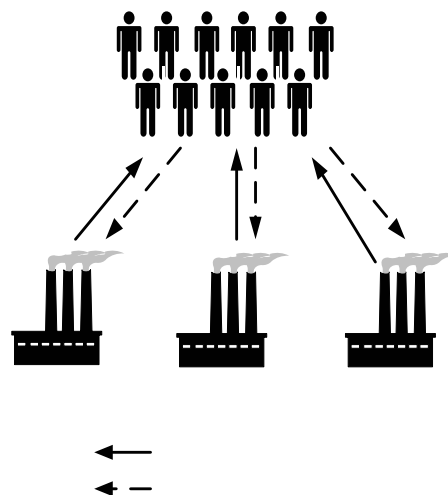


Figure 0.1: Model architecture.

¹ John E. Forsyth, Johanne Lavoie, and Tim McGuire, The McKinsey Quarterly, 2000 Number 4

Player decisions are introduced in the player model that computes outputs (called player dimensions) to be introduced in the market model.

Player Model

BSC Organization

The player model architecture is based on the Norton and Kaplan's balanced scorecards². It consists of:

- the process sub-model, which deals with internal process of the firm, such as activities leading to increase the overall quality of the e-commerce platform and service efficiency;
- the learning & growth sub-model, which mainly simulates human resources bound processes, as hiring, attrition, salary adjustment, experience, and productivity. Employees are beginners at hiring and after some periods become pros;
- the customer sub-model, which handles the customer satisfaction through the product offer (catalogue width and depth) and marketing actions;
- the financial sub-model, which computes balance and profit from expenses and incomes. This model is closely bound to other three models since it accumulates decision costs specific to other three models, such as security investments, salary expenses, or marketing expense. Another major input of the financial sub-model is the sale quantity and the sale price, allowing computing incomes. Product cost is fixed and is the same for all players.

Many items are accumulated from period to period, but not in a linear way. For instance, the sale platform security gradually increases with successive investments in R&D. However, when the security has reached a given level, new increases insecurity require higher marginal investments. Moreover, the effect of an investment may be delayed by 1 or 2 periods.

This mechanism, illustrated above with security, also applied to usability, system functionality, long time marketing, catalogue width, and catalogue depth.

Decisions and Player Dimensions

The current version of the game proposes the following kinds of decisions:

- sale price;
- product catalogue: width/depth extension and reduction;
- marketing: search engine optimization (referencing), banners, emailing, off line ads, and long time investments;
- HR: manager salaries, average salary, hiring, and dismissals;
- processes: system facilities, security, and usability.

This leads to **19 decisions**, which seems to be large enough.

² Kaplan, R.B and Norton, D.P; The balanced scorecard: translating strategy into action, 2nd print, Boston (Mass.) : Harvard business school press , 1996.

The player model transforms these detailed decisions into the following aggregated variables : the *player dimensions*. These mixed dimensions represent different steps in the relation among the company and the surfer/consumer :

Attract surfers on the web site → to Sell and to satisfy → Customer retention

- **Attractivity** : the aim of this variable is to represent how to attract a surfer on a specific web site and of course lead him/her to make a first purchase.
- **Customer satisfaction** : at this level we address strategies in order to make customers satisfied. we find elements like the price, the services provided, the quality of the web site (content, reliability, speed, etc.), the catalog of products, etc.
- **Customer loyalty**: one of the main objectives of the firms is to transform punctual transactions into repetitive consumptions. This long term strategy could be achieved by investing in personalisation systems, CRM, etc.
- **Price**.

The magnitude among and within these vectors differs between the different profiles.

Dimensions are computed as follow:

1. some initial decisions are accumulated in stocks;
2. some initial decisions are combined with other variables;
3. dimension values are computed as an arithmetical combination of decisions or stocks.

$$Dimension_i = \sum_{j=1}^n w_{ij} * decision_stock_j$$

where $w_{i,j}$ represent fixed weights, which values are given in the following table.

		Dimension Weight			
		Price	Attractivity	Satisfaction	Loyalty
PLAYER DECISION	DECISION VARIABLE/STOCK				
price	price variable	1	0,7	0,8	0,4
catalogue depth budget, catalogue depth reduction rate	catalogue depth stock		0,7	0,7	0,5
catalogue width budget, catalogue width reduction rate	catalogue width stock		0,7	0,7	0,5
referencement budget	referencement variable		0,8	0	0,1
banners budget	banners variable		0,6	0,4	0,1
emailing budget	emailing variable		0,3	0,4	0,7
off line advertising budget	off line advertising variable		1	0	0,1

average salary	productivity variable		0,2	0,7	0,7
amount of hiring, amount of dismissals	amount of employee stock		0,3	0,7	0,7
system budget	system stock		0,2	0,7	0,6
long time marketing budget	long time marketing stock		0,6	0,8	0,4
security budget	security stock		0,4	0,8	0,7
usability budget	usability stock		0,4	0,8	0,6

Obviously, weight values can be reviewed.

In the current prototype, decisions may be introduced by the screen of Figure 0.2. Obviously, such human machine interface is very poor, since the used tool exploited for developing the model, (Ithink tool) is a simulation tool and not a programming language.



Figure 0.2: Current user interface.

Player Scorecard

The player model computes a lot of variables or indicators. Some of them will be showed to the players. Note that players are expected to build their own simulation model in order to display their strategy. Thus little information is given to players...hoping that they will compute many indicators themselves.

The current prototype shows all available indicators, pedagogical scenarios specify which indicators are displayed and at which period.

Indicators are organized following the balanced scorecard discussed earlier, as illustrated by Figure 0.3: Example of player scorecard.

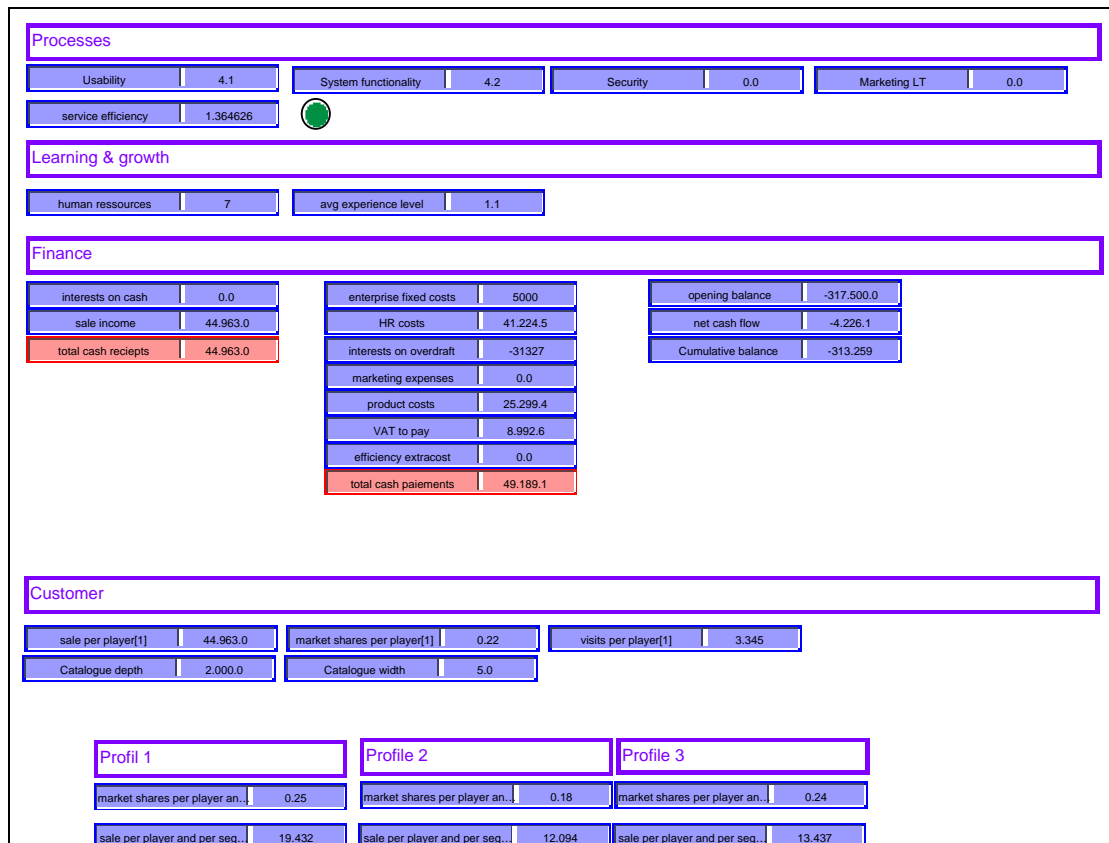


Figure 0.3: Example of player scorecard.

Pedagogical scenarios suggest the ability for players to buy information, such as market shares or indicators.

Game Parameters

The transformation of decisions into dimensions involves many parameters that have already been discussed in Section 0.

Many other parameters relate to the impact of player decisions on the state of the player firm. For example, the gain of security of the sale platform is computed from R&D investment. A specific parameter fixes the sensibility of the security to investment.

Examples of parameters are:

- for the **process sub-model**: security sensibility, usability sensibility, and system functionality sensibility to investment. Other options are fixed in the model but cannot be changed, such as the nominal volume of sales handled per employee (currently 10000 sales per person);
- for the **learning and growth sub-model**: average time to learn (time required for a beginner to become a pro), impact of experience on productivity, attrition fraction;
- for the **customer sub-model**: long time marketing sensibility to investments. Other options are fixed in the model but cannot be changed, such as the catalogue grow sensitivity to investment;
- for the **finance sub-model**: unit production cost and unit cost for catalogue management.

The complete parameter list can be founded in magnitude.xls.

Market Model

Demand Model

The demand model simulates a brand-new growing market. The demand reaches its maximum approximately at period 6 and begins a decreasing curve during the following periods.

Three customer segments or markets are independently simulated: pragmatics, good deals, and middle men.

Customer Status. Each customer segment evolves across three states. Consumers are first potential adopters, who simply exist but do not have any interaction with the market. Next consumers become visitors of player's sites, i.e., they exist in the digital market but do not buy yet. Finally, visitors become customers who proceed to a first purchase and then buy periodically.

The market lifecycle and successive customer states are illustrated in Figure 0.4

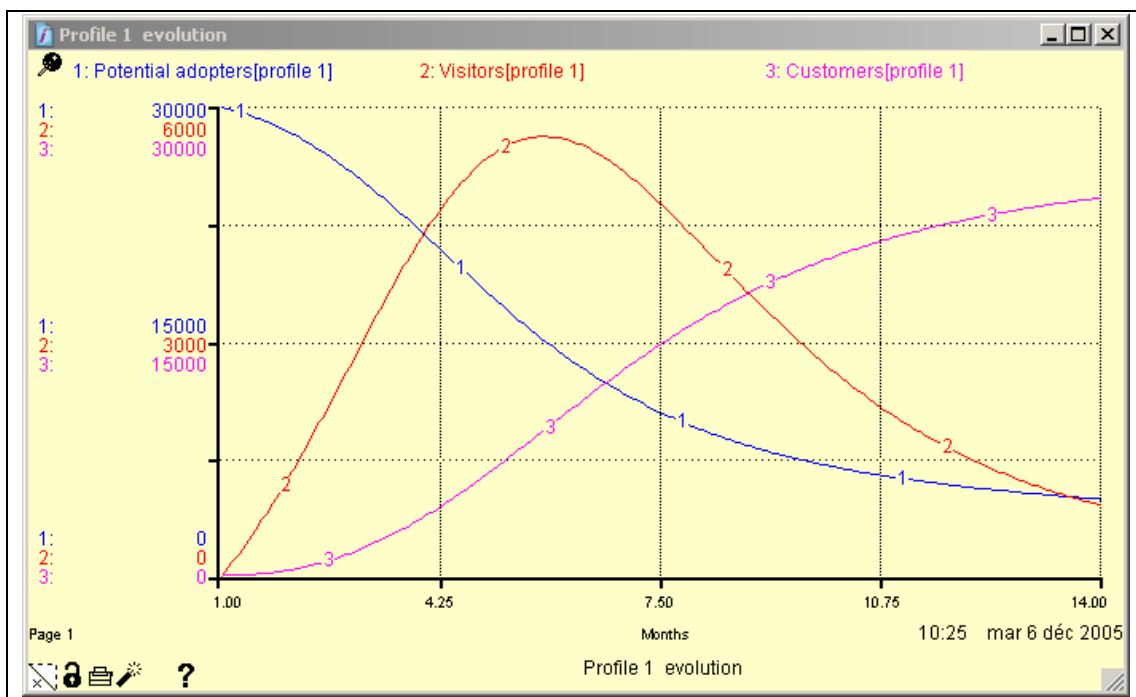


Figure 0.4: Profile 1 population evolution.

A visitor is supposed to visit player's sites a fixed amount of times during a period. The market model distributes the total amount of visits between players according to their respective marketing efforts.

Customers are supposed to buy a given quantity of products at each period. The market model distributes the total amount of purchase between players according to their decisions.

Bass Model³. Transitions between segment states (adopters, visitors, and customers) are computed from the Bass model, as showed by Figure 0.5. At the beginning of the simulation, the total population of a segment is in the state potential adopters. During the first periods, a part of potential adopters are

³ J.D. Sterman. Business Dynamics, McGraw-Hill, 2000.

becoming visitors according to two drivers: adoption from consolidated marketing efforts and adoption from word of mouth. The impact of marketing on adoption is stronger at the beginning of the game while word of mouth has effect after some periods.

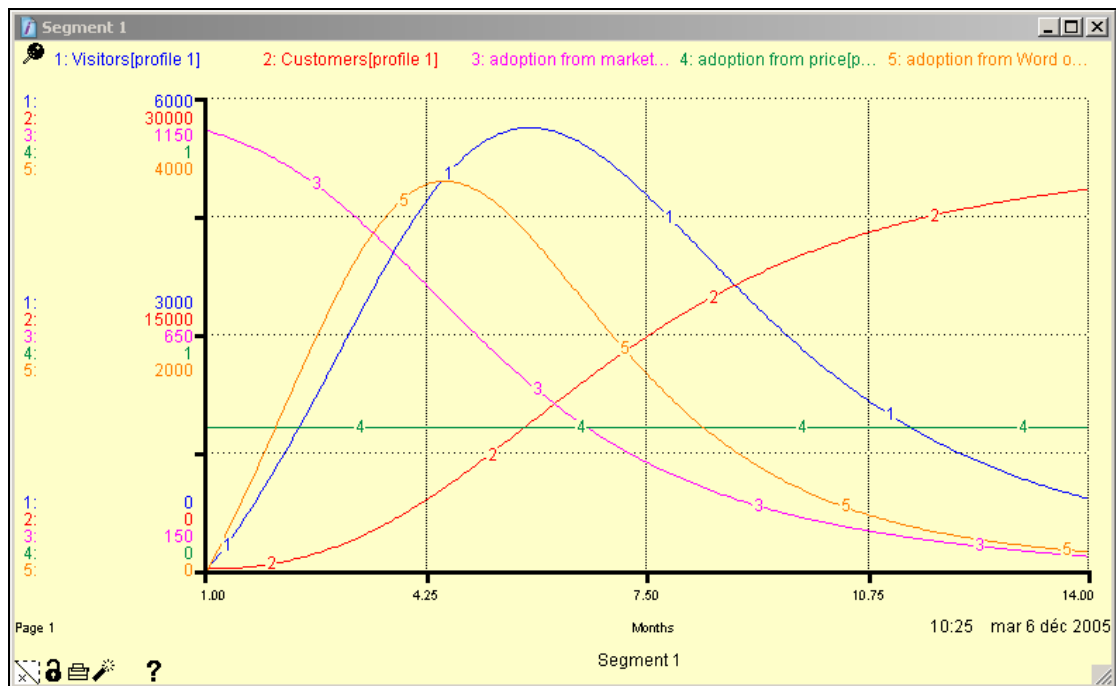


Figure 0.5: Segment states across time.

Next, visitors are changing into customers. This transfer is mainly automatic but price pressure on the market may increase or decrease the transfer rate. When becoming a customer, a visitor makes an initial purchase. Next, he buys products at each period.

Share Model

The Bass model computes the amount of product sold for each segment. Next, sales are computed for each player and each segment according to player dimensions and following the expressions below.

Let n be the number of player dimensions, d_{ij} the j^{th} dimension of player i , and w_j the weight of the j^{th} dimension. The sale of a player i is:

$$sale_i = total_demand * \frac{1}{n} \sum_{j=1}^n w_j * d_{ij}$$

In current game version, the weights are the following (no values have been defined for segment 3 yet).

	Price	Attractivity	Satisfaction	Loyalty
First periods				
Segment 1	0,8	0,7	0,3	0,1
Segment 2	0,6	0,8	0,6	0,3
Mid-time periods				

Segment 1	0,8	0,7	0,2	0,4
Segment 2	0,6	0,5	0,7	0,6
Last period				
Segment 1	0,8	0,6	0,3	0,1
Segment 2	0,6	0,5	0,8	0,8

Player dimension values are normalized according to the following expression, where gd_{ij} stands for the j^{th} gross dimension of player i , m is the total number of players, and d_{ij} are the normalized dimensions.

$$d_{ij} = \frac{gd_{ij}}{\sum_k^m gd_{kj}}$$

Game Parameters

The market model is highly parameterized in order to allow several game scenarios. Among other things, the game administrator may choose:

- the initial population for each segment;
- the speed of market evolution for each segment, by changing the drivers of state transition of potential buyers. The main drivers are the rate of adoption from marketing, the rate adoption from word of mouth, or rate of adoption from price pressure;
- the volume of sales, by changing the quantity of initial and recurrent demands for a representative of a given segment;
- the amount of visits of a customer of a given segment;
- the weights of the share model for computing sales for each player, which may vary along time for each segment.

The complete parameter list can be founded in magnitude.xls.

Figure 0.6 shows some parameters that the game administrator may directly change, but many others may also be used.

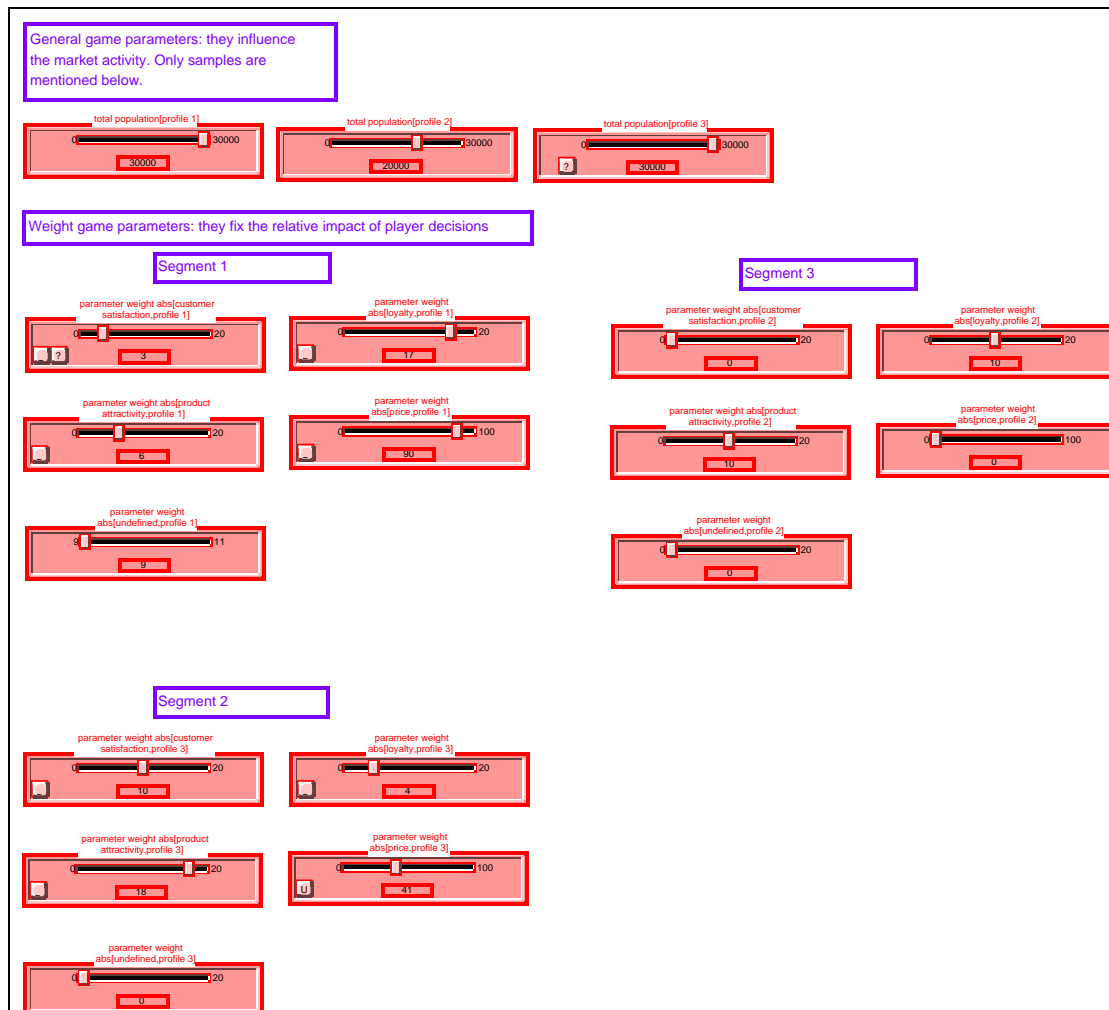


Figure 0.6: Example of game administrator interface.

Environment simulation

We intend to simulate the real world environment with agents able to interact with the market and players. These agents will be programmed by the game administrator in order to introduce a part of unforeseen events in the game. For instance, hacker agents could drive web attacks and decrease the security of player's systems which jeopardizing customer loyalty. Other agent examples are banks, legal representative, fashion drivers, etc.

Simulation Tool: Ithink

Ithink is a dynamic modeling tool that provides graphical interface for building model equations and running models. It helps to build model in an intuitive way, without directly dealing with mathematical expression.

It supports stocks, flows, and transformers. Ithink manages both graphical and scriptural visions of the model. More details about the tool can be found at <http://www.iseesystems.com/>.

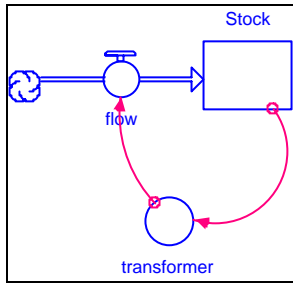


Figure 0.1: Basic building block of IThink.

The corresponding equations are:

```

Stock(t) = Stock(t - dt) + (flow) * dt
INIT Stock = 10
flow = transformer
transformer = Stock * 0.01

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Note that multiple graphical instances of the same transformer can appear in graphics (with dot lines) – see Ghost transformers in Ithink reference.

Ithink is able to execute simulation based three simulation algorithms (Euler's method, 2nd-order Runge-Kutta, and 4th-order Runge-Kutta- see Ithink reference for more details), that are encapsulated in the tool. It does not provide tools for developing a realistic user interface. Several simulation cycles can be run during a single period. A lot of cycles brings a more accurate simulation but requires more computation resources. Ideally, the market model should be simulated with high accuracy (5-10 simulation cycles) but a single cycle per period seems to be enough for the player model. In Ithink, the number of cycles are specified by the duration of these cycle, with a system simulation variable DT. For instance, if DT= 0.25, there will be 4 cycle per period.

In the following example, simulation will run over 12 periods with once single cycle per period.

RUN SPECS

Length of simulation:	Unit of time:	Run Mode:
From: <input type="text" value="1"/>	<input type="radio"/> Hours	<input checked="" type="radio"/> Normal
To: <input type="text" value="12"/>	<input type="radio"/> Days	<input type="radio"/> Cycle-time
DT: <input type="text" value="1.00"/>	<input type="radio"/> Weeks	
<input type="checkbox"/> DT as fraction	<input checked="" type="radio"/> Months	Interaction Mode:
Pause interval: <input type="text" value="1"/>	<input type="radio"/> Quarters	<input checked="" type="radio"/> Normal
	<input type="radio"/> Years	<input type="radio"/> Flight Sim
	<input type="radio"/> Other	
Integration Method:	Sim Speed:	
<input checked="" type="radio"/> Euler's Method	<input type="text" value="0"/> real secs = 1 unit time	
<input type="radio"/> Runge-Kutta 2	Min run length: 0 secs	
<input type="radio"/> Runge-Kutta 4		
<input type="checkbox"/> Analyze Mode: stores run results in memory (0.0 MB required)		

Figure 0.2: Itink simulation parameters.

The current prototype largely uses arrays in order to minimize the amount of equations. Array dimensions can be defined in an Array Editor (Model menu).