A Chain Game for Distributed Trading and Negotiation

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Abstract

This position paper introduces a simulation gaming environment for enacting a production network. The environment aims to be an integrative laboratory for investigating supply networks, as well as being a versatile training tool. The primary focus is on food production networks. The environment enables a number of teams of participants, each representing one actor in a food chain, to conduct business together. The teams can have the role of auction, co-operation, wholesaler, factory, retail chain, and retail outlet. Producers and consumers are simulated. The game leaders freely determine the products and production methods in each run of the game.

The gaming environment takes performance, process and institutional aspects of chains into account. It is particularly suited for investigating issues of sustainability and trust.

Currently the gaming environment is under development. The paper presents the prototype version Chain Game 1B. This version can be found at http://www.chaingame.org. It runs on the Web, enabling to model distributed chains.

Keywords:

Supply chain, food production network, simulation game, governance, sustainability, trust

Introduction

This article is about supply chains. More specifically the focus is on food production networks, although most of the paper applies to other supply networks as well. These days, food production networks are tightly integrated international ventures involving huge streams of materials, information and money. The quality of life of millions of people and the income of many thousands depend on the functioning of these food production chains. Wageningen University has therefore put a considerable research effort into studying food production chains. In 1998, Beers et al. introduced the term Chain Science for this purpose. They compare a chain scientist to a general practitioner. From the point of view of a medical specialist a general practitioner knows little – but he has to master a variety of disciplines of medicine at a certain level in order to be able to help his patients. He cannot afford to have the typical “professional deformation” that a specialist might have, but he must be able to recognise which specialist, if any, the patient needs.

According to Beers et al. (1998) and Trienekens (1999), the study of vertical co-ordination between organisations, or Chain Science, requires at least the disciplines of marketing, management science and economics. They distinguish three complementary perspectives on chains: performance, process, and institution. For establishing the *performance* of a chain, they state, the perspectives of all relevant stakeholders should be taken into account, implying a role for behavioural, social and political sciences. For studying chain *processes*, they say, Information Technology and related expertise are crucial. Logistics, tracking and tracing, and production management are important terms here. Thirdly, they define the *institutional* point of view as "possible ways of linking participants together", implying a role for political, legal and social sciences, for management studies and for game theory.

So far, these authors have not had much succession. This is not so surprising. It appears to be very hard to be so integrative in chain research. Trienekens (1999) has devoted an entire book to articulating the three complementary perspectives, with a strong focus on the process perspective. We have used his work as a basis for the gaming environment. Apart from this work, a cursory review of the literature on supply chains has not yielded any integrated treatments of engineering, quantitative and social scientific views. Contributing disciplines tend to either have a very partial worldview (e.g. economics) or lack the capacity to generalise, because solid theory is absent (e.g. information technology, management studies). Theory from social sciences (e.g. behaviour, leadership, communication, and cross-cultural issues) cannot be readily brought to bear upon chains.

This paper represents the first step in a stream of research that attempts to use a simulation game as a means to integrate various bodies of theory that bear on food production chains. A game is ideally suited for abstracting a situation to keep only the most relevant aspects from whichever discipline. This runs counter to the reductionism that is so prevalent in disciplinary science, and so it might be a way to further chain science as a practice-oriented interdiscipline. This is not to say that specialisation in science is undesirable; on the contrary, it is indispensable. But we also need to be able to bring together the various disciplines that study the same phenomenon.

Purpose of the project

This project aims to produce a chain game (www.chaingame.org). In fact the aim is not just one game but a gaming environment that can be configured to represent a variety of food production networks and highlight a variety of relevant aspects from the performance, process and institutional perspectives. As to target groups, it should be a tool for both research *and* for experiential learning. The gaming environment, together with people who use it, will constitute a microcosm of a real-world production network, including both engineering and social aspects. The environments' design should enable it to model the topology of a variety of real food supply networks, making it suitable for use in industry.

The gaming environment constitutes a laboratory for investigating food chains. Notably the gaming environment should make it possible to investigate the following chain issues.

From the performance perspective:

- Influence of variations in production, mirroring the erratic variations in yield in agriculture;
- Influence of variations in consumption, mirroring rapidly changing fashions in consumer preferences;
- National culture of actors in the network, mirroring international food chains.

From the process perspective:

- Mission of firms within the network, both declared and actual;
- Business strategy of individual firms within chains, both declared and actual.

From the institution perspective:

- Chain configuration and governance structure;
- Trust, which is widely seen as a key variable in a business environment without central ownership. Trust can be studied in relation to the institutional arrangements in the chain.

Supply chains

Supply chains are the popular denomination of what is more appropriately termed supply networks. Borrowing from definitions in the literature (van der Vorst 2000, Trienekens 1999) we define a supply network as *a network of institutional actors who co-operate to convert raw materials into products for* *household customers*. The actors are businesses that can belong to any of the categories in figure 1. Typically the network looks much like a directed chain, for instance: producer - co-operation – factory – retail chain – retailer – consumer. Each actor is independent and can therefore choose with which other actors it wants to do business. Because of the perishable nature of food products, there is a high premium in food production networks on stable relationships with minimal throughput time. Establishing new alliances can easily lead to increased throughput time, which harms product quality, which makes sales drop.

Relevant disciplines

Trienekens (1999) has presented an overview of scientific disciplines relevant to the study of supply networks. Trienekens' overview of relevant bodies of research, grouped by perspective, shows eleven approaches that are largely disjoint in their conceptualisations. The basic sciences behind these approaches are economics, management studies and information technology. There are no substantial contributions by non-economic behavioural sciences.

There can be no doubt that the process perspective on supply chains is a successful approach in many situations. In mature industrial production chains, supply chain management has its accepted body of concepts in the process perspective, see e.g. Simchi-Levi et al (2000), Sandoe et al (2001). Van der Vorst (2000) shows that the same applies for food supply chains in industrialised countries. Food supply chains have some special characteristics, the most prominent of which is the perishable nature of the products.

Some major current trends

We shall now focus on food supply chains specifically. Hofstede et al (1998) mention a number of current issues in international food chains. They can be categorised as performance issues and product image issues. Performance issues include competitive prices, high quality, freshness, and broad assortments available year-round. These issues force food chains to operate smoothly, flexibly and at high throughput speed.

Product image issues are issues that pertain to values. Their importance varies with national value patterns (de Mooij 2001). One of these is that products are perceived as new. This requires short product life cycles - which could arguably also be considered a performance issue. Products acquire a number of other image attributes during their life cycle. These could be called ethical attributes. They include environmental considerations in production and distribution, animal friendly production, use of genetically manipulated material, and humanitarian considerations, such as absence of child labour. The more prosperous consumers around the world become, the more these and similar product image considerations become crucial for food chains. Recently, product image issues have begun to force producers into changing their methods of production even before legal constraints are put into place. This shows how influential customers have become. In food chains this phenomenon is nicknamed chain inversion (from push to pull). In order to carry product image information to the customers, complex information systems spanning the entire chain are needed.

Limitations of engineering approaches

In industrial enterprises, operations management has been immensely improved by using mathematical techniques. Planning systems, Enterprise Integration systems and many similar types of automated information systems use mathematical techniques such as optimisation or heuristics.

While not questioning the huge contribution of Operations Research and related disciplines in improving planning processes in organisations, Hofstede (1995) has called attention to some limitations of these approaches. These are twofold. First, many planning situations in organisations cannot be conceptualised as mathematical problems without making unrealistic assumptions. They are better thought of as *open problems* than as *formal problems*. In these situations, the unpredictability and volatility of the business environment are too big for the mathematical formulation to be realistic. Second, mathematical or artificial intelligence models cannot do full justice to the human side of organisation.

In some situations the two objections are not so serious. This is the case where the environment is sufficiently predictable and the human side can be managed. This is usually so in industrialised countries with legal systems in place, exception-handling mechanisms, well-managed production and predictable consumption. For instance, in an extensive study about supply chain redesign in the Dutch context Van der Vorst (2000) defines uncertainty as follows (p. 229).

"(…) decision-making situations in the supply chain in which the decision-maker has lack of effective control actions or is unable to accurately predict the impact of possible control actions on system behaviour because of a lack of: a) information (or understanding) of the environment or current supply chain state; b) a consistent model of the supply chain presenting the relations between supply chain redesign variables and supply chain performance indicators. The presence of these supply chain uncertainties can be recognised by the presence of safety buffers in time, capacity or inventory to prevent a bad supply chain performance."

This is a very valuable definition. The point here is that it takes a view of uncertainty that is only meaningful within fairly narrow boundary conditions. What exactly is meant by "lack of understanding of the environment"? From the manuscript it becomes clear that it does not include interpersonal matters, political circumstances, cross-cultural clashes or the like. Nor does it address inherent unpredictability. Yet in international supply chains, unpredictable disruptions in demand are there to stay (Levy 1995). What happens if the boundary conditions are transgressed, for instance in situations of crisis – like the recent crises in the European animal husbandry sector? What happens in situations with new actors? And what happens in new markets where nobody really knows what image the products will acquire? For these and similar situations, simulations that include human actors can add much value to formal modelling methods. The gaming environment aims to create a laboratory to study this type of circumstance.

Gaming and food production chains

We shall now present a brief overview of existing simulation games that are relevant to the Chain Game.

Beer Game

In the area of supply chain management, one game has acquired the status of a classic: the Beer Game (Sterman 1992). In the Beer Game, the players enact a linear chain comprising factory, distributor, wholesaler and retailer. The game leader manually simulates the consumer demand. The point of this highly simplified food chain is that the teams are all myopic. Each team only sees the demand of its immediate successor. As soon as market demand changes, this leads to bullwhip effects in the chain due to human tendency to overcompensate. The learning from this game is that open information exchange is essential for the performance of a food chain.

Supply Chain Management Game

Other games about supply chains in which the chain is modelled as a series of actors are few compared to the large number of games in which several companies compete against each other in parallel. A few variations on the Beer Game exist. One game that models a chain similar to the beer game but with fewer restrictions and more behavioural richness is the Supply Chain Management game by Robert Brown (Brown 2001, see Web references). This game works with tickets and counts one production plant, one distribution centre, two field warehouses and four retail outlets. The teams have some freedom to decide with whom they wish to trade, i.e. they can change the institutional arrangements between them.

Distributed games and trust

Today's business environment does not always rely on same-place, same-time contacts. This affects trust, and trust is now one of the big issues in the business literature. Although both intuition and experience show that face-to-face interaction remains by far the preferred mode it is not always feasible. Distributed management games could model distributed business. One such game is A Daughter in Danger (Hofstede et al. 2001, Hofstede Web ref.). This game is about a business acquisition. Experiences with this game have shown that the distributed condition affects trust in particular. When messages failed to get across accurately, the recipients tended to assume that they had not been sent, and would conclude that the recipient was not to be trusted. A similar strong effect on trust can be expected in any business environment that relies on technology-mediated contact. The Chain Game allows to investigate these effects because it can be played both same- and different-place.

The Strawberry Chain and national values

Hofstede and Trienekens have created two simulation games that model food chains: The Strawberry Chain (Hofstede et al. 1998) and Food for Thought (Hofstede and Trienekens 2000). In both cases, there is no computer simulation involved and the game is intended for approximately one hundred participants who actually produce, distribute and consume food products. The setting in both cases is hectic. The chain precedence rules are not being enforced and therefore broken on a large scale. We could term this institutional creativity, or opportunism, of participants. The point is that, like in real life, a food supply chain is not immutable but constantly evolves.

In these two games the consumers were given fictitious national value profiles, so-called synthetic cultures (Hofstede and Pedersen 1999, Hofstede et al. 2001). This mirrors the prominent role of national values for predicting the behaviour of today’s customers (de Mooij 2001). In the chain Game these synthetic cultures can be used either for the participating teams or to moderate the simulated demand.

The Chain Game

The current chain game www.chaingame.org that will be described here is a prototype version 1B with limited functionality. Ultimately it should grow to become a gaming environment that allows “playing” with institutional, process and performance aspects of food production networks. The current version focuses on process. It allows to model some institutional and performance aspects as well.

Basic data

The Chain Game is really a gaming environment. One to over thirty teams of one to four participants can participate. Typically there might be about fifty participants to a game session. Each team plays the role of one company that is part of a fresh food chain. The chain extends from producer to consumer via many intermediates and each team has a different role (see figure 1). The teams engage in trade of simulated produce. The game proceeds over the Web, so that the teams need not be geographically close. All a team needs is a Web-connected PC and room to sit. Unlike in most business games there are no rounds but time is “condensed” to about one month per hour. Teams conduct trade via a dedicated graphical user interface, and they can use e-mail and chat to negotiate and communicate more or less formally. The game ends when the game leader decides so. Typically it might take a few hours. The game leader also sets the precise aims for each session of the game.

Preparing a game

Before being able to play a game session, the game leader has to decide for what purpose the session will be held: research, training, what precise aims. Knowing this he/she takes a number of decisions about the game:

- How the network will be configured, i.e. which teams will constitute the game world
- What product / market combinations will exist in the game
- What production options will be available to the actors
- How to model the network’s interfaces: the producers and the consumers.

We shall investigate each of these questions in some more detail.

Network configuration

Figure 1 below shows which roles could be present in the chain and in what configuration. Al but the producers, retail outlets and market are optional. Almost all actors can do business with almost all others.

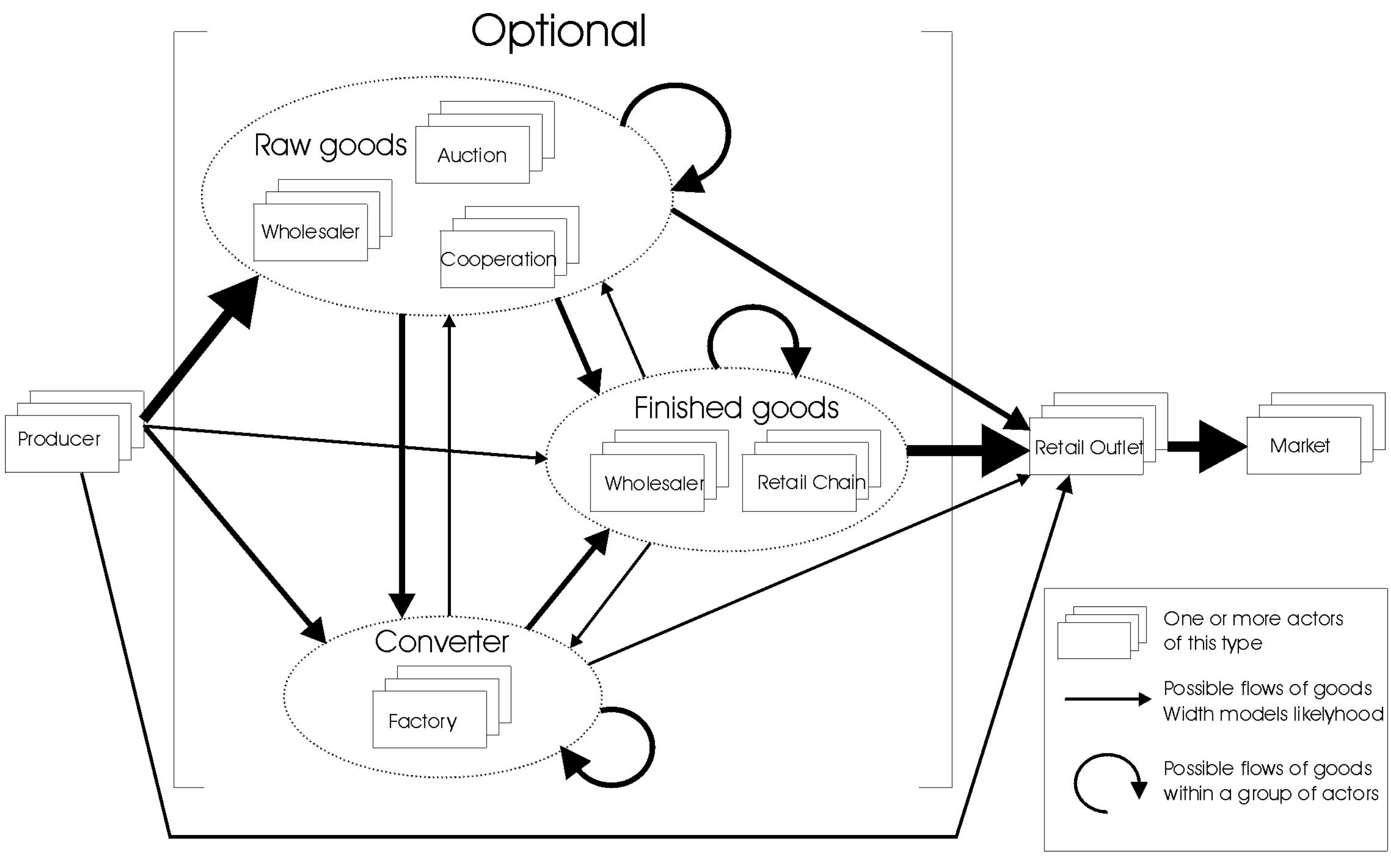

Figure 1: possible configuration of the production network.

Product / market combinations

The game's data model has been kept free of content. This means that the game can be about any type of product. The only prerequisites are that the products come in lots and that they be perishable. Typical products could be fruits, vegetables, meat, salads, meals or pizzas.

The prime quality attribute in the game is product freshness. Freshness automatically decreases over (simulated) time. If products are mixed, the freshness of the mix becomes that of the least fresh ingredient. The issue of freshness constitutes a powerful incentive to teams for lowering transaction costs across the chain so that they can speed up the flow of goods. In practice this means making deals to minimise lead times.

Production options

The content-free data model allows the game leader to freely specify what resources are available to the actors before starting the game. Each actor belongs to one country. The cost and effectiveness of a resource are country dependent. This allows realistic modelling of e.g. child labour.

During the game actors have to select what resources they wish to use, given the price / performance data of each available resource in their country. An actor can select a separate resource for each different task in the company.

The image and quality of a product are influenced throughout the life cycle by the way actors handle the product. For each transportation, conversion or repackaging action an amount of resources is needed, and product image-related information attached to these resources is kept with the lots as they proceed downstream.

Although an actor can lie about the resources to his client, the tracing function of the game is able to reveal which ones were actually used. Tracing, however, has costs attached to it, so that some lies may go undiscovered. However, random traces could also be carried out by the anonymous market.

Chain interfaces

The input and output of the chain are not enacted but simulated by the game leaders. Functionally, both the input and the output can be thought of as one or more actors. The output symbolises an anonymous market that might be composed of sub-markets. These features enable the game leaders to mimic a variety of real world occurrences. The most likely among these are

- Irregularities in the availability of raw materials,
- Changes in consumer preferences regarding any of the product attributes, whether performance- or image-related.

The game leaders can simulate both push and pull driven chains using the available communicating channels mail and chat. These allow simulating both the traditional “passive” consumer and the modern “active” consumer. The products that enter the network can have product image data attached to them. Due to the content-free data model the game leaders can freely determine these in advance of the game.

Participant teams who are instructed to hold certain values could also enact the market instead of the game leaders.

Starting a game

Each actor in the game runs a company. Similar to real world companies, these have a mission and a strategy to fulfil this mission. A team can determine its mission and strategy itself at the start of the game or it could be imposed.

Mission

The actors in this game are instructed to pursue one or more of the following objectives:

- Performance, or making money. This is the usual objective of business games. The criterion is the financial position of the company as measured by adding stock value and bank balance at the game’s end.
- Achieving continuity. Continuity is the ability to function over a long period of time, even after the period of time that is actually being enacted. It is related to sustainability. It involves the probability that a company would face downfall of its market if market conditions changed. This could happen if consumers became choosier, if new regulations were introduced or if existing regulations were being enforced. These regulations could concern ethical or environmental product attributes.
- Achieving trust with their fellow actors. Trust is measured at the end of the game – or at other points in time – by asking the actors to evaluate one another. It is therefore a decidedly subjective measure. Asking for trust extends the time horizon beyond the enacted time of the game run. This makes “predator” strategies less attractive because even though predators may have made much money they are likely to be little trusted.

The game leader is free to combine these three criteria in whatever way he / she wants to decide which team wins the game.

Another possibility is to compare games rather than teams in one game. If several instances of a game with identical preconditions are run, the total performance, as well as the average continuity and trust, can be measured.

Strategy

The actors deploy strategy to fulfil their mission. The current version of the game offers seven declared variables of strategy, which are highly related to the major current issues in food production chains.

1. Price. Competitive prices lead to higher volumes and a competitive position in the market. Pricing will in most cases be a central issue while running the game.
2. Ecology. This factor refers to environmental friendliness and good living circumstances for animals and crops. In this game the tracking and tracing possibility makes it possible for customers to check the origin of their goods. Companies can for instance check whether their products are of ecological origin, and they can impose constraints on their inbound orders. Companies that have a mission with a high score on continuity are expected to focus on ecology.
3. Humanity. Use of child labour and the level of wages paid to employees or small producers from the Third World are of increasing interest to the consumer. Again, companies can use tracing to check the humane origins of their products. A company that believes humanity is an important factor in trade will likely score high on continuity, because it is important to employees to have a guaranteed job for a long period.
4. Innovation. Marketing theory postulates that short product life cycles stimulate demand. An innovative firm constantly thinks about new product / market combinations. In the chain game there are factories, able to convert goods. Some companies have the ability to repack a lot. The simulated production actor can introduce new raw products.
5. Order compliance. Actors in the game can participate in contracts. When actors are accurate in complying with these contracts this is likely to make them trustworthier to other actors. In a less direct way, the chances for continuity will increase, because no long-term contracts will be broken. This is likely to lead to a larger order bundle.
6. Planning window. This factor refers to the difference in planning horizon between companies. Companies focusing on earning money fast and in large amounts tend to plan their activities in the immediate future. Firms with a more continuous approach will bind themselves to long term contracts. If the production is predictable and stable, an extended planning window can guarantee a broad range of goods throughout the year and can reduce lead times, thus bringing a fresher product to the customer. It also enhances continuity.
7. Quality. Today's consumers place high demands on the quality of their food. Quality in this game mainly consists of freshness, although the packaging method and production method may have their influence on the perception of a lot by the customer, as can product image attributes. What constitutes quality is up to the game leader, who manually simulates the demand in this game version.

Rules of play

Logistics

When an actor buys a lot it arrives in the inbound logistics department of the actor. The actor can then check this lot to see whether it is what they ordered or move it immediately to stock if the lot is from a trusted source. When a lot is in stock, the actor can move it to another internal department to be processed. When a lot is sold it is moved to the outbound logistics department. Here the letter of freight is made (It is possible to lie in this letter!) and the recipient is specified.

Institutional actions

The finite set of institutional actors is installed at the start of the game. No new actors can be created, and there is no legal system to adjudicate mergers or acquisitions Actors can disappear during a game run and other teams can fill their niche. Actors can make informal arrangements about their co-operation using chat and mail, and they can make contracts. The system keeps track of adherence to contracts.

Performance

Performance is modelled very simply as balance, plus value of stock.

Process

Possible external actions for each actor:

- Buy / sell;
- Send marketing messages: offer goods or request demand information;
- Make a contract / revoke a contract. A contract can be made between two or more actors and concerns future buying and selling of a product or a collective marketing action. Either party can mark the contract as “broken” if they wish to, but that is irrevocable. There is no direct penalty for breaking contracts;
- Exchange messages bilaterally with whatever possible content they wish to, including all sorts of informal arrangements between two or more actors.

Possible internal actions for some of the actors:

- All actors but the consumers can offer lots for sale by placing them in the trade department
- The wholesalers can repackage products in different units, usually smaller ones;
- The factories can combine articles to create new products – e.g. to create a fruit salad from various ingredients.

End of the game and debriefing

The game ends whenever the game leader decides so, or when time is up. After the period of playing, an extended debriefing will be conducted, whatever the aim of the game session. The structure and topics of the debriefing depends on the specific aims. During the debriefing, teams can still use chat and mail to vent their feelings. Each team fills in a form stating the trust they have in all other actors. Comparing the actors' declared mission and strategy with what happened during the game will no doubt be an important topic for debriefing.

Software and hardware

The software platform consists of Oracle, Remote Method Invocation (RMI), and Java. Hardware needed is modest. Each team requires a client PC. The server needs to be minimally a Pentium 166 with 64 MB RAM. A more powerful server allows for more participants.

Timetable

Version 1 should be online at the time of the conference, July 2001. At the time of writing, May 2001, it is still under construction. Later versions are expected next year.

Functionality desired for version 2 is extended modelling power of the gaming environment in institutional and value-related domains, and model-based consumer markets. The first priority is to experiment with version 1B to find out what works and what most needs changing. Some possible options are using simulation models to model production and consumption; integrating the environment with ERP software.

Concluding remarks

To simulate a fresh food chain including institutional, process and performance aspects and using both computers and human teams is a novel venture. The gaming environment that is described here can be used as a traditional business game. In addition it offers enormous versatility to the game leaders for putting it to various uses, either for research or for training purposes. Notably it is a living laboratory for the concept of inter-organisational trust.

Because the gaming environment runs on the Web it is very suitable for modelling geographically distributed chains with their attendant problems of governance.

Experiences with the first version are now needed before developing the gaming environment any further.

References

Beers, George, Adrie Beulens and Jan van Dalen (1998): "Chain Science as an Emerging Discipline". In Ziggers, G.W., J.H. Trienekens and P.J.P. Zuurbier (Eds) (1998): *Proceedings of the third International conference on Chain Management in Agribusiness and the Food Industry*. Wageningen: Wageningen University, Management studies Group, pp. 295-308.

Hofstede, Gert Jan (1995): "Open problems, formal problems". *Journal of Decision Systems 4(2)* 155-165.

Hofstede, Gert Jan, J.H. Trienekens and G.W. Ziggers (1998): "The Strawberry Chain", in Ziggers, G.W., J.H. Trienekens and P.J.P. Zuurbier (eds) (1998): *Proceedings of the third International conference on Chain Management in Agribusiness and the Food Industry*. Wageningen: Wageningen University, Management studies Group, pp. 75-85.

Hofstede, Gert Jan and Paul Pedersen (1999): "Synthetic cultures: intercultural learning through simulation games". *Simulation and Gaming, an International Journal*, 30:4 pp. 415-440.

Hofstede, Gert Jan and Jacques H. Trienekens (2000): "Food for Thought", in J.H. Trienekens and P.J.P. Zuurbier (eds) *Proceedings of the fourth International conference on Chain Management in Agribusiness and the Food Industry*. Wageningen: Wageningen Pers, pp. 41-45.

Hofstede, Gert Jan, Paul Pedersen and Geert Hofstede (in print): *Ten Synthetic Cultures for Intercultural Learning*, Yarmouth: Intercultural Press.

Levy, D.L. (1995): "International Sourcing and Supply Chain Stability", *Journal of International Business Studies* 26:2, pp. 343-360.

Mooij, Marieke de (2001): *Convergence and Divergence in Consumer Behavior: Consequences for Global Marketing and Advertising*. Ph.D. thesis, Universidad de Navarra, Pamplona, Spain.

Sandoe, Kent, Gail Corbitt and Raymond Boykin (2001): *Enterprise Integration*. New York: John Wiley.

Simchi-Levi, David, Philip Kaminsky and Edith Simchi-Levi (2000): *Designing and Managing the Supply Chain*. Boston: Irwin McGraw Hill.

Sterman, John (1992): "Teaching Takes Off: Flight Simulators for Management Education", *OR/MS today*, October 1992 pp. 40-44.

Trienekens, Jacques H. (1999): *Management of processes in chains, a research framework*, Ph.D. thesis Wageningen University.

Vorst, Jack G.A.J. van der (2000): *Effective Food Supply Chains; Generating, modelling and evaluating supply chain scenarios*. Ph.D. thesis Wageningen University.

Ziggers, G.W., J.H. Trienekens and P.J.P. Zuurbier (eds) (1998): *Proceedings of the third International conference on Chain Management in Agribusiness and the Food Industry*. Wageningen: Wageningen University, Management studies Group.

Web references

Brown (2001). http://www.rgbrown.com/pages/game.htm Robert Brown's Supply Management Game.

Chain game (2001) http://www.chaingame.org: The development site of the chain game, from which it will be accessible for playing.

Hofstede (2001) http://www.info.wau.nl/people/gertjan/gj-uk.htm. Gert Jan Hofstede's site with a number of simulation games.

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