

ILMG GAME: LEARNING ARRANGEMENTS AND SIMULATION SCENARIOS

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ABSTRACT

The modern logistics simulation game ILMG (International Logistics Management Game) developed by Robert W. Grubbström (Grubbström, Bikovska, 2004) is a business simulation game that simulates a number of companies competing with different products in different markets. The paper presents advanced ILMG features related to development of the game simulation scenarios and learning arrangements. Some advantages and shortcomings as well as the most preferable application areas and circumstances under which game could be used are analysed as well. The game allows participants to become managers of the virtual company and to try out the consequences of various logistics decisions and to explore their links to other core (marketing, financial, etc.) decisions. Game manager or/and an educational course leader needs to create a simulation scenario and provide correspondent learning arrangement according to the course goals and its participants' academic background.

INTRODUCTION TO THE INTERNATIONAL LOGISTICS MANAGEMENT GAME

Nowadays simulation games are successfully used in education and professional training. Due to such characteristics as an interactivity, dynamic nature, and accessibility, they are more attractive for players and also more effective in many cases than other training approaches. Nevertheless, the success of each individual training process very much depends on how that simulation game is developed and used in training.

The above-mentioned ILMG is a computer simulation and network business game covering different business areas such as marketing and distribution, production

and purchasing, locations and inventories - that is, about logistics and what it means for the company's success. So, it is especially suited to help participants appreciate the general management of a complete company, its main functions and how they interact. The scenario, the objectives of a game are set by game management. Thus, a game can be constructed to focus on functions or aspects of special interest to individual management courses.

In general a business simulation game is a contrived situation which imbeds players in a simulated business environment, where they must make management-type decisions from time to time, and their choices at one time generally affect the environmental conditions under which the subsequent decisions must be made. Further, the interactions between decisions and environment are determined by a refereeing process that is not open to argument from the players.

The ILMG simulates a number of companies or "corporations" competing with different products in different markets. These companies establish corporate units (which may have different functions) in one or more regions. Some units may be production plants, others may be units specialised in selling products (distribution center). Products may be transported between the regions in different transport modes either regular or express. Each corporation is represented by a team of players having access to the Game via an Internet terminal (Grubbström and Bikovska, 2004). The number of companies participating in the game is arbitrary and companies compete in different regions of the world. The game has a strong focus on logistics, but it is not only logistics; it is the meaning of logistics in the context of successful business.

In general computer simulations provide the following advantages that could be successfully used in the learning process (Fripp, 1993):

- Help understanding of complex problems;
- Increase learning motivation;

- Support team building;
- Provide a risk free environment for experiential learning;
- Provide a variety of situations;
- Partly close the gap to reality;
- Facilitate active learning.

Extensive use of simulation games has advantages when course objectives include (Mitchell):

- Allowing participants to experience more realistically the roles and responsibilities of a top decision-makers who are trying to position an organization in a tough, competitive environment;
- Allowing participants to experience the uncertainties and surprises by the unpredictable actions of competitors;
- Facilitating effective aspects learning;
- Promoting participants' emotional arousal and involvement.

The following aspects have to be taken into account while implementing those games in practice:

- Learners background has to be taken into account;
- Complexity has to be adjusted to learning environment;
- Game should be "suitable" for the particular learning problems and goals defined;
- Terminology has to be close to one used by learners.

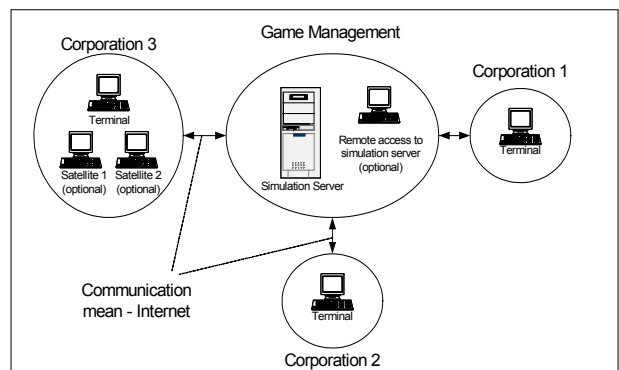
Besides above mentioned the ILMG has the following advanced features that make it unique among many others business simulation games:

- Internet-based that provides possibility of distance learning. Internet is a communication channel between educator and student. Game is accessible anywhere, whether participants are located next door or on the other side of the globe. Number of participants is arbitrary.
- Simulation scenario generation provides flexible game environment. It is possible easily make different games scenarios very simple or complex. Continuous time in the game is like in real life.
- Many kinds of reports and overviews such as balance sheets, profit and loss accounts, sales report, are provided to help participants to evaluate performance of their corporations.
- All data can be easily imported to Excel spreadsheets where different kind of calculations can be made in order to gain information to support decision-making.
- Different means of communication between game Management and corporations, between corporations like Chat, Memos are provided that is useful when the game is used in distance learning courses.

- Educational comments can be made by Management of the game or course leader to provide participants with helpful information and Web links concerning decision-making in various spheres of activity of the company.
- Distribution decision authorities between game participants within one team when participants play different roles such as a senior manager in the top of hierarchy, middle managers and operational managers who monitor the day-to-day activities of the corporation.

Game Management runs the game on remote server (see, Figure 1). Corporations represented by a group of participants are joining the game session from individual terminals via Internet. Each corporation installs and runs a program called **ILMG**, which communicates in a variety of ways with the Game Management program called as **Game Control Centre**. Corporations can use so called Satellites that allow distribute authorities.

Figure 1: Structure of the game



The **Game Control Centre** is the game management system and, unless this program is running, the rest of the game will not function. Using the Game Control Centre, it is possible to change the parameters of the game from the default values, either at the start or during it.

The **ILMG** program runs by the corporations taking part in the game. Typically, about 3-5 people are needed per team to play the game so that decisions have to be taken independently rather than through a consensus compromise based on participants own goals and interests. Corporations compete each with other in different regions of the world with specific characteristics. Each person can have a satellite screen and makes certain decisions, or each company can be based at a terminal. At the commencement, all corporations begin with the same opening position (all recourses are the same for all companies). The main role of the companies is to take decisions, regarding: the structure of the company (where to produce goods), markets and prices, production levels, transportation requirements to service markets, investment in

Table 1: Corporation decisions

	Purchasing	Production	Marketing	Distribution	Finance
Strategic		Location choice Investment into production capacity Process improvement	Market entry Product development Product improvement	Allocation market -> factory Investment into warehouses	Loan Liquidation of assets
Operational	Purchasing orders	Production batch release	Price Advertising	Shipping orders	Repayment of loan Stock exchange transactions

machinery and warehousing, the buying and selling of securities, liquidity actions (e.g. selling assets and issuing new stock), the ordering of market surveys, the distribution of decision authority around the satellites. Different kinds of reports are generated during the game and corporations can evaluate their performance.

Companies take action to enter sales market – this has a cost and time lag attached to it. Plants are located in regions and, to sell in a market, you must have a plant in the region. Plants may not be factories or warehouses, and could represent a sales department. Data can be downloaded into Excel spreadsheets. This data should show demand amplification, and provide some idea of the financial implications of the phenomenon. It may also give an insight into the dynamic behaviour within a supply chain network. It is recommended that the program to be run at least for twelve quarters that corresponds to 3 years of a real life.

The Game Management sets an environment for the Game by deciding on a number of basic issues such as the number of regions available and their names and several other characteristics concerning available products, etc. It also decides on the initial characteristics of an individual corporation joining the Game. The corporations take decisions of different kinds concerning production, marketing, transportation, and several other issues.

LEARNING ARRANGEMENTS AND SIMULATION SCENARIOS

The ILMG can be considered as virtual environment that is controlled by Game Management in a multitude of ways. One of the main tasks of the Game Management or course leader is to create a simulation scenario and learning arrangement according to particular course needs and participants’ background knowledge. It means, decision environment and reports could be made as complex as in real life. The principle of scenarios application is shown in Figure 2.

Usually scenario describes behaviour of the system, process of parameters changing and conditions of system functioning (Figure 2). It depicts how the system components interact with each other. The synthesized scenario allows reflecting adequately the process of behaviour of the system, to develop strategy of the organization and realization of measures of fluctuation of a situation, to generate strategic plans of action, to lead the qualitative analysis of consequences of actions, and also to predict prospective loss, possible damage and undertaken risk (Kononov, et. 1999).

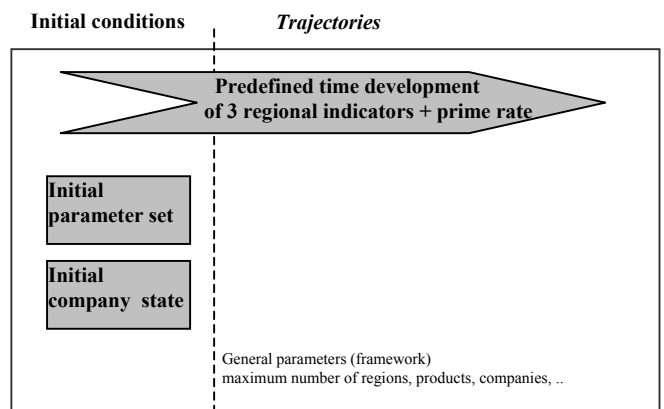


Figure 2. Scenarios in ILMG

Game Management has different means to create scenarios and control the game (Table 3).

First, there is *a set of parameters* that has to be set up. The parameters determine several basic properties of the Game and of its different functions such as different rates, costs and coefficients like market-related parameters (price effect parameters, advertising parameters etc.), financial parameters (prime rate, tax rate etc.) and many others.

Second, the *initial scenario* has to be decided. It covers the following properties of the game: number of available regions, products, securities, account types, initial corporation structure. Note, in the beginning of the game all corporations have the same initial

conditions (the same amount of cash on their accounts, the same operational corporate units and etc.).

Table 3: Scenario based simulation in ILMG

	<i>Tasks for a game manager</i>	
	<i>Before the seminar</i>	<i>During the seminar</i>
<i>Learning arrangement</i>	Plan and design seminar	Facilitate learning: announcements, educational comments, etc.
<i>Simulation scenario</i>	Design scenario: select general framework, initial conditions, preset values, edit parameters	Apply scenario
<i>Simulation model</i>		Control simulation: control timing, edit variables in case of erroneous decisions

Third, **preset parameters** have to be set up. There are time development of prime rate, regional productivity levels, regional wage levels, and business cycle indices.

And at last, has to decide about the **timing of quarters**. Game Manger can decide how long one quarter of the game will last and how many of them have to be run in the particular teaching course. If it's necessary Game Manager can define breaks between periods of the game.

Complexity of a modelled business environment basically depends on the actions described above. All parameters can be changed before the start of the game and during the game session as well. After scenario is decided learning arrangements should be prepared. Before the seminar Game Manager has to plan and design it. During the seminar in order to facilitate learning he should issue different announcements and educational comments. Educational comments can be placed to the game for educational purpose and participants can easily access them. Comments usually contain some useful information for participants regarding different theoretical aspects or some Web link to this information.

GAME RUNNING EXPERIENCES

Below some educational experiences are presented. In November-December 2004 the ILMG game has been running during three weeks at the Linköping University, Campus Norköping (Sweden) within the Industrial Management course for MSc-students in Electrical Engineering, and Transportation and Communication Engineering. Students were divided in 3 separate groups with six corporations in each group. In total about 70 students participated in the game.

3 game sessions for 4 hours each (in total 12 hours) were planed for every group.

Game handouts (see, Appendix) were issued to participants the day before the first session in order to review the initial conditions of the game. Those handouts contained description of the initial state of the corporation presented by its balance sheet and other useful information necessary to start decision-making.

In introduction to ILMG the main aspects of the game were considered, i.e. decisions that participants could make, reports and overviews provided, the game timing and schedule. Overview of the ILMG software was given as well as basic principles of taking decisions were given.

The following sessions were proposed in the schedule:

- 1st session with 4 periods (30 min each with break between the second and the third period);
- 2nd session with 8 periods (20 min each with some breaks in between);
- 3rd session with 4 periods (15 min each).

Let's note that in the beginning of the game run periods are longer to give participants sufficient time to get familiar with the game software and to make strategic decisions which normally take more time then operational level decisions.

During the game manager follows to all participants activities online as well as compare performance of all companies and in case of necessity to give guidelines how problems can be solved. For instance, on the computer screen the current Profit & Loss Account for all companies could be analysed. Since corporations main task (like in real life) is to make profit, game manager can easily assess which company is the most successful in this particular moment.

It could be the situation when all corporations except one are profitable and this one has tremendous loss due to very high unit production cost. In this case the game manager can take a further look to another report or overview what is available in the game, for instance, to Key Indicators including Liquidity Ratio, Gearing, Return on Total Capital, Return on Equity, Inventory Turnover Rate, Capacity Utilisation, etc. For example, the Capacity Utilisation is about 10% and corporation produces enough items to satisfy a demand. In this case an existing capacity of corporate units should be checked. It could be found that corporation has very high production overheads and they have to sell their production equipment (to make decision Sell Assets) or abolish the unit (this is strategic decision)

After the last period (that corresponds to 8 years of the real life) students are given time to prepare a short presentation about corporate performance. At the end of the game debriefing session is given where students

are involved to the discussion of the following questions:

- How do you feel after the game is over? How did you like it?
- What happened with your corporation during the game?
- What did you learn?
- What next? How would you play the game differently using what you just learned?

Game participants took part in this discussion by answering the questions and presenting the results of their corporation operations to others.

CONCLUSIONS

The paper describes modern Internet-based simulation game that uses scenario-based approach. In particular, the following strong advantages or strength of the ILMG game were defined: the game requires a multi-disciplinary approach, requires members of the corporation to work as a team, it takes a total enterprise perspective rather than focusing on a particular function, the game provides users friendly interface and etc. The following opportunities were found: the functionality of the game is learnt quickly, the game enables efficient teaching of virtual rooms and quick feedback to enable students to understand cause and effect relationships and etc. Advantages of simulation games and the ILMG unique features are given in the paper. Game management and learning scenarios generation problems are discussed in the paper. Example of learning scenario is proposed as well.

Though the ILMG is fully operational and interest for it increasing there is still a lot of work to do. The most important items are: scenario developing, storing and distributing; designing educational comments and to relate ILMG to theoretical studies in forecasting, inventory control, transport planning, investment analysis, accounting, etc. Judging by the commentary and positive ideas that are coming from the ILMG users the game developers considering the possibility to continue its development and add new features.

REFERENCES

- Berglund, Jan E., Grubbström, Robert W., *Företagsspel - lek och verklighet (Management Games – Fiction and Reality)*, Stockholm: Bonniers/Aldus 1968.
- Fripp, John. Learning through simulation: A guide to the design and use of simulations in business and education. New York: McGraw_Hill, 1993.
- Grubbström, R.W., Bikovska, J., The International Logistics Management Game Internet Version 3.0, Participants' Manual, December 2004.
- Kononov D.A., Kulba V.V., Kovalevsky S.S., Kosjachenko S.A. Development of scenario spaces

and the analysis of dynamics of behaviour of social and economic system. Preprint, Moscow, 1999. In Russian.

Mitchell, Rex C. The Complementary Benefits of Cases and Simulations,
www.exchangesjournal.org/print/print_1103.html

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APPENDIX

Initial Conditions of the Game

You are the managers of the corporation and you have to decide what to produce and where to sell produced products. You are also responsible for the financial department of your corporation.

There are two types of products available for production: **Standard Bike and Sports Bike**. You can decide to produce and sell bikes in three different regions: **Scandinavia, Baltic States and Western Europe**.

The initial state for each company is the following:

Company has initial cash amounting to €40,000,000 and Securities Type 1 amounting to €1,000,000 as its initial assets. It has one operational plant in Scandinavia valued at €5,000,000. The Corporation has an initial bank loan amounting to €10,000,000. The Corporation's Ordinary Share Capital is €41,000,000. Market in Scandinavia is established and two products are adopted.

Market investigation shows a price between 1000 and 4000 is realistic. The volume is depending on industries price level, marketing effort, product development and Business Cycle index in the different markets.

ASSETS		LIABILITIES	
Current Assets	41 000 000	Current Liabilities	
Current Bank Account (Debit)	40 000 000	Current Bank Account (Credit)	
Interest Receivable		Accrued Interest	
Short Term Investments	1 000 000	Trade Creditors	
Trade Debtors		Current Tax Due	
Materials-on-Order		Bank Loans	10 000 000
Materials-in-Transit		Provision for Bank Withdrawals	
Raw Materials Stock		Total Liabilities	10 000 000
Work-in-Progress		EQUITY	
Finished Goods		Ordinary Share Capital	41 000 000
Goods-in-Transit		Profit/Loss	0 000 000
Fixed Assets	5 000 000	Opening Balance 1.1.01	-5 000 000
Buildings and Machinery	5 000 000	Retained For the Period	
Warehouses		Dividends	
Plant under Construction		Total Equity	36 000 000
TOTAL	46 000 000	TOTAL	46 000 000

Figure 1: Balance Sheet of January 1st, 2001

You have available several data related to Financial Parameters, Regional Parameters, Products Technical Parameters, and Transport Parameters as showed in the Tables below.

Table 1 - Initial Conditions period 1

Region	BCI	P	W
Scandinavia	97	100	300
Baltic states	100	100	330
Western Europe	100	90	250

BCI =Business Cycle Indices
 BCI-f =Business Cycle Indices-forecast
 P =Regional Productivity Indices
 W =Wage Levels

Table 2 – Financial Parameters

Prime Rate (%)	2.5
Bank Loan Rate Factor	2
Standard Loan Period (Years)	5
St Loan Repaym Freq (Quart=0, Ann=1, Month=2)	0
Tax Rate (%)	30

Table 3 – Regional parameters (Examples)

Item	Scandinavia	Baltic States	Western Europe
Unit Projecting Cost (€1000)	2500	1800	2000
Construction Time (Days)	40	50	45
Unit Abolishment Cost (€1000)	300	200	300
Abolishment Time (Days)	30	30	30
Nom Capac Expansion per Inv (Monthly Mach Hrs/€1000000)	3000	3200	2800
Capacity Expansion Fixed Cost (€1000)	100	100	100
Capacity Expansion Lead Time (Days)	20	30	25
Warehouse Capac Expansion per Investm (Units/€1000000)	1000	800	1000

Table 4 - Market-Related Parameters

Region	Market Introduction Time (Days)	Market Introduction Fee (€1000)
Scandinavia	15	200
Baltic States	10	150
Western Europe	15	200

Table 5 – Material Move Tariff

From \ To	Scandinavia			Baltic States			Western Europe		
	Time (Days)	Fixed Cost (€)	Variable Cost (%)	Time (Days)	Fixed Cost (€)	Variable Cost (%)	Time (Days)	Fixed Cost (€)	Variable Cost (%)
Scandinavia	2	500	5	4	400	5	6	600	5
Baltic States	4	400	5	2	500	5	4	400	5
Western Europe	6	600	5	6	500	5	4	500	5

Table 6 – Regular Transport Tariff (Express Transport Tariff)

From \ To	Scandinavia			Baltic States			Western Europe		
	Time (Days)	Fixed Cost (€)	Variable Cost (%)	Time (Days)	Fixed Cost (€)	Variable Cost (%)	Time (Days)	Fixed Cost (€)	Variable Cost (%)
Scandinavia	1	300	5	2	500	5	2	500	5
Baltic States	2	500	5	1	300	5	2	500	5
Western Europe	2	500	5	2	500	5	1	230	5

Table 7 – Technical Coefficients of Products

Item	Scandinavia		Baltic States		Western Europe	
	Standard Bike	Sports Bike	Standard Bike	Sports Bike	Standard Bike	Sports Bike
Material per Unit (Tons/Unit)	0.01	0.02	0.01	0.02	0.01	0.02
Machine Hours per Unit	5	10	5	10	5	10
Work Hours per Unit	10	20	10	20	10	20
Setup Cost (€)	50	50	50	50	50	50

Planned Seminars: 1st - Introduction and Strategic Decisions, 2nd - Tactical and Operational Decision, 3rd - Operational Decisions and Debriefing Session.