FACTOREASY®: DO STUDENTS TAKE A RISK?

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Abstract

In the article, we focus on students' risk level in making decisions in strategic management. To compare, in which strategy students show higher risk, we use a repeated experiment. As the experiment environment, we use business simulation FactOrEasy®, which is the online dynamic deterministic simulation of decision-making in financial, operation, or strategic management using artificial intelligence to compete against human player. We use exports from the best games of 37 students (1st year of masters' studies). To define risk, we identified decision-making spots in the game, clustered them logically, and used following groups to identify level of risk undertaken by students in the simulation: strategy behaviour, buying behaviour, selling behaviour, result behaviour, and profitability behaviour.

Keywords

Artificial Intelligence, Business Simulation, FactOrEasy®, Risk, Strategic Management

Introduction

In the article, we follow previous research identifying the benefits resulting from the use of the unique business simulation FactOrEasy® (Švec et al, 2016) and expand the identified educational benefits focusing on risk taking attitude in strategic management decision-making and strategy implementation. As the experiment environment, we use business simulation FactOrEasy®, which is the online dynamic deterministic simulation of decision-making in financial, operation, or strategic management using artificial intelligence to compete against human player (Švec et al, 2016).

As we focus on the area of strategic management, the strategy is the key term to be defined. Unfortunately, many authors (Mintzberg, Ahlstrand and Lampel, 2009; de Wit and Meyer, 2014; Norton and Irving, 1999) agree there is no single definition of the strategy, which would be universally accepted. De Wit and Meyer (2014: 3) even say that there is too many different opinions and disagreements 'that even a common definition of the term strategy is illusive'.

Mintzberg (1987) provides sufficiently broad view of strategy definition with five terms: plan, ploy, pattern, position, and perspective. Moreover, Mintzberg explains a plan as consciously intended course of action, the ploy as a specific manoeuvre intended to outwit an opponent, the pattern as a stream of actions, the position represents location of an

organisation in an environment, and perspective as not just a chosen position, but as the common thinking behaviour of employees in specific organisation (Mintzberg, 1987).
Every player in the FactOrEasy® can make only limited number of actions each round (such as decisions about how many materials to buy and for what price, how many products to produce, how many products to sell and for what price, to buy an additional factory or not, and to take a loan or not). In this article, along with Mintzberg (1987), we see strategy as stream of actions, which we consider as one of Mintzberg's point of view on strategy (pattern).
Each FactOrEasy® game is set up in an environment of decision under risk. However, every player has available analytical tools, which help to diminish the risky environment. Similarly, as in case of strategy, there is no consensus on how to define and interpret risk (Aven, 2015). 'We perceive the world before we react to it, and we react not to what we perceive, but always to what we infer.' (Knight, 1964: 201). Holton (2004: 24) adds: 'It is not easy to operationally define perceived risk because perceived risk takes many forms. To simplify the tasks, we may operationally define some aspects of perceived risk.' It might be, for example, a variance of return or maximum likely credit exposure or any other. Lopes (1987) frames the decision situation to be whether attractive (it means an opportunity) or risky (a threat). Krueger and Dickson (1994: 387) agree on that as managers 'tend to categorize decision situations into opportunities and threats. They tend to see controllable situations as opportunities and they tend to see uncontrollable situations as threats'. Therefore, risk can be understood as a situation that involves evidences of uncertainty.
Šotič and Rajič (2015) used a lot of definitions of risk from different authors and categorized them into several groups, where risk is expressed: 1) by means of uncertainty and expected values, 2) through consequences and uncertainty, or 3) in relation to objectives.
In this article, we define risk in accordance with Mun (2006) as consequence of actions taken despite an uncertainty. In addition, the following text is divided into parts corresponding to selected operationally defined aspects of risk logically linked to the corresponding research questions. We consider aspects as defined by Holton (2004): strategic behaviour, selling and buying behaviour, and profitability and results behaviour. The aim of the article is to analyse students' risk attitude behaviour in FactOrEasy® games. This analysis would provide a valuable insight leading to better comprehension of different game results, i.e. why some students bankrupt, take a loan, buy an additional factory (factories), make better cost or price estimates and some students do not. Consequently, the results of this analysis can be used not just in the Enterprise Management course regarding better aiming on students' educational needs, but also development needs in management training.

Materials and Methods

We used the results from the pilot run of the FactOrEasy® simulation, which had been played in December 2015 and January 2016 with a sample of 44 students of Enterprise Management course taught at Faculty of Economics and Management, Czech University of Life Sciences Prague (Švec et al, 2016). 'Students were in the 1st year of master studies, all of them were studying the course Enterprise Management' (Švec et al, 2016: 568). Results of 7 students had to be excluded from the further analysis as students did not finish all 12 rounds. Therefore, 37 exports from 11 male and 26 female students are used in the risk attitude analysis. The overview of the context of FactOrEasy® and its gameplay

process is described in Pavlíček et al (2015), techniques of data acquisition are described in Švec et al (2016).

The main aim in the game for students was to earn as much 'cash' as possible. Students could play as many games as wanted to present their best game (Švec et al, 2016). Each round of the game consists of three phases: 1) purchase of materials, 2) product processing, 3) sale of products. Therefore, a player of the FactOrEasy® game can make only limited number of decisions each round as: 1a) how many pieces of material to buy, 1b) what the price for the material will be, 2) how many products you can process, 3a) how many products to sell, and 3b) what the price for the products will be. Further, there are two additional decisions each player can take anytime during each round: 4) to buy additional factory, and 5) to take a loan.

We use three main aspects of students' perceived risk regarding students' in-game behaviour: 1) strategic behaviour, 2) buying behaviour, and 3) selling behaviour (regarding 3 main phases in each round). Nevertheless, we also watch two results oriented categories: 1) profitability behaviour, and 2) results' behaviour. In *strategic behaviour*, we include number of loans student takes in a game, number of factories student additionally buys, number of bankrupted competitors in the game, and a strategy student takes in a game. According to these data and its combinations, we distinguish risk averse, risk neutral, and risk seeking strategic behaviour. In *buying, resp. selling behaviour*, a student must decide about the amount of money he/she wants to exchange for a material, resp. products. In order to detect the risk level, a student is willing to take, we use student's distance from the market price (purchase price, resp. selling price). For the analysis, we use calculation of standard deviation to determine student's risk attitude behaviour.

In *profitability behaviour*, we pay an attention to three indicators of financial analysis available from game records: 1) Return on assets (ROA), 2) Return on sales (ROS), and 3) Debt-to-equity ratio. To compare students' risk attitude, we use market order of achieved ROA and ROS. ROA 'assesses a company's profitability relative to the assets it controls and is therefore a measure of how efficiently a company is using the assets at its disposal.' (Marr, 2012: 49). ROS, operating margin, operating income margin, operating profit margin basically 'tells how much money a company makes (before interest and taxes) on each dollar of sales.' (Marr, 2012: 17) Debt-to-equity (D/E) ratio basically means dividing a company's total liabilities by its equity (Marr, 2012). *Results' behaviour* represents students' outputs categorised into three categories regarding student's objective in the game. Poor results' behaviour means that student experienced deviation disrupting the main objective, neutral results' behaviour shows that student did experience deviation, which undermined the main objective, whereas focused results' behaviour represents the game with no deviation in the objective.

Within the above mentioned five categories, we expressed the following research questions:

- What types of strategy or strategies do students use in the game?
- What relation is between used strategies and risk attitude representing by operationally defined aspects: 1) factory buying, 2) loan taking, and 3) bankrupted competitors in the game?
- In which strategy used in the game did students exhibit riskier behaviour in buying material?
- In which strategy used in the game did students exhibit riskier behaviour in selling products?
- In which strategy used in the game did students achieve higher level of profitability?

- In which strategy used in the game did students remain more consistent with initial aim?
- Is there any strategy used in the game we can assume to be the riskiest?

We used contingency tables in order to answer the research questions.

Results

Strategic Behaviour

Students used three different strategies in the game. In the first strategy, students focused on the costs' lowering in their external environment (further reported as CLS1). In the second strategy, students focused on the internal factors and cutting their own costs (further reported as CLS2). The third strategy was the mutual combination of CLS1 and CLS2 (further reported as CLS1&CLS2).

Nearly half of students (49%) used CLS1 strategy, which means they tried to find ways to take advantage of cheaper material. Nearly third of the students (30%) used CLS2 strategy as they focused on lowering costs inside the production. Only 21% of students were able to follow both strategies simultaneously. As we can see (Table 1), the absolute majority of students (78%) did not take loan during the game. Games without bankruptcy occurred in 35% cases, one bankruptcy in the game appeared in 46% of games, which reveals low students' willingness to take risks and proactivity, as the exits of competitors (artificial intelligence) did not occur due to activity of human students. The overall strategic behaviour results indicate that 38% of students show risk aversion, 43% risk neutrality, and 19% of students belong to risk seeking behaviour.

Strategy used	Number of students	Students bought factory		Students took loan		Students bankrupted competitors	
CLS1	18	12	66.67%	5	27.78%	14	77.78%
CLS2	11	2	18.18%	1	9.09%	6	54.55%
CLS1&CLS2	8	7	87.50%	2	25.00%	4	50.00%
Total	37	21	56.76%	8	21.62%	24	64.86%

Table 1: Additional bought factories, taken loans, and bankrupted competitors disaggregated over the type of strategy (source: own calculation)

According to Table 1, the most active behaviour in factories buying were presented within the CLS1&CLS2, followed by CLS1. Moreover, from the point of loan taking, these two strategies (CLS1 and CLS1&CLS2) were used the most. On the other hand, CLS1&CLS2 with the CLS2 were the strategies with the lowest occurrence of bankrupted competitors (50%, resp. 54.55%).

Buying and Selling Behaviour

Comparing buying and selling behaviour in Figure 1, we can see very similar pattern. In both cases, students tend to be risk neutral in buying material and selling products (68%). Further, less students tend to risk in material buying (13%) than in products' selling (19%).

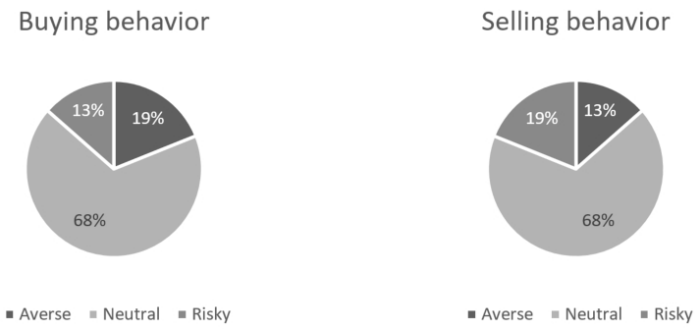

Figure 1: Overview of buying and selling behaviour (source: own calculation)

Strategy used	Number of students	Risk averse		Risk neutral		Risk seeking	
CLS1	18	1	5.56%	13	72.22%	4	22.22%
CLS2	11	2	18.18%	6	54.55%	3	27.27%
CLS1 & CLS2	8	2	25.00%	6	75.00%	0	0.00%
Total	37	5	13.51%	25	67.50%	7	18.92%

Table 2: Buying behaviour disaggregated over the type of strategy (source: own calculation)

In Table 2, we can distinguish differences in risk buying behaviour regarding all three strategies used in the game, whereas Table 3 summarizes risk attitude considering selling behaviour. There are clearly visible changes in buying and selling behaviour in risk averse and risk seeking category and stability in risk neutral category across all strategies. Strategies in which students did not take risk at all are CLS1&CLS2 in buying behaviour and CLS2 in selling behaviour. Strategy, which does not lead to risk averse in selling behaviour is CLS1&CLS2.

Strategy used	Number of students	Risk averse		Risk neutral		Risk seeking	
CLS1	18	2	11.11%	13	72.22%	3	16.67%
CLS2	11	5	45.45%	6	54.55%	0	0.00%
CLS1 & CLS2	8	0	0.00%	6	75.00%	2	25.00%
Total	37	7	18.92%	25	67.57%	5	13.51%

Table 3: Selling behaviour disaggregated over the type of strategy (source: own calculation)

Profitability Behaviour

The most students (60% for ROA and 81% for ROS) were the first in profitability (ROA, ROS) at their markets/games. In total 87% of students behaved profitably in the game. Despite that fact, only 41% of students did follow the objective of the game with no deviation (Results focused), 43% of students experienced deviation which undermined the main objective (Results neutral), and 16% of students experienced deviation disrupting the main objective (Results averse).

Strategy used	Number of students	Results averse		Results neutral		Results focused	
CLS1	18	1	5.56%	9	50.00%	8	44.44%
CLS2	11	4	36.36%	6	54.55%	1	9.09%
CLS1&CLS2	8	1	12.50%	1	12.50%	6	75.00%
Total	37	6	16.22%	16	43.24%	15	40.54%

Table 4: Results behaviour disaggregated over the type of strategy (source: own calculation)

Strategy used	Number of students	Profitability averse		Profitability neutral		Profitability focused	
CLS1	18	1	5.56%	0	0.00%	17	94.44%
CLS2	11	0	0.00%	1	9.09%	10	90.91%
CLS1&CLS2	8	1	12.50%	2	25.00%	5	62.50%
Total	37	2	5.41%	3	8.11%	32	86.49%

Table 5: Profitability behaviour disaggregated over the type of strategy (source: own calculation)

Table 4 shows the difference between strategies in results' focus. The most results oriented were students using the CLS1&CLS2 strategy (75% students) followed by CLS1 (44.44% students). The highest objective rejection is evident within the CLS2 (36.36%). We can assume as the most profitable strategies CLS1 (94.44%) and CLS2 (90.91%). Table 5 sumarizes all profitability behaviours with regard to all three strategies.

Discussion

Strategy Behaviour

Lowering costs of its operations, which was the strategy of all students in the game, is the 'Cost-leadership strategy' described by Porter (1998). To use this strategy, cumulative costs of a student must be lower than the cumulative costs of his/her competitors. The students used three ways to reach the cost-leadership in the game: (1) they controlled external factors affecting costs better than competitor (CLS1), (2) they improved balance of cost activities in the chain (in internal environment) (CLS2), and (3) they used both previous strategies in a combination (CLS1&CLS2). These findings perfectly fit with the Pohlmann's, Gardiner's and Heffes's (2000) view of the ways how to implement Cost-leadership strategy.

In general, we can say the students maintained within a low-level risk in the games (35% of games without any bankrupts, 46% of games with one bankrupts). In the real world, we usually cannot compare in which strategy the 'students' show higher risk in strategic management decision process or within the strategy implementation. In our context, using benefits of repeated experiment, we are able to determine any relation of strategy type and students' risk attitude. If we would express the risk in relation to the objective of the game (the highest possible amount of money earned by students), we can say that the higher number of events out of status quo (consciously decided by a student beyond the obvious gameplay) the higher risk attitude a student shows. Therefore, we can say, according to Table 1, that the strategies in which the students showed the riskiest behaviour were strategies CLS1 and CLS1&CLS2. Strategy in which students did not show such high level of risk behaviour was the CLS2.

Buying and Selling Behaviour

In the buying and selling behaviour students used the price setting, which had been the best prediction of real market price in each round. Real market price of materials and products is set by the one-round auction, where minimal price for buying material and maximal price for selling products exist. This mechanism of products' price setting set in the game is close to 'price leadership' strategy in real market's conditions. 'Price leadership is common in oligopolies whereby a price leader sets the price and all the other competitors feel compelled to lower their prices to match.' (Investing Answers, 2017) The conditions in the game best suit to barometric model of price leadership in which 'particular firm is more adept at identifying shifts in applicable market forces, allowing it to respond more efficiently within the market sector' (Investopedia, 2017)

Meanwhile the selling behaviour of a student directly affects the conditions of external environment, the buying behaviour directly affects the conditions of internal environment. This effect can be seen in Table 2, where the students undertaking CLS2 strategy are the riskiest in buying behaviour (27,27%) while in Table 3 we see they are the most risk averse in selling behaviour (45,45%). Similarly, the effect works almost the same for the buying behaviour. From Table 3 it is obvious that the CLS1 and CLS1&CLS2 are the riskiest strategies within the selling behaviour (16.67%, resp. 25%) and from Table 2 we can see, that the most risk averse strategy in buying behaviour is CLS1&CLS2 (25%).

As the students had a little or none knowledge in theory of cost-leadership or price-leadership strategy, there may be a premise the knowledge of strategy name, characteristics, the pros and cons, or even the strategy placement in the typology is not necessary for successful strategy execution in the game. The more important is to make an unbroken stream of good decisions, which we can than see as Mintzberg's point of view on strategy – pattern (Mintzberg, 1987).

We see from the previous results that there are two extreme types of behaviour among students in the game (CLS1 and CLS2) and their combination (CLS1&CLS2). In the game, students naturally split into three groups within the strategy affiliation. In the first group of extreme behaviours (CLS1), students missed the internal environment and, in the second one (CLS2), they missed the external environment. It is important to remind that the results of this analysis are based on the best games of participating students and the number of games they could play was not limited. We also expect no or little knowledge in theory as already mentioned. Therefore, we suggest that the most students are not either capable of holistic approach in the game (they are not able to create a stream of good decisions in both environments simultaneously) or they do not consider one of the business environments in the game to be important based on their experience from previous games. As Akan et al (2006) stated, there must be a low-cost leadership mind-set to achieve a low-cost advantage. We will consider these results in following research within the usage of qualitative methods and improved monitoring of students' development depending on finished games.

Profitability Behaviour

We consider results' behaviour in relation with the focus to the objective demonstrated by students in the game. The highest risk averse attitude (36.36%) and the lowest focus (9.09%) to results are present in CLS2. As students undertaking CLS2 are concentrated only on internal firm processes, they might lose sight of the main objective. On the other hand, strategies orientated to external environment show more focus to results (CLS1

44.44% and CLS1&CLS2 75%). This result leads to the hypothesis that more holistic strategy is also more focused to the aim. We will test this hypothesis in further research. The highest focus to profitable behaviour present strategies CLS1 (94.44%) and CLS2 (90.91%). The higher profitability in CLS2 is caused by lower investments in factories' purchases (Table 1). On the other hand, the highest profitability within the CLS1 was caused due to high number of students who invested in factories' purchases, as well as the students were able to bankrupt the opponents and increased market revenues.

Conclusions

In the article, we follow previous research (Švec et al, 2016) and we expand the outcomes of FactOrEasy® focusing on risk attitude in strategic management decision-making and strategy implementation. The students playing FactOrEasy® used in general Cost-leadership and Price-leadership strategies. They used the strategy naturally without previous deep theoretical knowledge. Only a minority of students could take an advantage of using the holistic approach to Cost-leadership strategy. Majority of students tended to miss the internal or external environments' settings. The level of students' risk attitude in the games was a lot less than we expected. Yet it is obvious that there is a certain level of risk in each of identified strategies. Unfortunately, we are not able to identify what strategy is the riskiest one in this moment as we do not have sufficient number of observations. Very important output for further work is that there is a group of students who, playing the CLS2 strategy, changed the initial goal for the intended goal and therefore missed the assignment. The conclusions we made in this article are only valid for the analysed sample. Thoughts, assumptions, and hypothesis arising from this study must be verified on samples with greater range.

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