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Az ellátási lánc menedzsment gyakorlat orientált oktatása
Practice oriented education of supply chain management

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Introduction

The role of logistics is really important in the life of enterprises. The large amount of costs came from that field and the efficiency also highly depends on it. In the globalised world cooperation is indispensable, mainly inside the supply chains. It causes that the importance of supply chain management highly increased.

We can find lot of books and studies which deals with supply chain management. The theoretical background is quite large and deep. To learn these are useful because we can find answers to a lot of question, but it is not enough. The theories are not always the same as the really life situation. Simulation and modeling can bring closer the theories to the real life situation. It can teach the students how does really life communication work, which fields are really need high attention.

In the supply chain management game based learning can be used in beer game. It can show the main characteristics and the principals of operation. It brings the bullwhip effect closer to the students, they can see and experience also why it is formed and how can they deal with it. They can study how the costs changes according to the stock, inventory and backlog. They also have opportunity to try different supply chain models.

In this report we introduce the different decision-making theories, their use in supply chain management and we also introduce the different game theory models. A correct decision-making is very important not only during negotiations with suppliers and distributors but also to construct the right order strategies. Knowing different strategies may help making decisions well and later utilize our experiences.

In education the decision-making theories and game theories get only little emphasis, however students have to know how to react in different lifestyles. In this part of the thesis we introduce the different theories and we write how to use them in higher education

In this report we show how these theoretical things can come in to practice and we also present how candidates can profit of game based learning. The structure of this text will be the same as the structure of the semester, so it is really adaptable for a real subject.

First week: Supply chain management

In the first class the teacher have to tell the main goals of the semester. He also has to show the requirements. In this course the students have to actively participate on classes it means 10% of the grade. They also have to make the homework week-by-week, which means 34% of their grade. In the semester they will work with two big topics: supply chain simulation and inventory strategies and decision making and game theory. For the last 56% of their grade they have to write two short reports. In this report they have to sum up what they learned about each part. The deadline of these tests is the 13th week.

Supply chain

Supply chain is a complicated and complex network of companies. Inside products, services and information flows upstream and downstream. The supply chain management's task is to coordinate this difficult cooperation. The main goal is to reach the customers satisfaction, gain competitive advance and reduce cost in the same time. In this cooperation we can find various companies with different connection and power. The dependence is also diverse between them. It is a dynamic system which has to adapt to environment really fast. (Seyda, 2012)

The hardest thing in this network is the common and individual goals. The enterprises are individuals, and all of them want to reach as high profit as possible. But they also have connection with each other and make decision in different level. Numerous researches showed that the cooperative supply chains can reach better performance. This collaboration needs a common management system, as an integrated part of the chain which goes for the universal goal, to reach the best possible performance.(Seyda, 2012)

Handling supply chain is important, because market is changing. The sold product is important, but we can find a lot of product or service which can replace ours. Now the emphasis is on the quality and price. Price can be reduced if the members of the chain work together. Nowadays the competition is between whole supply chains in formal or informal ways and not between single companies.(Farahani, Rezapour, Drezner, Fallah, 2013)

The main goal of this class is giving theoretical knowledge with practical methods. When we start this course it is important to clear up the basics of supply chain management, because the whole semester based on this topic. In this class students can meet with the main definitions and also with beer game.

Paper based beer game

Student in this class can try a role in a supply chain. They can be a retailer, a wholesaler, a distributor or the factory. They have to learn the main rules of the game which are the followings:

- Information can't flow in the chain.
- For the factory the manufacturing of a product takes 3 round
- Stock and backlog cost money (1 \$ for stock, 2\$ for backlog)

In the first class the students can play the simulation in paper format. It is a good start because they have a possibility to check their previous rounds, and this way they also can see the consequence of their decisions. Before the game they have to know the meaning of the column. They have to write down the amount of stock, shortage, incoming order and incoming product and the delivered and ordered amount.

Figure 1.:
Paper based beer game

Csoport/Group:



Rendelés/Order
Sör/Beer

Kör Round	Raktáramban van In stock	R rendelt tőlem R ordered	Kiszállítok R-nek Delivered to R	Hiány Shortage	Megrendelek D-től I order from D	D beszállít nekem D delivers to me
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
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11.						
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24.						

Forrás: Szander Norina (2013): Applying Balanced Scorecard measurement system in BeerGame environment. szakdolgozat, Széchenyi István egyetem, Győr

After this they can test themselves in the game. They will see in the end that keeping costs in a low level is not easy, mainly without communication. They will recognise that the operation of a chain is really complex and complicated.

For the next class they have homework. They have to count the costs of the members of their chain and the whole chain. This shows them that efficient work of a chain depends on every person, and to reach the minimal cost they need to pay attention on the others not only on themselves. In the class the game is played on several groups which mean that they can compete with each other. It shows efficiency further. The other part of the homework is to try to find the causes of the backlog and the fluctuation of inventory.

Second week: Bullwhip effect 1.

The second class start with the conclusion of the first. The students make their short presentation of the homework and they show their remarks of the game. Their result will show if they understand the first class properly or not. In this week they can get a tool for a proper analysis. They can study which are the most important fields.

The second week will show the cause of the problems in supply chain. The main goal of this week to teach the students what is the bullwhip effect, and also the causes of this phenomenon. In the beginning of the class the students can show the causes what they found out, after during the class they can complete it.

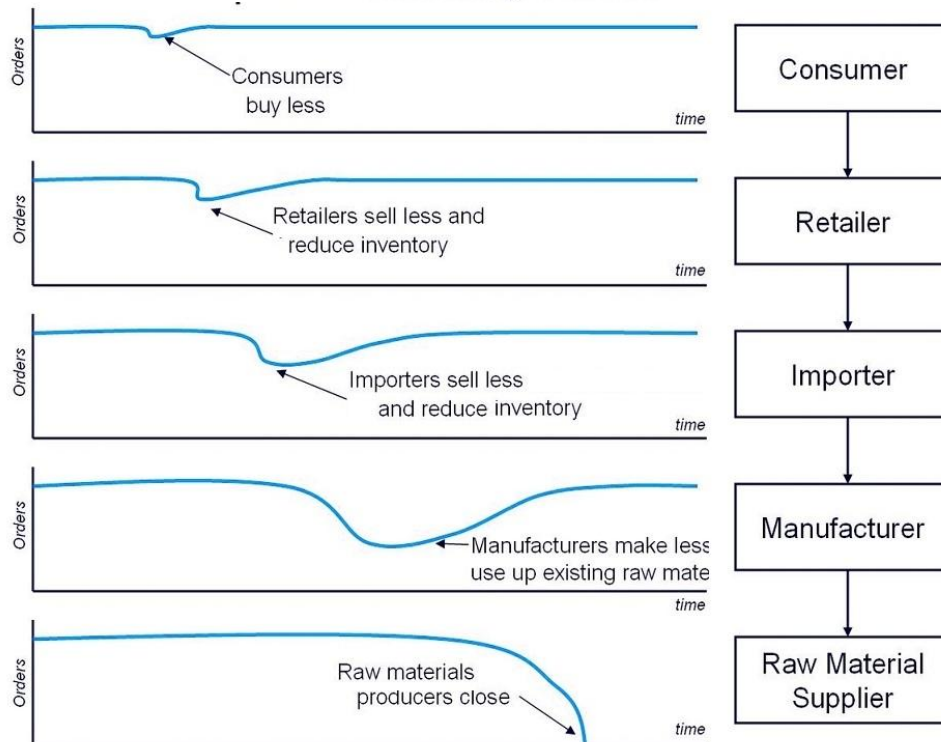
Bullwhip effect

The phenomenon was firstly recognized by the Procter and Gamble. They examined the selling of Pampers and noticed fluctuation in sale. The consumption was relatively permanent, but the retailers order was not constant. In the level of wholesaler the difference was higher. According to the data they determined that moving forward in the chain the demand fluctuation is become higher and higher. This effect makes the supply chain instable. (Hau, Padmanabhan, Whang 1997)

In different articles and reports we can find a lot of different definition of the bullwhip effect. One of the definitions is based on a variance of order and demand. It says that we can count the bullwhip effect by dividing the variance of order with the variance of demand. In this case if the result is 1 there is no variance amplification. If it is lower we can't recognise bullwhip effect, but if it is higher the bullwhip effect is exist. (Oyatoye, Fabson, 2011)

The following figure show how the bullwhip effect appears in the supply chain. We can see the growing fluctuation.

Figure 2.:
Bullwhip effect
Bullwhip Effect



Source: <http://bizdiagram.com/>, letöltve: 2014.03.29

After this class the students will be able to draw up their personal definition of it. They also can decide if they experienced this effect in their chain or not.

Causes of bullwhip effect

The causes of bullwhip effect are also the topic of this class. These are the followings: (Hau, Padmanabhan, Whang 1997)

- **Demand forecast updating:** Every member of the chain make estimation, which are usually based on the experiences. That is also effected by several other moments, like information flow from upper or downer links or the level of trust against the partners. In addition they are count with security stock. As a result the lower links real demand will be different from the given member of the chain.
- **Order batching:** Each company of the chain place and receive order. Demands come in and the inventory decrease. The company can send the order for the replacement of inventory directly to the supplier, but it is not common. Often they wait for larger amount of demand before ordering. Companies mainly order in weekly, biweekly, or monthly periods. The cause of this method is that suppliers

can't handle frequent ordering, because of the time and cost factor. But the weekly or monthly ordering also hard to the supplier, because the ordered amount is big.

- **Price fluctuation:** Because of the discounts the 'forward buying' is really frequent. This means that the companies buying product in larger amount and they don't follow the real change of demand in lower positions. Beside the quality discount other price fluctuation is also frequent. In the chain when the prices go down, every member try to make stocks, and when it is go up they use the previously bought ones. That means that real needs and order is not on the same level.

- **Rationing and shortage gaming:** We talk about this for example when the demand is higher than the supply. In that case the manufacturer can determine the price and also can decide which demand will be fulfilled. That's why the customer's order larger amount than the needed and the real demand and order will not be on the same level.

The mentioned four points can be completed with some others, which are the followings: (Ranjan, Susmita 2010)

- **Lead time:** The ordered amounts are not the same which generate variable lead time. These changes generate bullwhip effect because they are uncountable.
- **Fear of shortage:** Every company as a main goal try to fulfil their customers demand, it can be done only if they have the proper amount of goods. Therefore the increase of order fear the supplier and they will keep larger amount of stock.
- **Inventory policy:** The proper inventory policy is necessary too. The company need to properly coordinate the stock and plan the orders. If they do not pay attention in this they will not be able to react to the changes fast.
- **Number of echelons:** Bullwhip effect becomes harder if the number of echelons grow. We can recognize a multiplier effect. It can be harder if the inventory strategy and the delivery conditions are not harmonised in the chain.
- **Lack of transparency and improper control system:** If the processes are not organised well the cooperation is impossible. It needs transparency, control and consistency. Share of information is needed because without it the real solution of problems will not come out.

- **Misperception of feedback:** It can result too high or too low stock level, which makes a company inflexible.
- **Local optimization without global vision:** This is also connected with the share of information. To work efficiently the companies have to make decisions which are the best for the chain and not for one member. Without this global and local points can be different.
- **Company processes:** The performance and reliability of machines change in time, therefore the quality of products also can change. Continuous development is necessary. It is also important because of the adaptability.

We can see these causes in the simulation too. In the examples of the previous class we can examine that if the players don't have a common strategy a little change in incoming order will grow up to higher amount in the outgoing order. So because of the expectation and estimation the stock and the real demand will separate. Order batching is also observable in strategy less simulations. We can see that the chain members make a specific amount of stock and later they let it get in a lower level. They mainly try to keep their stock between a personal minimum and maximum amount. But when the customer order changes the companies change strategies, and make larger stock. It is also related to the shortage gaming and fear of shortage because the first priority is the customer for every member of the team and growing stock make the links to hold greater stock. After the first backlog in the chain the fear of shortage became greater because the lead times are also growing.

The transparency is really important in the simulation. The students need to know which personal or common strategy they follow, and they also need to know which steps did they took in the previous rounds. It is necessary to keep the stocks and backlog in the lower level. This is also a kind of control above their job. Feedbacks in simulation come out with the delivered amount. The members can conclude to the position of higher member. If their demands haven't been fulfilled, the other member has backlog.

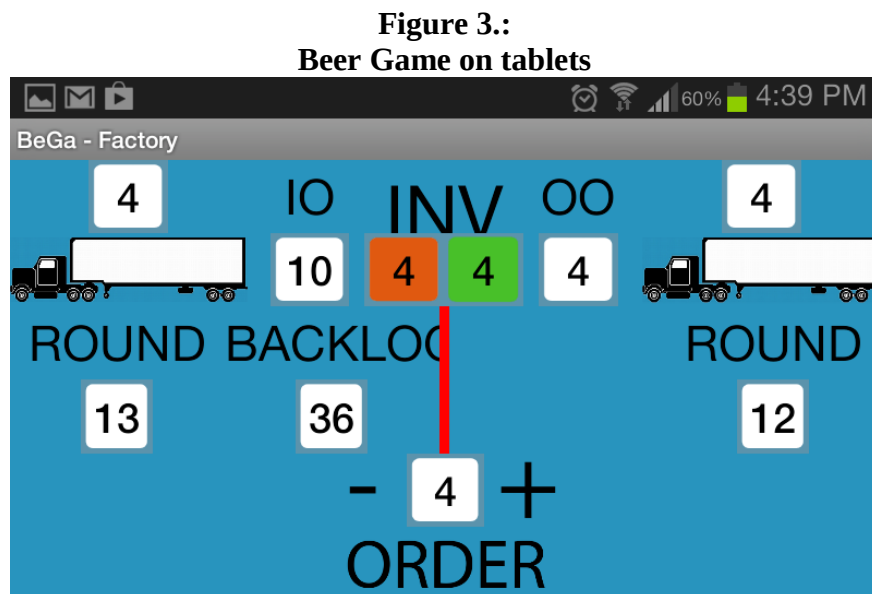
The local and global vision is also really exciting in the simulation. In the local aspect everybody try to fulfil demands and keep low stock and backlog. But if one of the members get backlog and can't deliver properly the personal vision (and fear of backlog) make the member's order higher to get the needed amount. This generates bullwhip effect in the chain because the real demand and ordered amount move apart.

This is useful because the students know the simulation which they tried and these causes get really close to them. They will understand them in practice, and they will also get

to know the proper theoretical background. In the class they can analyse in groups the causes in their results.

Beer Game application

After they cleared up the causes the students try the simulation on tablets, but for this round they have a common strategy. All of the members have to order the same amount as the previous player during the game to simulate the market driven policy. The teacher introduces the beer game application the class. It will be understandable for them because they know the main structure of the game, and the goals too. They just need to know what the buttons mean. The screen shot of the application based game can be seen in the second figure. In the screen they can see which round they are in, the amount of inventory, the incoming and outgoing order, the backlog. They can change the amount of order too.

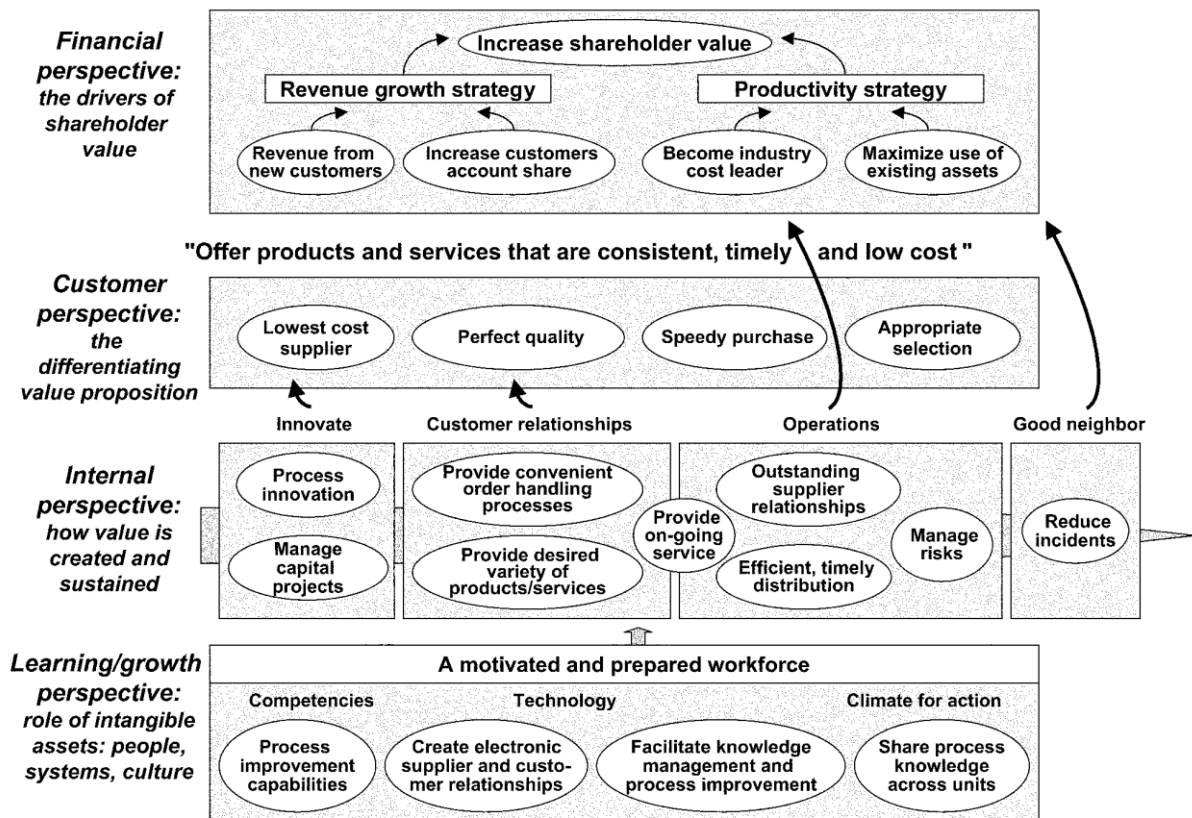


Source: screen shot, Beer Game

Balanced Scorecard

After the discussion of causes the teacher shows a possible evaluating system for the students. The following figure introduces the Balanced Scorecard performance measurement system:

**Figure 4.:
Balanced Scorecard**



Forrás: André A. de Waal, (2003) The future of the Balanced Scorecard: an interview with Professor Dr Robert S. Kaplan, Measuring Business Excellence, Vol. 7 Iss: 1, pp.30 - 35

This system is the Balanced Scorecard. In this method we can separate Financial, Customer, Internal and Learning perspectives. (de Waal, 2003)

- **Financial perspective:** Fast and punctual details about the costs. In the class students can count the following in this category: total amount of backlog, cost of backlog, cost of inventory, total cost, average cost.
- **Customer perspective:** The customer will buy the products, he has a high impact on the manufacturing so we need to take into consideration. The students can count in this factor: amount of backlog, maximum amount of backlog, lead time, average lead time, and average backlog.
- **Internal perspective:** This factor is about the company's internal problems and dysfunctions. The students can examine the capacity utilization.
- **Learning perspective:** This category is about the connections, networking and possible development. The development is based on learn, so the students can examine this. They can examine how the members react on backlog. They can

also examine if this changes in time or not. If the members work in a different way after gaining practise or not.

In the end of the class students get the excel file of the game. For homework they have to look through again their results from the first class and they have to try to find the learned causes (find out the causes which is present in their scenario but they didn't found for this class). They have to check the new results too and compare them. They also have to search results (in each strategy outcomes or in the comparison), which they connect to bullwhip effect. In the homework they have to use the learned procedure (BSC).

Third week: Bullwhip effect 2.

The class starts with a discussion of the homework. The students can show their results again. They have to tell which conclusion they have and which causes did they found in their chain. They also can show which numbers or changes they consider to the result of bullwhip effect.

Results of bullwhip effect

The bullwhip effect can have several results, which are the followings: (Szegedi, 2012)

- **Large amount of stock:** It can pile up because of the estimations. The orders based on estimation generate higher stock and the fear of shortage too. It has a multiplier effect too because every member wants to have enough stock to serve the other and make a little bigger stock, this generate false orders and in the end of the change it will be not just a little larger amount of order but really different and has nothing to do with the customers original order.
- **Inefficient usage of resources:** The demand is not permanent, so the company can use the resources permanently. The amount of order getting higher and suddenly it get lower again. The fluctuation generate loss, greater fluctuation generate higher loss. If a company settle for the high demand when it get lower they can't fulfil the requirement, but if they settle for low demand they can't produce enough when the claimed amount grow.
- **Growth in the cost of delivery, storage and other logistic stuff:** Fast changes in storage make the delivery more expensive. Higher stock also makes the cost higher in addition the probability of damages has also grown this case.
- **Decreasing level of customer service:** The manufacturers can plan completely the manufacturing procedure. This generates long lead time but the customer got used to fast service, and won't wait long time for the product.

All of these results can be experienced in the simulation. With uncoordinated supply chains the information can't flow and the companies can't synchronize their work, delivery policy, inventory strategy. In the end this means growing costs.

In the class the teacher can point this results and they can discuss how the student see it, which one was discovered by students in the homework, and which one was not discovered by them at home.

After the discussion of causes they can play a scenario again, but with a different strategy. In this case every member of the supply chain has to order the same amount. The ordered amount depends on the group. They can count out which number they consider the best.

For the next class the homework is to summarise the causes and results (using the 3 tested scenarios) and build the studied new knowledge inside the analysis. The other homework is to prepare for the next class with searching possible solutions of solving the problem of bullwhip effect. In addition they have to try to find methods to put these solutions in the simulation.

Fourth week: Bullwhip effect and supply chain models

In the beginning of the class the students have possibility to tell what they think about preventing, eliminating or cancelling the problem according to their experience. The class can try to collect all of the methods together.

Solutions of eliminating bullwhip effect

The main methods for eliminate the bullwhip effect are the followings:

First of all the **information sharing** is a possibility. Which means that information are transparently shared between the members. It is a hard question because supply chain member not only have common goals but also personal goals. They would like to maximize profit and don't really care about other companies. But the competition today is between supply chains and not between individual companies, therefore they need to gain efficient work together and this need compromise. It is mainly important for the retailer and the factory. The factory need to know the main information about the customers demand and changes and the retailer need to know if the manufacturing have a problem, and the product not arrive on time. (Gürdal, Emere, 2008)

Transparent information sharing can't be easily done in the real life and also in the simulation. Beer game has a regulation that the members can't talk to each other, but it is not make it impossible. Harmonisation can be carried out by common strategies. The basis of the strategy can be anything for example the aimed level of inventory, the ordered amount, or the maximum backlog etc. The students could try some of these common strategies, so in their results they can see if they could eliminate the effect or not.

The other solution is to **reduce the member of the supply chain**. In the simulation it can't be shown but it is an important possibility in real life situation. In this case the customer and the manufacturer is in direct connection or there is only a few intermediate company. In this case the members don't need to keep a large amount of stock because the manufacturer knows the real demand of the customer. This method is efficient only if the members not base their strategies on estimation but on the real demand. In this case the level of customer service will also grow. (Szegedi, Prezenszki, 2003)

In a reduced and harmonised strategy the **cut back of time** is a possibility. The members can base their operation in the real demand, they do not have to keep so much stock, the turnover of the stock will be also faster. The customer service becomes faster and cheaper.

It is important because it helps to be competitive in two aspects: time and cost. Of course to start this operation the chain has to invest money to make a proper system of sharing information, but in long term thinking this is the only possibility in the high competition. The harmonized system also works more flexible and reacts quickly. (Hirkó, Bikás, Bajor, 2008)

In the simulation if we allow the flow of information the customer satisfaction will be also higher. In this case the estimations will be replaced by real demand and there will be no or only a little and short duration backlog.

The fourth possibility to reduce the effect is **the smoothing replenishment rules**. These rules are based on periodic control of stock. In this strategy the order is smoothed via proportional controllers. The cause of this policy is the limitation of over reactions or under reactions according to the fluctuation of demand. In this strategy according to the inventory the ordered amounts are regulated. The main advantage of this model is the possibility to eliminate bullwhip effect and reduce inventory costs in the same time. The disadvantage is the nonflexible work which slows the reaction down. (Cannella, Ciancimino 2010)

In the game there is also a possibility to simulate this. The students can make regulations about the amount of stock, or the possible ordered amounts. They can make a common strategy which is obligatory for the whole chain.

Supply chain types

According to information sharing and number of links in the chain we can examine different types of supply chains. These types are the followings: (Cannella, Ciancimino 2010)

- **Traditional Supply Chain:** there is no harmonization and communication in the supply chain. The members make their strategies alone and consider only their needs. In this case the efficiency of the chain is not important just the self efficiency.
- **Information Exchange:** The harmonization is planned, but the orders are not depends on the other members. They only make long term cooperation.
- **Vendor Managed Replenishment:** In this case the harmonization is based on the inventory. The supporter takes the responsibility to maintain the stock. In this case the amount of stock can grow only limitedly.
- **Synchronised Supply:** This is the highest level of cooperation. The members work together from the planning to the registering. The supplier responsible in an operative level for the inventory replenishment, it plans the delivery tasks

transparently. The members can maintain individual strategies but they have to adjust to the main strategy of the chain. The result is the total transparency, which helps to adapt to the changes of the customers demand.

If the students keep the rules of the beer game strictly they behave as a traditional supply chain. They don't play for common goals and they don't share the information. The information exchange supply chain can also simulate with common strategies. For example the members have a common maximum inventory. Vendor managed replenishment based on harmonised inventory. In this case the harmonisation is deeper and the connection between the members is stronger. The synchronised supply chain with total transparency can't be simulated in beer game.

This class is mainly theory based. After the discussion of the homework the main part is a kind of brainstorming about the possible solutions. For the next class the homework is to look for inventory strategies and also to try to find out how can it be used in the simulation.

Fifth week: Inventory strategies 1.

The class start with a discussion about the homework. In this part the students collect all the solutions they found and also the beer game simulation possibilities of them. After that the teacher completes the list of theories and also explains the main characteristics of the mentioned strategies.

Theoretical background of inventory strategies

We can distribute the inventory strategies in three groups. One of them can be easily determined, because changes of demand are periodic and countable. These are the static models. We can plan easily, we only have to examine one period and it shows the whole method. The other group contains finite number of periods. In this case we don't determine the optimal point of each period, but we determine a barrier of demands for the all periods (for example: we can order every week for the following week or in every half year). These models are dynamic models. To solve the problem of the second group is harder, the algorithms are more complex and complicated. We need to use proper computer programs to clear up the problem. The third model is the stochastic model, it is useful because the customer demand can't be augured properly, the effect of the unexpected is really high. (BME: Termelésmenedzsment, Készletgazdálkodás)

Inventory strategies

Inside these categories we can find a lot of strategies, because there are a lot of feature which can be changed and also of course a lot of combination. If we make models all of them has the same beginning: we have an inventory level at time 0, in time our stock start to decrease and the demand of customer changes in a stochastic way. The main models are the followings: (BME: Termelésmenedzsment, Készletgazdálkodás)

- **s, Q strategy:** When the amount of stock arrive to a critical number (s) which is determined in the beginning the company need to order a quantity (Q) which was also determined in the beginning. This order is sent automatically so we call the s point order point. When the supplier delivers our stock goes up and this period starts again. In this case we need to follow up the stock carefully. We can find this system for example in supermarkets. In this case we have to

determine the s and Q point properly. (BME: Termelésmenedzsment, Készletgazdálkodás)

This model can be played in the simulation. In this case the members define the critical amount of stock and the quantity. They have to figure out which numbers are the best. To find a best solution it can be played in several groups and different numbers, because in the end they can compare the results.

- **R, S strategy:** In the other case we have a total stock (S) and in the beginning it is fulfilled. In time this amount starts to decrease. We don't have a continuous control, we just examine the inventory in certain time (R). During the examination we count the sold stock, and order the sold quantity. After the supplier delivers this order our stock will be again almost equal as the total stock. (BME: Termelésmenedzsment, Készletgazdálkodás)

In the simulation the total stock has to be determined by the teams, and the examination period. For example they can consider 12 as total, and they can examine in every second round.

- **EOQ (Economic Ordered Quantity):** It is a simple model of inventory strategy. It has some clauses: the demand is permanent, the ordered things arrive in the same time (so the delivery needs 0 time), every demand is fulfilled, cost of order not depends on the ordered quantity and the cost of inventory is proportional with the purchase cost. This is the deterministic model. The stock decreases consistently and when it runs out we order the same quantity as the starter stock (Q). This method goes continuously until one of the parameter changes. To optimise this method we only need to determine the Q properly. If we would like to reach an optimal Q we need to count the Total Cost. Total Cost contains order cost (cost of order multiplied by number of order), purchase cost (demand in a period multiplied by purchase cost) and inventory cost (stock level multiplied by inventory holding rate multiplied by purchase cost). To optimise this equation we need to derive it, and make it equal to 0. As a result of the equation we can get the optimal Q . (BME: Termelésmenedzsment, Készletgazdálkodás)

In the simulation they can use previous results to find the proper Q , than they can order that amount in every round. The customer demand will change but they counted the average so this strategy has to work with low costs.

- **s, S strategy:** In this case the minimum (s) and maximum (S) stock is determined. It requires permanent supervision. When the stock reaches the minimum level we need to order. The demand will be equal with the difference between the maximum and the minimum stock. In this case the amount of stock is limited, so there is no chance to make too high inventory. (Pintér, 2010)

In this case the students need to define minimum and maximum stock. They have to look the previous games carefully and figure out the proper number. It is hard because the customer order changes. The main goal is the shortest cost in the chain. They can follow different strategies inside this. For example they can make higher safety stock or they can count with a little backlog.

- **t, Q strategy:** In this strategy our work depend on time and quantity. In this case we order in every t period a determined Q quantity. It is useful when the product running smoothly. But when the order changes frequently this strategy can't work.(Pintér, 2010)

Students need to define time and quantity. It can be a lot of different strategies inside. In this case also good to try the simulation with different numbers. For example every member orders 6 in every 2 round. It would be also exciting to try it with different strategies inside the chain. In the end they also can compare different results of different groups.

- **EPOS supply chain strategy:** In this chain the customer is the dominant. All participant of the chain order the same amount as him. This can avoid the unnecessary stock, but it only works in flexible supply chain, in which the reaction is fast. (Disney, Naim, Potter, 2004)

It can work with the rules of beer game, just if we don't observe the information flow criteria. In this case everybody order the same as the customer. It not guarantees the best solution because of the factory's manufacturing time.

- **VMI (Vendor Managed Inventory) strategy:** In this case the retailer and distributor cooperate with each other. The aim is better availability in the possible lowest cost. It generates a good system because it can be constantly examined and developed. (Nagy, 2008)

In this case two members have to work together. It also means violate of rules. This harmony can make for example between retailer and wholesaler.

In the simulation we can use other previously not defined strategies. In these strategies we can also make regulation about backlog, inventory, ordered quantity. These are the followings:

- **Market driven strategy:** In this case in the chain all of the participant order the same amount as the incoming order. This strategy is good because customer real demand go through the chain just shifted on time.
- **Maintain inventory:** In this case the goal is to keep the 12 unit in inventory. This strategy limits the amount, so too high inventory not likely to be formed. It is also good to avoid shortage.
- **Order batching:** It is another solution of simulation. Every member can order whatever he want they just have the regulation that the number have to be a multiple of a number. For example they can only order multiple of 4 (4, 8, 12, 16...).
- **Fear losing the customers:** The customer is really important element of the supply chain, he makes the process work. In a lot of cases in real life companies make big security stock which helps them to be able to fulfil the requirement. In the simulation the inventory cost is 1 \$ and the backlog cost is 2 \$ but in the real life it can be different. There are a lot of company whose products can be stored easily and in a low price. In this case the simulation can be changed. The price of stock is lower but the price of shortage is higher because it equal as lose a customer.
- **Gambling:** As I mentioned before bullwhip effect is partly generated by the price fluctuation. It can change the inventory strategy, because if a member can buy a product in a lower price he can afford the inventory cost if the difference is high enough. In the simulation it can come out too, for example the teacher can introduce that in the second rounds the price of the beer is lower.
- **Involvement of a logistic service:** Outsourcing of logistic tasks is quite frequent. It can gain reducement of costs. About the logistic services students studied in Logistic course and also in the theoretical course, so in this part we sum up their opinion based on the previous studies and also complete their knowledge with practical items. To simulate this situation in the class the

students need to play two scenarios. In the first it is played with a minimum amount of stock and in the second is played with higher cost of inventory. In the end the result can be reached by a comparison.

- **Agile system and lean system:** It is the result of the modern world. Consumers now don't buy mass products they buy products which can be convert personally. Lean and agile models are also a part of the theoretical classes so in this part the teacher just make a summary and also complete the student's knowledge with some practical details. In this case the customer may have to wait a bit, but in the end she can get what she wants. In the simulation this also need the change of weights. In the agile part of the chain change is not necessary, but in the lean part the backlog means a much higher cost compared to the stock.

After the theoretical background the students have a possibility to play again. Previously they could try the game without strategy, with ordering a same amount and also ordering the same amount as the previous. In this class they can try one more: the strategy with multiple orders. They can decide which number they want to multiply.

As a homework they have to analyze this strategy and compare with the previous. They have to decide which of the played strategies were the best and tell why. They also need to show the advantages and disadvantages of each strategy.

Sixth week: Inventory strategies 2.

This class also start with the homework discussion. The students can show their results and debate about advantages and disadvantages. They have to choose together the best solution against the tried.

In this class they have a possibility to play some more scenarios. They played the EOQ strategy before but they just figured out a number, now they have to count the EOQ on the class and play the scenario. In the end they will see the differences. They can choose three other strategies too. So to sum it up they will play four scenarios on the class. In this class they also can ask about the short report they have to make for the 13th week.

To make the students work easier in the class the teacher show them a model analysis of supply chain. In this part the students can complete their previously used methods with new ones and they also can make criticism. The class can come out with new possibilities also.

For the essay they can introduce their plan to the teacher and ask for some help. This class give place for brainstorming about this exercise.

Seventh week: Decision making in a theoretical way 1.

In this report we introduce the different decision-making theories, their use in supply chain management and also introduce the different game theory models. A correct decision-making is very important not only during negotiations with suppliers and distributors but also to construct the right order strategies. Knowing different strategies may help making decisions well and later utilize our experiences.

In education the decision-making theories and game theories get only little emphasis, however students have to know how to react in different lifestyles. In this part of the thesis we introduce the different theories and we write how to use them in higher education.

Decision-making theories

In our everyday life we always have to make decisions. Sometimes there are not so important e.g.: take an umbrella with me or not, but sometimes very important decisions like opening a new store in another country or not.

Everybody is different but the process is more or less the same. First you have two choices: to do or not to do. You think about the possible consequences, ponder to chance, and finally make a decision. The process seems simple, but there are many possible ways of one choice. In this part we write the process of making a decision and demonstrate the different decision-making strategies.

The theory

Before we start talking about different decision making theories we have to clear the meaning of decision. We meet with it everywhere, in households, in school and in all companies.

If we want to define decision-making first we have to define the word of decision which is a choice between the alternatives of activity (Kovács, 1994). According to the classical decision-making theories the psychological process can typified by two things: by the utility and by the probability. If somebody makes a decision he has to take into consideration the possible damages and benefits and its chance to befall. The quantitative definition of utility is hard in everyday situations we should use the qualitative methods with some filters.

According to Kindler (1978) we can talk about:

- prevalence model,
- conjunctive decision model and
- disjunctive decision model.

The prevalence model says that we have to choose that alternative which is better regarding at least one evaluation factor and no worse than the rest of all other evaluation factors as regards of the remaining. At the conjunctive decision model we have to define criteria value and have to be better than others so we can choose those of them. The last model is the reverse of the previous model.

According to other theories *decision making* is a mental process resulting in the selection of a course of action among several alternatives. Every decision making process produces a final choice in an action or an opinion of choice. (Doya, Shadlen, 2012). We have to make difference between making a decision and analysing/solving a problem. When we solve a problem it must be done first and just after can we decide.

Students now know the basics of decision making and they also know the Kindler model. They have individual homework to write a short handout about choosing place for higher education (university vs. college). They have to send it via e-mail at least two days before the class.

Eighth week: Decision making theories in a theoretical way 2.

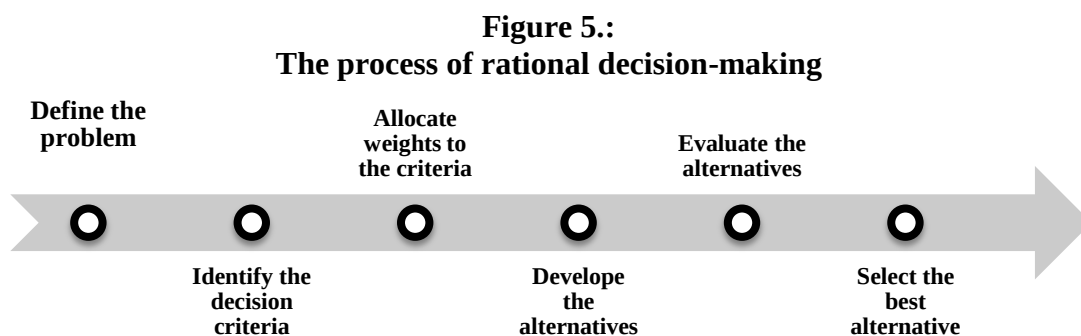
The lesson begins with the checking of the homework. After analysing the results we have to start the theoretical approach of general decision making methods.

The general decision-making methods

Many researchers have been dealing with different decision making methods with different views. The following list is basically based on Turpin and Marais work, where they have been working on the theory and the practise of decision making analysis.

1. The rational model

According to Hatch (2002) the traditional decision-making within economical theories is rational decision-making model. Robbins (2003) presented a model about this which consists of six steps which are the following.



Source: Own editing by Anderson-Wemner (2008)

This process describes how the decision-maker should behave in different situations. In this model the process begins with the problem definition. After first step you need to recognize the decision criteria, which is a very important part. After allocating the weights to the criteria we have to generate the possible alternatives and give them the correct priority.

The given alternatives have to be evaluated and at the end we can chose the best of them. The decision maker (“economic man”) is described by neoclassical microeconomic theory around the middle of the twentieth century. In classical or perfect rationality, methods of decision analysis are used to attach numerical values or utilities to each of the alternatives during the “choice” phase. The alternative with the highest utility (or maximum subjective expected utility) is selected (Turpin, Marais 2004).

This model has been criticized by Herbert Simon who identified and questioned the assumptions that the rational model is based on. The human mind can make simplified

estimates to be able to manage the complex situations that an individual can be put in (Anderson, Wemner, 2008).

2. The model of bounded rationality

The so called bounded rationality or also called „satisficing” process-oriented view is based primarily on Simon’s work on bounded rationality. Admitting that the rational manager does not always have complete information, and that optimal choices are not always required. Bounded rationality is characterised by the activities of searching and “satisficing”. Alternatives are searched for and evaluated sequentially. If an alternative satisfies certain implicitly or explicitly stated minimum criteria, it is said to “satisfice” and the search is terminated. The process of searching might be made easier by the identification of regularities in the task environment.

3. The incrementalist view

The logical incrementalist view involves a step-by-step process of incremental actions and keeps the strategy open to adjustment.

4. The organisational procedures view

The organisational procedures view seeks to understand decisions as the output of standard operating procedures invoked by organisational subunits.

5. The political view

In this model making a decision is driven by the agendas of participants rather than rational process. People differ on the organisation’s goals, values and the relevance of information. The whole process never ends, but remains a continuous battle between different coalitions. After one group wins a round of the battle, other parties might regroup or become even more determined to win the next round. Influence and power is wielded in a deliberate manner and to further self-interest. The goals of the coalitions are defined by self-interest rather than by what is good for the organisation as a whole.

6. The garbage can model

This model emphasises the fragmentedness and chaotic nature of decision-making in organisations, rather than the deliberate manipulations implied by the political view. In the garbage can model, a decision is an outcome or interpretation of several relatively independent streams in an organisation. When a decision is made, the garbage can is removed. This might happen without having solved all or some of the associated problems in the garbage can. Since participants are the ones generating the garbage, or problems and solutions, the decision made is totally dependent on the make-up of the team of participants in the can.

7. The individual differences perspective

The model focuses the attention on the problem-solving behaviour of the individual manager, as influenced by the manager's decision-making style, background and personality. It tries to explain how managers might use different methods or come to different conclusions because of differing personalities.

8. Naturalistic decision-making

It is concerned with investigating and understanding decision-making in its natural context. The empirical foundation of naturalistic decision-making differentiates it from other descriptive models, such as the organisational procedures, garbage can or political views.

9. The multiple perspectives approach

This method classifies perspectives as either being technical, organisational or individual in nature. Analytical models that collect data as a basis of understanding the system would all fall under the technical perspective. Different analysts or modelling projects will come up with different technical views, even if these projects claim to present an objective or rational picture of the situation. Thus, it is encouraged that more than one technical view of a system is obtained. In order to cover the organisational and individual perspectives, as many as possible of the role players and stakeholders should be investigated.

After this class students have a general knowledge of different approaches. They individual have homework to use the rational method of opening a new warehouse in Győr. They have to send it via e-mail at least two days earlier of the next class.

Ninth week: Decision making in Supply chain

For the understanding supply chain management decision making theories they have two weeks because it is a big part.

The ninth week begins with a short test about the general models. They have to enumerate the nine methods. If they know all of them they get extra points in the test of the end of the semester. After the test we check the homework and start to see how we can use the models on supply chain management. They also have individual homework for the tenth week to make a Decisive Model about buying a washing powder.

Supply Chain Management decision making theories

After the general introduction of decision making process we can talk about specifics of management models. According to the study of Shanteau (2001) there have been two approaches of management decision making process: the normative and the descriptive analysis. The history of normative analysis method came from Neumann and Morgenstern in *Theory of games and economic behaviour* (1947) a variety of techniques have been derived for making optimal decisions. A distinction is often drawn between riskless (certain outcomes) choices and risky (uncertain outcomes) choices. The descriptive analyses of decision making were initially concerned with accounting for the discrepancies between normative rules and actual behaviour.

These methods may be able to collect by supply chain but there are other methods which are more useful of analysing decisions in supply chain.

There are three types of complexity in supply chain management models: the static, the dynamic and the decision-making. At the complexity of decision making the emphasis is on the volume and the nature of the decision-maker. (Serdar-Asan 2009)

When somebody is making a decision in a whole Supply Chain (retailer, wholesaler, distributor, factory and of course the customer) affects the whole chain. According to Andersson (2008) the most important thing to find the key point which is that the entire process must be viewed as one complex system. According to the above mentioned study the decision-making in a supply chain has to focus on the impact and the other supply chain members. For this the best is the Decisive Model, which will be presented.

The Decisive Model consists of six parts:

1. Define the problem

In the first step you have to define the problem as thoroughly as you can. In every decision is where important to know what the problem is, how to solve and what will be the result. With that you will get a complete description about the situation.

2. Identify concerned supply chain members

The second step is to know that you have the complete supply chain (costumer, retailer, wholesaler, distributor and the factory) or you have reduced supply chain because the priorities can change easily.

3. Identify the strategic decision criteria

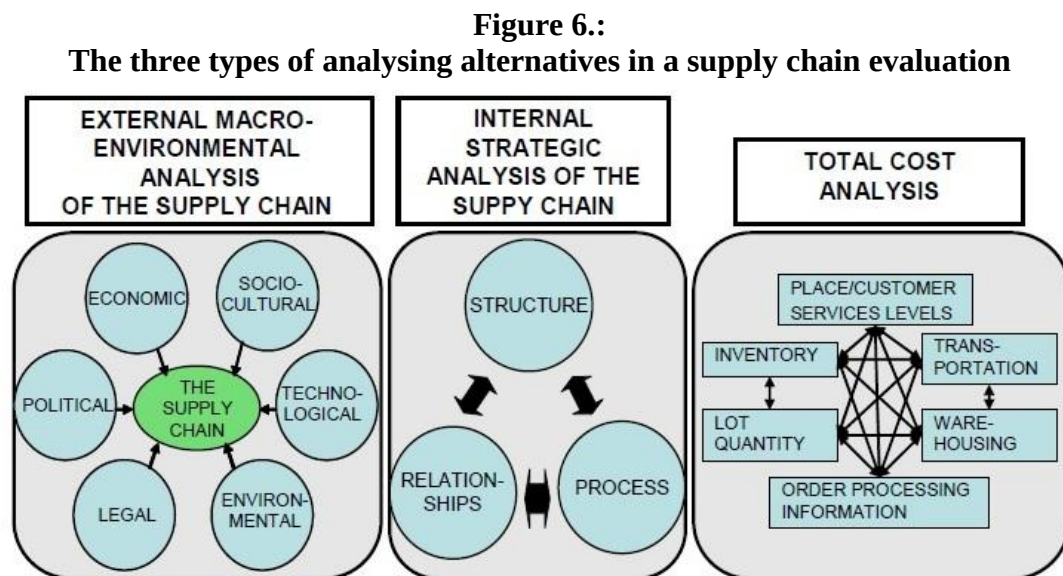
The supply chain objectives are aligned with the corporate strategy and set the decision criteria in accordance with the supply chain objectives.

4. Develop alternatives

It may help resolving the problem.

5. Evaluate the alternatives

In the penult step you need to evaluate the possibilities and critically analyse them. For this are usable the external macro-environment analysis, the strategic model of the supply chain and also the total cost analysis. The following figure will shown the three analysis.



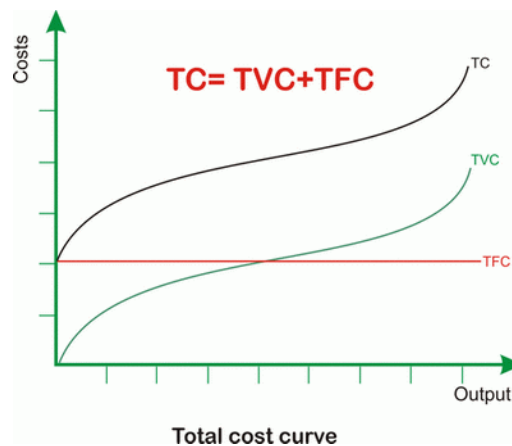
Source: Anderssen-Wemner, 2008

6. Select the best alternative

After evaluating the alternatives and evaluate the all you have to choose the best fittings for the supply chain.

For the cost analysis they have the basic knowledge form Logistics class, but teacher will say the most important things of the proper analysis. The total cost (TC) is the sum of the fixed and variable costs. The fixed costs (TFC) are not dependent on the level of goods or services produced by the business. For example the cost of the employee, the taxes etc. The variable costs (TVC) are changeable, it depends on the amount of the working hours, the used materials. Change in proportion to the good or service that a business produces. Variable costs are also the sum of marginal costs over all units produced.

Figure 7.:
The total cost function



Source: www.dineshbakshi.com Downloaded: 07/03/2014

For the total cost analysis we have to know the direct costs, the production overheads and the central management costs. The basic analysis has to contain the target cost, the transfer cost, the distribution cost and the logistics cost. The exact numbers will be given in the class by the teachers.

They have individual homework for the tenth week to make a Decisive Model about buying a washing powder/perfume including a total cost analysis of producing washing powder.

Tenth week: Game theory in a theoretical way

The tenth week begins the check of the homework. After the checking we continue with the three types of analysing alternatives in supply chain evaluation.

Decision making in a supply chain cannot be used only with the help of decisive model, but we can use the game theory also. In this part I introduce the most important parts of the game theories including the Nash-equilibrium and the usage in supply chain management decision making methods.

Students now have a general overview about different decision making models. The tenth week begins the homework-checking and continuous with the introduction of game theory.

Introduction to game theory and the Nash equilibrium

First of all we have to clear that the game theory has two types: the cooperative and the non-cooperative game theory. According to Nash (1951) in non-cooperative games it is impossible for the players to communicate or collaborate in any way, but in supply chain we can use the cooperative game theory model where the payoff of a player in a cooperative game is the value created through the cooperation.

The most known game theoretic model is a Prisoner's Dilemma where you and your partner have been committed a serious crime. You are arrested and known that you are one of the guilty ones, although evidence is lacking. You are put in separate cells and are not able to communicate to each other. You each get the same proposal:

- if you both deny, you will only receive a sentence of one year,
- if only one of you confesses this person will be rewarded for her/his collaboration and will be released. The other one that does not confess will receive a sentence of ten years,
- if both of you confess you will each receive a sentence of five years.

Deny-confess situations are the following.

**Table 1.:
The Prisoner's Dilemma**

	A deny	A confess
B deny	-1; -1	-10; 0
B confess	0; -10	-5; -5

Source: Made by myself using Tóth Tamás: Decision-making theory and methodology 2013/2014 summer semester 26/02/2014, Széchenyi István University, Győr

In this situation you can choose to cooperate or desert, which are the following:

- (S) Sucker's payoff,
- (P) Punishment for mutual defection,
- (R) Reward for mutual cooperation,
- (T) Temptation to defect.

In that game these are the followings.

**Table 2.:
Cooperation-desert**

	A deny	A confess
B deny	(R)	(S)
B confess	(T)	(P)

Source: Made by myself using Tóth Tamás: Decision-making theory and methodology 2013/2014 summer semester 26/02/2014, Széchenyi István University, Győr

We can conclude that for both you and your partner no matter what the other person decides, the best choice is to confess. Logically, you and your partner will confess and receive five years, although the optimal outcome is without doubt if you both deny and receive only six months each. The lack of communication is the reason why the best outcome is not achieved. If you and your partner in crime could communicate, you could come to an agreement and trust each other to deny all guilt. When each player's individual goal is only to maximize his benefits or to minimize his costs, the agreements obtained by negotiation may be fragile and will generally not guarantee global optimality for the supply chain as a whole. (Van Meirvenne, 2012)

Concluding the above mentioned we can talk about Prisoner's Dilemma when

$$T > R > P > S \text{ and } 2R > T + S.$$

By the general shape of the Prisoner's Dilemma the meanings are $T=5$, $R=3$, $P=1$ and $S=0$, and in table is the following.

**Table 3.:
The general shape of Prisoner's Dilemma**

	A deny	A confess
B deny	3;3	0;5
B confess	5;0	1;1

Source: Made by myself using Tóth Tamás: Decision-making theory and methodology 2013/2014 summer semester 26/02/2014, Széchenyi István University, Győr

When we are talking about game theories we have to mention the Nash equilibrium too. Nash equilibrium is a fundamental concept in the theory of games and the most widely

used method of predicting the outcome of a strategic interaction in the social sciences. A game (in strategic or normal form) consists of the following three elements: a set of players, a set of actions (or pure-strategies) available to each player, and a payoff (or utility) function for each player. The payoff functions represent each player's preferences over action profiles, where an action profile is simply a list of actions, one for each player. A pure-strategy Nash equilibrium is an action profile with the property that no single player can obtain a higher pay-off by deviating unilaterally from this profile. Comparing to the Prisoner's Dilemma it means that in addition to "A" is given a choice, the choice of "B" is optimal and in addition to "B" is given a choice, the choice of "A" is optimal.

The Pareto Optimal

At the Prisoner's Dilemma we do not have to look at the Nash equilibrium but we also have to take care to the Pareto optimal. Pareto optimality is a measure of efficiency. An outcome of a game is Pareto optimal if there is no other outcome that makes every player at least as well off and at least one player strictly better off. That is, a Pareto Optimal outcome cannot be improved upon without hurting at least one player. Often, a Nash Equilibrium is not Pareto Optimal implying that the players' payoffs can all be increased.

In the Prisoner's Dilemma the Nash equilibrium is when A and B are denying (Reward for mutual cooperation) and the Pareto optimal when both are confessing (Punishment for mutual defection).

The Nash equilibrium is also useful for the two-stage supply chain, where we have only two actors for example a distributor and factory.

At the tenth week they do not have hand-out homework. Instead of that they have to separate in groups (5 people per group but it depends on the whole number) and make a short (10 minutes) presentation about Nash equilibrium and Prisoner's Dilemma of opening a new shoe store. They can also use the Stackelberg duopoly what they studied during their Bachelors years. If we can make 4 groups we have 4 locations: city centre of Budapest, city centre of a small town, suburb of Győr and suburb of a small town.

Eleventh week: Game theory in supply chain 1.

The eleventh week begins with the presentations. Every group has 10 minutes to present their decisions. After the presentation we start to see how game theory works in supply chain. In that class they are going to know the Multiplayer Prisoner's Dilemma.

Game theory in supply chain

All of the actors in the supply chain have the same aim: to hold a share in a market. They want to maximize their profit, get the biggest circle of costumers etc. For this the cooperative game theory can help, but the non-cooperative game theory is more appropriate to determine the set of equilibrium points that can be reached in trade conditions.

Multiplayer Prisoner's Dilemma

We can make differences in two-players or multiplayer's Prisoner's Dilemmas. The second is more available for the supply chain modelling. The main content is based on Hardin's ecological philosophy of the tragedy of commons which is the following.

A village has a common pasture with 10 owners and every owner has one cow with 1000 pounds of weight and they are getting fat in the common pasture. The owners are getting earn more money, and some of them buy another cow. One of the owners decides to graze two cows. When only one owner decides that we cannot or just rarely see the changing of the condition. When 11 cow graze than every cow has 900 pounds weight. In that case the costs and the benefits are the following. The arising benefit of investor is $2 \times 900 - 1000 = +800$ pound and the arising loss of others is $1000 - 100 = 900$ pounds.

When the second and third owner decide the same, we can see a little change but not so countable. The cows are getting losing their weight, but not as much as we expect. When the seventh owner decides to buy another cow the other cows are thin and the sum weights of the 17th cows are less than in the first state (10 cows). When the 10th owner wants to buy a second cow all cows are getting dead. Meanwhile, the thing is that 2 cows worth more than one so it worth to everybody to buy a second cow until all die. The table-form is the following.

**Table 4.:
General form of tragedy of commons**

	The others		
		<i>Buy a second cow</i>	<i>Not buy a second cow</i>
	<i>Buy a second cow</i>	2;2 Has two very thin cows	4;1 Has two enough fat cows
One owner	<i>Not buy a second cow</i>	1;4 Has one very thin cow	3;3 Has one very fat cow

Source: Mérő, László: Moral Calculations: Game Theory, Logic and Human Frailty, 1998

The numbers have the following meaning: 1: the worst case, 4: the best case. The second numbers show of the average benefits of the others. The dominant strategy and the Nash equilibrium is the 2;2 when everybody buys a second cow (0 in weight of one cow). However in long-term period is not working because every cow is going to die, but when they realise that it will be too late. The Pareto optimal is when nobody buys a second cow and nothing happens (1000 pounds of sum weights). The available profit maximum is 1800 on weight of two cows, when only one owner buys a second cow. The Pareto optimal strategy is a safe strategy and the numbers are the following in each case.

**Table 5:
The problem of common pasture in numbers**

Numbers of cows	Weight of one cow (in pounds)	Weight of two cows (in pounds)	Sum weight (in pounds)	Loss in the sum weight (in pounds)
10	1000	0	10000	0
11	900	1800	9900	100
12	800	1600	9600	400
13	700	1400	9100	900
14	600	1200	8400	1600
15	500	1000	7500	2500
16	400	800	6400	3600
17	300	600	5100	4900
18	200	400	3600	6400
19	100	200	1900	8100
20	0	0	0	10000

Source: Decision-making theory and methodology 2013/2014 summer semester 17/03/2014, Széchenyi István University, Győr

In the supply chain we can play the same. We have 5 actors (customer, retailer, wholesaler, distributor and a factory). When one of them changes a strategy it is going to affect to others strategy. Let us assume that we have one very good quality products, which goes through the whole chain. The factory produces only that product, and the customer buys one of them, so every actor in the supply chain deals the sale of it. Later the customer decides

to buy two of the product. In that case we have the same case as the commons tragedy. The table-form is the following.

Table 6.:
Tragedy of commons in supply chain

	The others		
Costumer		<i>Buy a second product</i>	<i>Not buy a second cow</i>
	<i>Buy a second product</i>	2;2 Has two very low quality products	4;1 Has two products in good quality
	<i>Not buy a second product</i>	1;4 Has one very bad quality products	3;3 Has one very good quality product

Source: Edited by myself using M  r  : Moral Calculations : Game Theory, Logic and Human Frailty, 1998

However the situation is very theoretic because the customer has many opportunities to buy as much high quality products as she/he wants and two bad quality products worth less than one good quality products. In that model we do not count with the real environment and the multinational market.

For the twelfth week they have to write a short hand-out individual about what other Multiplayer strategies they find. They have to search other strategies on the internet and send on e-mail at least 3 days before the class.

Twelfth week: Game theory in Supply Chain 2.

The twelfth week begins with the out-looking of the collected strategies. They will know some of the multiplayer strategies and they have the basic knowledge of Prisoner's Dilemma. At the twelfth week they get knowledge about different models and different viewpoints in managing a supply chain. The main role of the class is to meet the different viewpoints and to summarize the semester.

Different models

When we start to analyse decisions we have to fix that each player are individual and uniquely want to maximize his/her gain and minimize his/her loss. According to Hennes and Arda (2008) we can consider the case of n decision variables $(q_1, \dots, q_n)$, and m players with utility functions $\pi_1(q_1, \dots, q_n), \dots, \pi_m(q_1, \dots, q_n)$. It can be assumed that each player i has some decision variables imposed (uncontrollable to him) and others that he can choose (set of controllable variables Γ_i). The whole mathematic background is in the first appendix.

On the one hand we can use the Nash equilibrium but on the other hand we can use the Stackelberg-model, which may fit better if we have a two stage supply chain (Qiun, 2011).

In supply chain decisions are heterogeneous, however we have 5 factors: the costumer, the retailer, the wholesaler, the distributor and last but not least the factory. Their decisions affect them and however in the beer game they do not allowed communicating each other they can guess what will be the next step of the others. For this "guessing" using game theory is one of the best theories.

The different viewpoints

When we decide as an individual we make our own decision without knowing the others decisions. The different models imply variables of decision and mechanisms of compensation which could easily apply to the real supply chains, subject to parametric adjustments obtained by simulation. However the chain consists in five actors, we can talk about only three because the retailer, the wholesaler and the distributor are the suppliers.

1. The costumer

As a costumer, utility function depends on the quality of the product that is both its added-value and its lead-time.

2. The suppliers

The suppliers' decisions are determined by negotiation with the producer, and the internal optimization problem of the producer reduces to selecting its optimal inventory level.

3. The factory

Under a price-only contract, the payment transfer does not depend on the inventory level. The factory is the last actor in a five-player supply chain so he is the last person to get the information according to the rules of the beer game.

They do not get homework about the twelfth class lesson because they have a test on the thirteenth week to get a note.

Thirteen week: Summary

To the thirteenth week we did not plan any theoretical class because they have to present their reports about the two main part of the semester. We want to size up their knowledge and we are interested in their opinion about the semester. We have a viewpoint about the doing-by-learning educational system which is the following.

Because the semester can passed buy continuous evaluation this class is also for discuss the grades. The teacher sums up the students points and gives them a recommended grade. If they are not satisfied with the get grade they have a possibility during the exam period to replace their missing works and they can reach a higher grade. This is only a possibility to improve the grade, so if somebody can't reach the minimum requirement it is not working, because of the type of the evaluation. This correction can concern to only one chosen task.

Benefits of learning – by – doing

This class the teacher also talks about the benefits of learning by doing. In the education system there are only few classes where we can learn not only the theoretical part but also the practical parts. For the developing this we can use the beer game simulations and the different decision making models. Students can learn the basics and the background of the process of supply chains, the inventory strategies, the decision-making methods, can learn the different game theory aspects. The practical lesson is more interesting than only learning from books, students can listen and remember more for them. And also not every class is in the morning so the afternoon-classes when people are more tired can be more interesting and have less chance to nobody participate in the class. It is also useful in the subsequent life, because they have to use these methods in their job and life. Practical learning can give them a proper tool for this.

A game theory helps thinking more logical. In some university abroad there have not only few hours of game theory but a whole semester.

In the semester the class took place of two sections: the first is introduction in the supply chain management, the bullwhip effect and the inventory theories and the second is the decision-making and game theory models. Both parts have their own benefits and both parts can give practical knowledge. After the 2013/2014 second semester the Decision-making

theory and methodology is going to stop as an individual class so students do not have the opportunity to meet that. That's why it is important to get parts in other class.

Summary

In our report we worked with learning by doing and the importance of it. We chose this topic because we experienced that the theory based learning is not good enough to develop a person. In theory based learning the students have to learn a lot, they will be able to use the learnt things in the exam, but after they will forget it soon. Game based learning is better because they do everything in practice and they don't really have to learn theories but the way of thinking and some kind of logics.

After university studies the students need to start working in a company. It doesn't matter if they start a carrier in logistic fields or not they need to show what they know. For a good job there is a large competition. In this case candidates need to show every possible surplus. This logical thinking is a big surplus.

It is also part of the technological development. It has affect on education. The teachers use the modern technology which makes the illustration and simulation easier and more spectacular. In this class the students also can use applications in tablet PC-s which makes the analyses easier.

This class is important because the students don't have opportunity to learn these parts of logistics in other classes. After the university they can use this knowledge because of the practical way and also because they got a surplus in a specific field.

The students got more practise orientated thinking in this class than others in different educational institutions. This is a good start for reforming a whole mater study. If this method was driven in every subject, the students would be able to think more practically.

This way is also help the teacher – student relationship. Because of the common work they get closer to each other and the students can ask the teacher with more trust and respect.

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Appendix

Appendix I.

First class	Supply chain management
Homework:	Count costs, show efficiency, search for causes of bullwhip effect
Second class	Bullwhip effect 1
Homework	find a causes in the personal example, search result
Third class	Bullwhip effect 2.
Homework	summarise the previous results, search for possibilities to solve or avoid bullwhip effect
Fourth class	Bullwhip effect 3, Supply chain models
Homework	Search inventory strategies
Fifth class	Inventory strategies 1
Homework	analyse and compare results
Sixth class	Inventory strategies 2
Homework	Start the report
Seventh class	Introduction to decision making strategies
Homework	Write a short handout about the Kindler-models (individual)
Eight class	General decision making methods
Homework	Write a handout about one of the general decision making methods (individual)
Ninth class	Decision-making in supply chain
Homework	Make a Decisive Model about buying a washing powder (individual)
Tenth class	Decision-making in supply chain
Homework	Make a total cost analysis about buying a perfume in group
Eleventh class	Introduction to game theory
Homework	Make a presentation about the Nash equilibrium in the view of the costumer and the retailer
Twelfth class	Game theory in supply chain decisions
Homework	Make a presentation about using of the Nash equilibrium and the Stackelberg duopoly model
Thirteenth class	Summary of the semester

Appendix II.

SUBJECT CURRICULUM

Supply chain management practical course

NGM_LO00X_Y

Responsible lecturer: Minta Péter, PhD

Semester: 2014/2015/1

Minta József, PhD student

Reporting form: Continuous evaluation

Number per week: 2/4/0

Number per semester: 28/56/0

AIM OF THE STUDY

Managing the operation of supply chain gets more and more complex and complicated. For the proper operation the knowledge of theories is not enough, so we are creating a practice oriented education programme. The game based learning helps to get experiences in the application of theories in the professional life. Beer game is a widely accepted tool of demonstration how supply chains work. It shows the main characteristics of distribution systems and the impacts of bullwhip effect. The candidates can also examine with it several inventory strategies, different supply chain models, the economic order quantity and the optimal amount of stock. This education programme contains the main theory of supply chain management, creation of performance measurement systems, and evaluation of KPIs. Besides these we introduce game theory applied in the management of the chain of supply. Through the different models participants can see how their decisions effect on the whole system, principally the unexpected results.

COURSE CONTENT

Fist week	Supply chain management
Second week	Bullwhip effect 1
Third week	Bullwhip effect 2.
Fourth week	Supply chain models
Fifth week	Inventory strategies 1
Sixth week	Inventory strategies 2
Seventh week	Introduction to decision making strategies
Eight week	General decision making methods
Ninth week	Decision-making in supply chain 1
Tenth week	Decision-making in supply chain 2
Eleventh week	Introduction to game theory
Twelfth week	Game theory in supply chain decisions
Thirteenth week	Summary of the semester

EXAM AND EVALUATION SYSTEM

Continuous evaluation, the contents are the following:

Homework: 34%

Two short report: 28-28%

Presence: 10%

POSSIBLE GRADES

0-50%: fail (1)

51-62%: pass (2)

63-75%: satisfactory (3)

76-87%: good (4)

88-100%: excellent (5)

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