Learning Production Management with "The Clock Manufacturing Game"

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Abstract

Purpose: Design a business game to provide hands-on training on processes, related to production management

Methodology: A stepwise approach is taken. First learning goals, existing approaches and constraints are considered. As a next step a system of conceptual models is developed and finally the model is formalized to the level of detail, necessary for real implementation

Findings: The methodology is applied for goals of common interest among teachers in industrial management. Constraints and game features are adapted to computer environments. Good practices for simulation and training games are also formulated.

Practical implications: In the paper a strictly formalized game model is developed. In order for it to be able to fit both in trainees comprehension and computer's hardware, the model is simplified and abstracted-out of key concerns. These are stated explicitly.

Value: The paper comes to meet specific needs in an area that covers rich and highly competitive industries. It both steps on previous experience and puts its focus in a poorly exploited field.

Keywords

Educational games, game design, production management, player experience

1Introduction

Industrial management has become a highly complicated field of business, associated with ever increasing competition, investments and risks. People, involved in production management in particular often face situations where they need to have multidisciplinary expertise and profound understanding in technical, financial and psychological aspects of business. In their career paths towards senior management, people encounter enormous amounts of information and the fast pace does not allow them to attempt to reconsider important aspects. Exactly for these reasons there is need for dedicated educational training for different isolated aspects of the perplexed business reality. Putting focus on specific learning goals allows people to gain complete understanding of particular key aspects before facing the entire complexity of business as a whole [King 2001]. A similar attempt is made in the PRIME project [Cassina, Oliveira, Taisch, 2006], but it employs a different approach, as it is a far more ambitious and far-reaching attempt.

In this paper a game is drafted, based on established best practices from commercial entertainment gaming that serve to motivate people to play the game [Crawford 1984]. The aim of the presented design is to allow players to examine in depth three particular issues, to analyse possible strengths and weaknesses of different approaches and to get better understanding of the decisions to be taken:

- One of the considered issues is the differences, advantages and drawbacks of alternative approaches to production lines. Players are encouraged to

continuously reconsider whether **continuous flow, batch production or outsourcing** is more appropriate for each particular part of the production process. Each of the alternatives has its own specifics and is appropriate under given circumstances.

- Another issue in focus is the **specifics of investments in technology, when compared to investments in human capital**. Usually undertaken with similar intentions, these two types of investments develop in time very differently. They are related both to essentially different cash flows and to different risks. This is a key issue when companies seek an optimal balance between investments in machinery and specialists.
- A third issue is handling the **market aspects of business**. Since enterprises exist in a market, it is a key factor in their decision processes. That's why commodity markets, contracts, negotiation, pricing and procurement in general need to be included even in a simple model and players need to get used to taking decisions under such free market constraints.

Some other key issues in production management are considered as fixed for the game, so players could concentrate on the decisions under focus and abstract themselves out of others that are complicated and distracting.

The paper presents a preliminary proof-of-concept. In order to make an actual and successful game design, extensive market research and detailed visual and psychological design need to be conducted. All this falls beyond the scope of the current paper. In this sense what is presented here is only conceptual design and covers the first step of what is commonly accepted as game design process [Laramee 1999]. Outside of this scope remains also the design and development of authoring tools, as well as analysis of possible player strategies.

The structure of the paper follows the design creation process. In the next section the paper reviews several successful games. The subsequent sections deal with the game rationale, design constraints and process. Sections six and seven deal with a prospective result of the considerations in the form of high concept of the game and player experience. At the paper's end suggestions for future work are accumulated. Appendices include notes on scalability of the game and user scenarios.

2Existing Approaches

The proposed game design builds upon numerous games already available. Those games aim at a broad variety of markets and serve a broad variety of purposes. Yet, however wide, these different market branches are still unable to cover the heterogeneous world of industrial management. This paper shortly discusses good practices and elements in some famous existing games that are taken over in the current design [Carless 2003].

A widely popular game branch is card games. Common to these games is that usually the complete game mechanics is understandable to players. In computer-based card games often there are additional hidden rules and some of the roles are taken by artificial players. Card games are mostly turn-based, with each turn influencing some mathematical score in the game according to a random generator. One recent example of an online card game is the BBC **Climate Challenge** game.

Board games have many similarities to card games, but contain also geographical gameplay and have more complicated rules in general. The game world of **Jones In the Fast Lane** is represented by a board game-like ring of buildings in squares and

its objective is to attain as much of four scores as necessary to win. Each turn would represent a working week of the player's life. On the weekends, the character would experience an "Oh What a Weekend" event out of player’s control. Most buildings feature a live action clerk or store person who greets the player with a variety of humorous phrases.

In Maxis **SimCity** the player may face disasters including flooding, tornadoes, fires, earthquakes and attacks by monsters. If the player demolishes a church, a tornado strikes the area.

In Sid Meier's **Civilization** [Edwards 2007] the player takes on the role of the ruler of a civilization starting with nothing but a single unit. The game is turn-based. As time advances, new technologies are developed. This is the primary way in which the game changes and grows. Most advances give access to new units, city improvements or derivative technologies.

A game in **Colonization** revolves around harvesting food and manufacturing and trading goods. The prices of commodities fluctuate depending upon supply and demand. Specialist units, who produce more per turn, can be trained or recruited. Those can be also transformed into improved unit types by education.

In **StarCraft** players can have only a limited number of units at a time, each of which demands a certain quantity of supplies. Players must maintain enough unit-supporters each to serve some number of units. However, all of these units cost resources to build. The balance between different player races has been the subject of countless gameplay tweaks introduced via infrequent updates.

World of Warcraft is the most popular massive-multiplayer online game (MMOG). The majority of the quests during the early and middle stages of its gameplay can be completed without the help of other players. Other portions of the game are designed to require cooperation with other players for success. Non-player characters (NPC) can buy and sell merchandise, train class and profession skills, give quests and provide a large number of services that are needed in the game. Crafting professions also have specialization categories that when trained, allow for more diverse items to be created.

Guild Wars [Gillen 2005], another MMOG, encourages its players to form parties with other players or AI-controlled NPCs, in order to be able to fulfil cooperative goals.

3Rationale

In the development of the proposed game design, several key guidelines have been viewed as very important for the successful player learning experience. The design seeks balance between simulation and story [Dobson, Forbus 1999]. The game storyline should be **based on real historical processes**. This brings the game to an area that players know, thus giving them faster entrance into the game world and a setting to allow focusing on the key goals. However this generates a strong contrast to mainstream MMOGs in that each game has a strictly predefined start and end - something that helps handle game addiction issues.

The game design aims to engage players in thinking about their production lines and investment focus while interacting with other players. Thus it is of major importance to provide a very **simple game model**, so players can focus on those issues and solve with ease or even only observe other aspects of general interest. This allows for a cleaner and more concentrated learning process, avoiding issues

as information overwhelming and perplexed decisions.

The game is to be designed, so that its **learned lessons are simple and commonly accepted rules**. The advantage of learning within a game is that players receive the opportunity to experience consequences as in a game – with extreme clarity and no fatal outcomes. This concept steps on the idea of challenging player's knowledge of the field [Rollings, Adams 2003], as a typical part of learning games is establishing some knowledge.

The intended design is a simulation, constrained by an accompanying temporal development model – the **game environment imposes evolving restrictions** (like in Civilization). Players should not be able to recruit new experts or buy new tools at complete freedom. Constraints are both market-based and chronological and influence player's decisions. All system-dependent decisions (e.g. random number generations) will be weighted towards the intended story baseline (real historical development), thus making significant deviations unprobable. Variations in markets will also give push to some business models, and stagnate others.

The game design was also influenced by the consideration that the conceptual model of the game also needs to be **clearly readable to players**. As in card and board games it should have a transparent gameplay [Cook 2002]. Players need to be able to easily see what alternatives they have, how do these alternatives differ in their consequences and how their decisions influence further game development. During the entire game they should be able to identify changes in the environment and be able to identify different alternatives for ways they might want to react. It has also been considered important to make effects of taken actions as visible as possible, so players can develop a strong understanding for relationships between actions and effects.

In this design, it is intended to allow players the freedom to decide when and how long they want to play. They are not bound to one-another. Each player should be able to choose to enter or leave a game at any time as this is in real-life market economies. Given their financial possibilities, it is intended that players are able to completely restructure their production lines and to invest in entirely new production at any moment.

No spatial gameplay is going to take place, as this is done in BBC Climate Challenge. This decision is taken for the sake of simplicity, but is related to a significant compromise with the game's attractiveness to players.

An interesting issue is **how much the actions of a particular company could influence the global environment**. Although in reality there are many such examples, this remains outside of the focus of the game and the only influence players have is the balance between profit margins and market prices. Also for the sake of simplicity, marketing, research and development (R&D) and logistics remain outside of the game model.

Implanting humour in the game design significantly increases enjoyability of the game as can be seen in many of the existing games. This could be achieved simply by funny names, phrases and cartoon graphics [Moraldo 2001].

4Design Constraints

The game has the purpose to show and to teach players the pros and cons of different approaches to the production lines and the investment focus. With this aim, it is natural not to expect from players to be already familiar with specifics of

the possible solutions. However they may already have some partial intuition of what they do and what the consequences might be. Through putting their intuition into respective actions, they should be able to observe results. This will help players to pick those of their assumptions that have appeared correct and develop them further. In the same time players will have the opportunity to reconsider assumptions that have appeared not to match the game model.

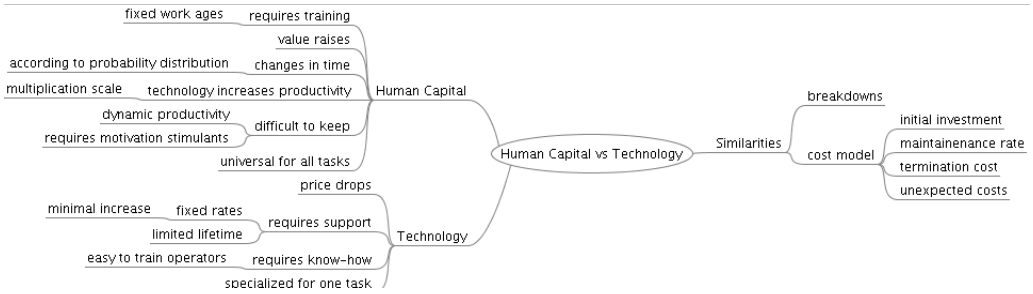

Figure 1: Human Capital vs Technology Mind Map

Additionally we approach a specialized analysis of the investment focus decision to clearly distinguish alternatives. A mind map illustrates different considerations that influence the resulting model on figure 1.

Rules and natural laws that hold in the real world should also be made to hold in the game environment. These rules should not be explicitly stated anywhere in the game, but should be easy to formulate when playing. Examples for such rules are:

- Continuous production lines produce large standardized amounts at low cost
- Installing, starting and stopping machines for continuous production lines is expensive
- Batch production allows for higher customisation of the product line and product itself
- Technologies loose value over time
- Experience improves people's skills
- When a specific product is abundant on the market, its attractiveness falls

The proposed game design **targets at students, as well as junior managers, interested in industrial management**. It provides them with the usual challenge of an enterprise – to create and develop a company that will survive and benefit from the market. Each player is a side in the market, thus they all have the options to collaborate or to compete at any moment. This social side of the game allows for more emotional experiences, shared in the community of players (compare to MMOGs). From the very beginning of the game players see the possible range of actions they could take. On the other hand, the industry and the market evolve, facing them with decisions about how and when to adopt new technologies and enter new markets, as well as what risks to take. New developments appear in time, become a factor at markets and raise game complexity. The entire gameplay is oriented around a popular industry that players have seen as customers, so they should be able to intuitively immerse into the game world [Howland 1999].

5Design Process

Once design goals and constraints are defined, the actual game model should be subjected to the target audience. The proposed game design builds around 3 views

of the conceptual model that are developed stepwise one after another:

- The **design model** represents the game concept as intended, including its goals, representations and internal relationships for the system
- **User's model** is the player's anticipated reaction to relations in the game, the ways he/she interprets systems events and responses and the messages he/she takes away after playing
- The **System image** is the actual interface between the system and the player. At any particular moment it is responsible for conveying key takeaway concepts to the players, as well as for collecting all relevant player feedback in order to adapt the gameplay.

A sketch of the discussed design follows.

6High Concept of the Game

In order to allow easy entrance in the game, the game matter is chosen to be something people are used to. An industry, such as the clock and watch production has widely evolved in the centuries. It has long tradition and at the same time has endured the industrial and semiconductobr revolutions. The proposed game involves the management of a clock production company. The players should be able to choose to play in any period between the end of the Renaissance and the end of XX century [Costa 2007].

6.1Design Model

Players are responsible for putting together their **production lines**, install machinery or hire personnel as described. They are also responsible for provision of material resources and distribution of production. This is described in use case diagrams on figure 2. Players are given predefined processes for different kind of clocks. Players can also choose which process to embrace, thus choosing the kind of product they are constructing and the resources they need, as can be seen from figures 2 and 3. Initially players are not allowed to make some kinds of watches (e.g. electronic) and need to wait for the required technologies to be invented. When having defined their construction processes, players can configure which tasks are to be implemented as a sequence of batch-wise operations, which are dedicated continuous production lines and which outsourced. Each task is related to its direct and indirect costs, as well as operational and service time. For the purposes of outsourcing beyond current contracts, there need to be also futures.

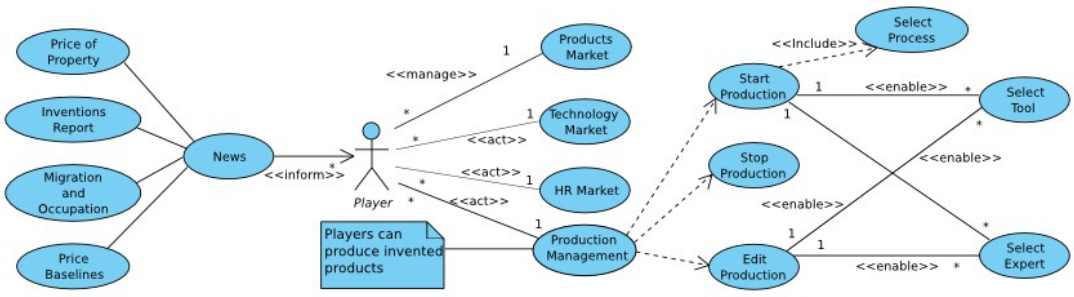

Figure 2: Game Turn Use Case Diagram

Tools and personnel (taxonomy on figure 3) are work resources that can be managed separately. Players buy, sell, upgrade and dispose machinery in order to build and improve their production lines. Tools are constrained to match only

particular tasks. Once set up, these machines can significantly automate the production process and improve quality of the product, but also require special attention from skilled personnel. Employing the proper workforce can drastically improve the value of a single product and reduce breakdown rates of machines. Players can opt to train their workers to become experts in some specific tasks. Experienced and skilled employees can contribute to the introduction of new products by increasing the speed of deployment. Any expert is able to combine specializations as in Colonization. Experts have an improvement factor and both experts and tools have defects rate associated. The improvement factor of workers plays a role on the speed he/she gains experience.

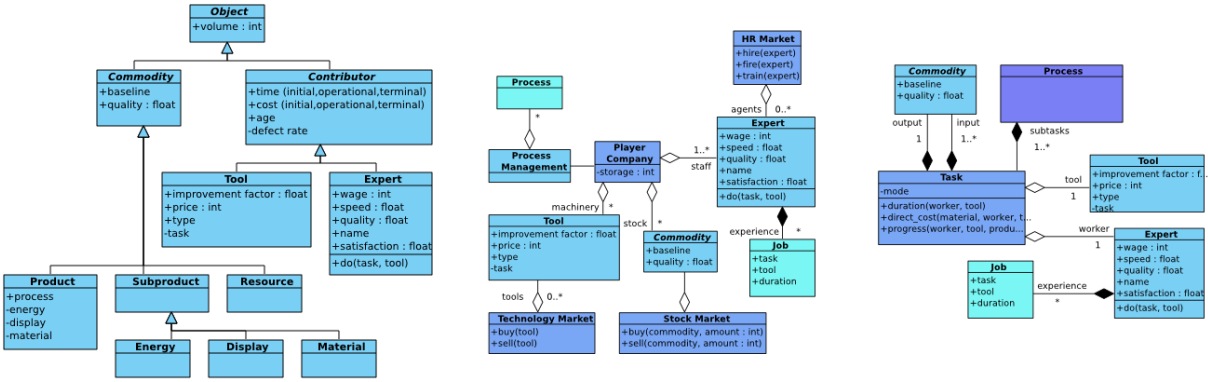

Figure 3: Game Objects Taxonomy, Game Structure and Production Management Class Diagrams

As a result of the choice of employed process and resources, certain derivative quality variation among similar products occurs. These derivatives also influence the final price of the product, adjusting the current price on the market. Factors in price forming are volume, quality and type of commodity.

Each worker, machine and commodity uses particular **storage space** that needs to be provided by housing. Space is measured only by capacity as is done in Colonization and StarCraft. To avoid further complexity, housing needs are reduced to providing a single building to serve all these needs.

Temporal and technological development is similar to Civilization and Colonization. Technology tree is projected to the timeline, since the player has no influence over the process. Technology is one of the drivers of the storyline.

6.2User's Model

The player starts the game with his/her own character – a skilled professional, like in Jones.

The game develops in **turns** and each player has sufficient time to actually do everything intended – figure 4. When all players are ready, they indicate that the turn has ended. The environment – supply and demand for resources, production and personnel, as well as technologies and competition evolve in a discrete time steps with each turn.

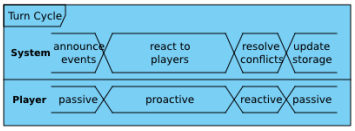

Figure 4: Game Turn Timing Diagram

Clock/Material	wood	metal	plastic	stone	software
Mechanical	-	+	+	-	-
Sand	-	+	+	+	-
Electronic	-	+	+	-	+
Network	-	+	+	-	+
Sunlight	+	+	+	+	-

Figure 5: Raw Resources to Products Relation

Players are provided a parallel view of both commodities and processes, which should hint them that both are factors in the decisions what to produce and what processes to employ. The **production** process starts with raw resources. These are commodities that can only be obtained from the market. It goes through subproducts that can be produced, sold or bought and finally reaches end products – clocks and accessories. An example of possible dependencies between raw resources and products is illustrated on figure 5. Players can also choose what machinery and personnel to employ for each single task and how to spread these resources between tasks over time as this is done in Colonization.

6.3System Image

As the game is turn-based (figure 4), at the beginning of each round there is a **news** announcement (newspaper, similar to the one seen in SimCity or Jones in the Fast Lane). Changes in markets at each turn are decided randomly, but heavily biased towards the storyline

In order to avoid further complexity outside of the main focus, players are set up to operate in a single location. Nevertheless there are **different markets** for commodities, tools and experts. These are represented as databases of buy and sell offers. The players can respond to any of these, as well as announce new ones. When a response to an offer arrives, the player can finally decide whether it is suitable for him/her or continue to seek better conditions, including bargain. This holds not only for different stocks, but also for technologies and personnel. Training personnel is also a service provided by the market.

In order to provide a fully functional market even when there are only few players, **artificial players** need to be introduced. Thus the challenge of competition should be present even in games with one player. Artificial players are supposed to have the same capabilities as human players, but their behaviour is to be influenced by the storyline as they are supposed to serve as one of the channels the environment uses to impose the game story. Another kind of actors present in the game environment are dummy players. These are market participants that provide boundary commodities (i.e. sell resources and buy end products), as common players have no means to provide these. Dummy players are not constrained by the market and their behaviour is determined only by the storyline. Part of those are travelling traders that give players access to a global market, so demand and supply are not limited to a small community. Guidelines for the amount of artificial players, depending on actual players are given in appendix 1.

Adoption of common visual symbols and context-driven user interface and other such techniques should be used in order to make player entrance, immersion and focus easier [Dalmau 1999].

7Player Experience

The game is intended to serve as a hands-on tool to help players understand production management. One of the most important aspects for its playability and

attractiveness is to have a neatly modelled storyline with nice sense of humour. The start of the game should be extremely simple and complexity should emerge gradually to allow players easy entrance in the game. On the other hand any unnatural market fluctuation may result in misleading threats or opportunities. Thus it is very important that these are carefully maintained and updated even after the game release.

Choosing to develop the game in turn-based mode allows the players to carefully consider all options at hand and draw conclusions. The players need this in order to be able to find their approach to technologies, personnel and markets and get most of their business. In this the game is similar to games like Civilization, Jones In the Fast Lane, Colonization and BBC Climate Challenge. The game environment takes care that players are put in a context where natural laws continuously hold and directs players toward formulating their own learned lessons. The game can be viewed as classical business simulation, - players are put in a free market environment and have to develop their own business.

Three sample player scenarios are given in the paper to demonstrate the playing experience and the learned lessons from it.

8Future Work

As a form of evaluation of the approach, questionnaires are to be distributed to selected pools of university teachers and to game developers. The first group will be questioned about acceptance of learning goals and their projection in the game design, the second survey will be targeted towards the levels of enjoyment and immersion of the proposed design. The results will be included in the presentation of the paper.

The simplistic game model provides a liberal market environment that gives ways to complicated business strategies. A research on possible cooperative business strategies and tools that could help such processes could shed more light and help stimulate cooperative thinking.

As in recent trends in game development, this design is not something that stops to be developed once it is released. Although the game framework is then fixed, the actual game model is intended to be under continuous refinement by adjusting parameters according to feedback from played games. Tweaking the parameters that define the storyline (as for example market's reactions to some behaviour and resulting situations) should make possible imposing entirely new and previously unplanned learning goals, as well as making less attractive unwanted (e.g. immoral) business decisions, similar to the way disasters punish immoral actions in SimCity.

Finally, other models can be added, possibly combined with removal of currently included models to preserve simplicity. Business aspects that could be included are R&D, marketing and logistics. The personnel improvement factor model could be further expanded to match the theory of multiple intelligences [Gardner 2006] and influence worker learning, productivity and innovation. Another option for making trade more enjoyable is to introduce dialog-based negotiation [Ruskov 2006].

9Conclusion

The hereby presented paper marks one possible simple approach how to examine and study some issues of interest in production management with educational games, based on successful entertainment games. The paper only sketches the way

for a joyful and immersive design. The concepts here need to be further developed in order to make a game that can be comparable to state of the art entertainment games. The actual software implementation may differ from the model for technical purposes.

Successful examples show that game design is both an art and a science. Trying to find an optimal balance between learning goals and attractiveness is very difficult and hard to quantitatively measure at the design stage. That's why at this stage the value of the design needs to be evaluated subjectively by prospective stakeholders – both in academics and industry.

Appendix 1: Game Size

Human Players	Artificial Players	Dummy Players
1-3	2	1*
4-8	3	2*
9-30	10	5*
31 and more	0	8*

Table 1: Recommended balance between human and AI players, according to game size.

* For each role, some might overlap

The design itself is scalable and needs not adapt to number of players, the necessary storyline changes could be implemented in the predefined behaviour of artificial players. Apparently when the game size grows toward massive multiplayer game, it is extremely difficult to impose story via market trends regardless of number of artificial players, since human players will have enough critical mass to determine market prices.

Appendix 2: Sample Scenarios

1. 1 Player - The Swiss Workshop (mostly story)

A single player is put in the role of a small Swiss clockmaker. The player's character is very skilled in hand-made watches, so his manufacture naturally starts with assembling final products. With time the player hires apprentices to train them and to let them specialize in other fields. He maintains working with end products, utilizing his craftsmanship to adopt new technologies. At the same time each of his employees starts to build their own experience and specialize in some field, according to the master's will, which on the other hand is influenced by the demand. The manufacture keeps growing with major focus on craftsmen until the start of industrialization of clock making. With the industrialization and later globalisation processes going forward, the player finds himself forced to start adopting continuous production and outsourcing in order to meet the market demand for ever decreasing prices. At the same time he continues to occupy the traditional niches of hand-made watches, which keep constantly diminishing.

In this scenario the player can learn that while the biggest advantage of small businesses is the flexibility that results from batch production, this approach raises enormous difficulties for larger enterprises that deal with large turnover and feel a squeeze on profit margins. Managing to achieve a proper balance between flexibility and scale could give crucial competitive advantage to companies.

2. 4 Players - Family Game

A family with two children starts playing a game together. The children have played numerous times before, so they have empirically developed winning strategies. They produce batch-wise and only in isolated cases of continuous production and outsourcing when this is sure to pay-off. Since they are familiar with the development of the particular storyline in advance, they react very timely on new inventions and market fluctuations. Parents on the other hand have their preferred approach that appears to work regardless of specific events. The father is a fan of antiques, so from the very beginning of the game, he builds his production processes around traditional markets and trains his personnel to be extremely skilled in that whole area and gain relative independence in his production. The mother on the other hand observes other player's behaviour. She does not take risks, but is structuring her business so that she can deliver anything on the market that is in shortage and thus

has higher prices. Although not focused, this approach allows her to be able to fit in and fill in the gaps of any segment, often forming short-term partnerships with other players and balancing the market.

One of the lessons of such a game is that on a market that is not being squeezed by extreme competition, there are niches for diverse business models. As a side effect people could see the expressions of their personalities through their behaviour on the market and how they react to the social side of the market.

3. Massive multiplayer game - Battle for the World (mostly simulation)

A group of students from a business course join an existing massive multiplayer game. They have previously agreed to form a cartel, each of them specializing in a particular task. Part of their tactics is to adopt an invention, made close to their entrance in the game, in order to approach a market segment that is not mature already (in terms of optimised processes of competitors and tight profit margins). Their initial agreement includes always preferring to trade with teammates compared to other players and that their main strength is continuous production lines with accumulated experience. The plan starts well and the cartel very easily captures the majority of the market segment. Due to mass production techniques, both production costs and end product market prices fall. As a result all the players manage to accumulate good profits and steadily start expanding their business in other market segments. One of the team invests his whole profit in a market, where the competition squeezes his new business. The rest of the cartel supports him by temporarily providing goods at no profit and buying production at higher prices as much as the markets allow it. However this appears not to be enough and the new endeavour continues to slide in a turmoil that results in the player's bankruptcy. Having lost part of their production chain, the rest of the group cannot replace it at a cost, acceptable to the market. This results in enormous surplus of components on one side and shortage of low-cost parts on the other. The cartel is broken. The group has to search for new niches.

In contrast to previous scenarios, this case demonstrates a market with very harsh competition. Entrants here need to form strategic partnerships and prepare risk management plans. In such environments theoretical background and cooperation become a critical success factor.

References

J. Cassina, M. Oliveira, M. Taisch, Development of a Virtual Businees Environment for on line business gaming, 10th International Workshop on Experimental Interactive Learning in Industrial Management, Trondheim, 2006

D. Cook, Evolutionary Design: A practical process for creating great game designs, lostgarden.com, 2002, http://www.gamedev.net/reference/articles/article1661.asp

A. Costa, History of Watches, Clocksonly.com, 2007, http://www.clocksonly.com/watch_history.html

C. Crawford, The Art of Computer Game Design, McGraw-Hill Osborne Media, 1984

D. S.-C. Dalmau, Learn Faster to Play Better: How to Shorten the Learning Cycle, Gamasutra, 1999, http://www.gamasutra.com/features/19991108/dalmau_01.htm

D. Dobson, K. Forbus, Towards articulate game engines, 1999 AAAI Symposium on Computer Games and Artificial Intelligence, 1999, http://www.lggwg.com/wolff//aicg99/dobson-forbus.html

B. Edwards, The History of Civilization, Gamasutra, 2007, http://www.gamasutra.com/view/feature/1523/the_history_of_civilization.php

H. Gardner, Multiple Intelligences: New Horizons, Perseus Books Group, 2006

K. Gillen, Social Game, not Social Life? ArenaNet on Guild Wars and the "Casual" MMORPG, Gamasutra, 2005, http://www.gamasutra.com/features/20050330/gillen_01.shtml

G. Howland, Game Design: Immersiveness, GameDev.net, 1999, http://www.gamedev.net/reference/articles/article262.asp

B. King, The Simple Games People Play, Wired Magazine, 2001, http://www.wired.com/gaming/gamingreviews/news/2001/12/49151

F. D. Laramee, The Game Design Process, GameDev.net, 1999, http://www.gamedev.net/reference/articles/article273.asp

H. H. Moraldo, Fun factor for game developers, Pixelate, 2001, http://www.gamedev.net/reference/articles/article1828.asp

A. Rollings and E Adams, Andrew Rollings and Earnest Adams on Game Design, New Riders Games,

2003

M. Ruskov, P. Ruskov, Negotiation design pattern for serious games, 10th International Workshop on Experimental Interactive Learning in Industrial Management, Trondheim, 2006

S. Carless, Interview: Bruce Shelley – The Mythology of Empires, Gamasutra 2003, http://www.gamasutra.com/features/20031126/carless_01.shtml