DECISIONS FACTORS OF SIMULATION GAME PLAYERS ON THE PRODUCT MIX COMPOSITION

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Abstract: This paper analyses the behavior of players of a simulation game in the context of the composition of the product portfolio, the number of material ingredients and the necessary initial investments. The aim of the study is to provide knowledge for managers and entrepreneurs in optimizing investment strategies to achieve maximum results. The results show that investments in know-how have an impact on overall production and sales success, with higher investments associated with lower production and a higher percentage of successful sales. This study provides important insights for strategic decisions regarding the optimal allocation of resources and the use of know-how, with the aim of achieving competitive advantage and high results in the market.

Keywords: Simulation Game, Material Ingredients, Initial Investment, Production Size, Sales Percentage.

1 Introduction

This paper focuses on the analysis of the behavior of players of the simulation game, on finding out the causes of their decisions about the composition of the product portfolio, on the influence of various product parameters, the influence of the number of ingredients, the influence of the necessary initial investments. Previous studies have shown the positive effect of simulation games on managerial skills and managerial efficiency (Smutny et al., 2016). The findings reached in this paper extend the existing valuable knowledge for managers and entrepreneurs who strive to optimize their investment strategy and achieve maximum results.

The results of this study may have an impact on strategic decision-making in the corporate environment. Managers and entrepreneurs should consider the optimal allocation of their investment resources between increasing production and investing in know-how. Previous research reveals investing in know-how as a path to Industry 4.0 (Zangiacomi et al., 2020). By rationalizing production, reducing material requirements and lean production, the enterprise can achieve personnel savings (Shenshinov et al., 2020). The combination of these two factors can lead to optimal results and competitive advantage in the market.

2 Simulation Game

The game is a simulation of a market environment in which the player takes on the role of a manager of a manufacturing enterprise focused on the production of soft drinks. The main goal of the game is to establish and run a viable company that achieves positive economic results and generates Economic Value Added (EVA). The EVA indicator is measured as the product of net operating profit (NOPAT) and cost of capital (C × WACC). The EVA indicator was chosen because it allows the evaluation of the sustainability of a company (Jankalová & Kurotová, 2020). A key factor in achieving positive economic value is to achieve a higher return on capital than the alternative cost of capital.

The production process is a mix of inputs:

- Material: The manufacturing process requires a supply of materials. The player must always decide when and how much material to order if needed. Delivery times of material are one month. Individual types of products differ from each other by the material consumption of individual material items.
- Employees in production and administration: The player can decide to hire and fire production employees if necessary. Employees hired in each round are immediately available and their costs must be covered immediately. There are six categories of employees in production created with different levels of work performance and wage rates. Employees' work performance reflects their time efficiency but never reaches 100% due to absences caused, for example, by vacation or illness. Production workers without administrative support are not productive and still must cover associated costs, such as wages.
- Machines: The maximum production capacity of one filling line for a given product type is limited. There are three levels of the filling line – chaotic, disordered and ordered – and moving to the next level requires investment in the production process. It is important to note that production workers without adequate equipment are not productive, although the wages associated with them still must be paid.
- Production and storage facilities: The player has the option to decide to increase or decrease the production facilities if necessary. The labor and capital factors of production occupy a certain production space, which can be increased until capacity is filled. Materials and products occupy a certain storage space, and their quantities can be combined until the capacity is filled.

All inputs represent costs for the virtual business.

The key production factor is the production staff, according to whom the production capacity is managed. Exceptions are situations where employees in production do not have administrative support, capital support, or material support. This is a parameter where the simulation game exactly corresponds to the current reality and the near future in the environment of Industry 4.0 (Sgarbossa et al., 2020).

As part of the simulation game, the company can produce a portfolio of up to five soft drinks:

1. Soda water is a mix of 3 types of material and its introduction into production does not require any investment in know-how.
2. Lemonade is a mix of 4 types of material and its introduction into production does not require any investment in know-how.
3. Fruit drink is a mix of 4 types of material and its introduction into production requires a lower investment in know-how.
4. Juice is a mix of 3 types of material and its introduction into production requires a lower investment in know-how.
5. Energy drink is a mix of 6 types of material and its introduction into production requires a higher investment in know-how.

3 Player Behavior

3.1 Total Sales According to the Complexity of the Production Process, i.e., the Number of Inputs

The production portfolio of soda water, lemonade, fruit drink, juice and energy drink can be segmented into groups according to the number of ingredients and then monitor the players' decisions on the volume of production.

Products with 3 ingredients

- Total soda water sales: 7,034,131 pcs.
- Total juice sales: 4,880,131 pcs.

Products with 4 ingredients

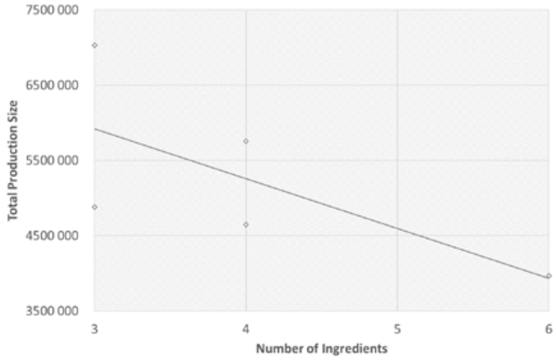
- Total lemonade sales: 5,753,907 pcs.
- Total sales of fruit drinks: 4,647,629 pcs.

Product with 6 ingredients

- Total sales of energy drinks: 3,970,620 pcs.

If the total production size is compared depending on the number of ingredients, the values shown in Figure 1 are found:

Fig. 1: Dependence of the Size of Production on the Number of Ingredients



Source: Authors

The number of products produced decreases by an average of 662,170 pieces with each additional ingredient. This conclusion shows a value of R-squared $R^2 = 0.472$ and a Pearson correlation coefficient r = -0.68705, which corresponds to a strong negative relationship.

3.2. Total Sales According to the Complexity of Commissioning, i.e., Investment in Know-how

The production portfolio can be segmented into groups according to the amount of necessary initial investments and subsequently monitor the players' decisions on the volume of production.

Products with no investment required.

- Total soda water sales: 7,034,131 pcs.
- Total lemonade sales: 5,753,907 pcs.

Products with a lower investment required.

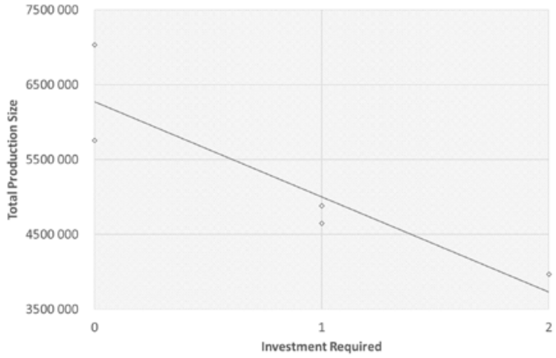
- Total sales of fruit drinks: 4,647,629 pcs.
- Total juice sales: 4,880,131 pcs.

Products with a higher investment required.

- Total sales of energy drinks: 3,970,620 pcs.

If the total production is compared with the necessary input investment for commissioning, the values shown in Figure 2 are found:

Fig. 2: Dependence of the Size of Production on the Investment Required



Source: Authors

The number of products produced decreases by an average of more than 1 million units with each additional stage of investment. This conclusion shows a value of R-squared $R^2 = 0.8122$ and a Pearson correlation coefficient r = -0.90122, which corresponds to a very strong negative relationship.

3.3 Percentage Sales According to the Complexity of the Production Process, i.e., the Number of Inputs

The production portfolio can be segmented into groups according to the number of ingredients and then monitor the success of sales.

Products with 3 ingredients

- Percentage sales of soda water: 93% of production sold.
- Percentage of juice sales: 96% of production sold.

Products with 4 ingredients

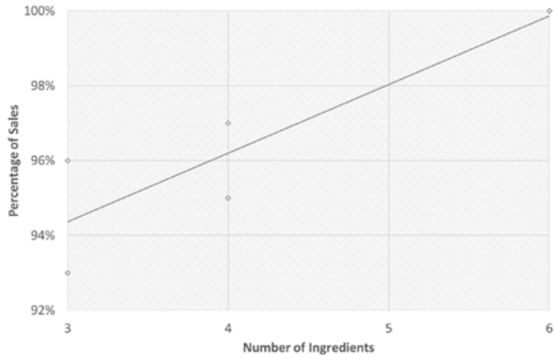
- Percentage of lemonade sales: 95% of production sold.
- Percentage sales of fruit drinks: 97% of production sold.

Products with 6 ingredients

- Percentage sales of energy drinks: 100% of production sold.

If the treatment, non-utilization, or sale of production is compared depending on the number of ingredients, the values shown in Figure 3 are found:

Fig. 3: Dependence of Sales Success on the Number of Ingredients



Source: Authors

The probability of selling increases by an average of 1.83 percentage points with each additional ingredient. This conclusion shows a value of R-squared $R^2 = 0.7525$ and a Pearson correlation coefficient r = 0.86746, which corresponds to a very strong positive relationship.

3.4. Percentage Sales According to the Complexity of Commissioning, i.e., Investment in Know-how

The production portfolio can be segmented into groups according to the amount of necessary initial investments and subsequently monitor the success of sales.

Products with no investment required.

- Percentage sales of soda water: 93% of production sold.
- Percentage of lemonade sales: 95% of production sold.

Products with a lower investment required.

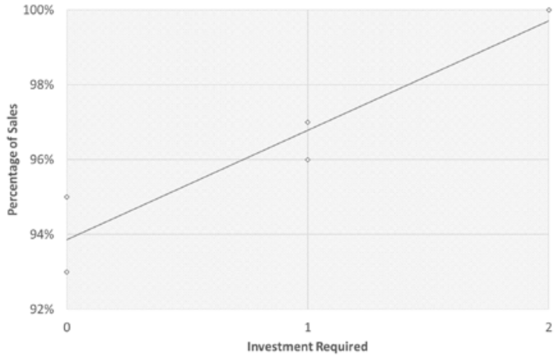
- Percentage sales of fruit drinks: 97% of production sold.
- Percentage of juice sales: 96% of production sold.

Products with a higher investment required.

- Percentage sales of energy drinks: 100% of production sold.

If the treatment, non-utilization, or sale of production is compared, depending on the input investment needed for putting into production, the values shown in Figure 4 are found:

Fig. 4: Dependence of Sales Success on the Investment Required



Source: Authors

The probability of a sale increases by an average of 2.93 percentage points with each additional investment step. This conclusion shows a value of R-squared $R^2 = 0.8961$ and a Pearson correlation coefficient $r = 0.946602$, which corresponds to a very strong positive relationship.

4 Conclusion

The investment required has the greatest impact on total production. These conclusions coincide with real-world research, both in the agricultural sector (Gavrilova & Fedorova, 2020) and in the industrial sector (Borisov & Pochukaeva, 2019). In a simulation game, the higher the need for investment in know-how, the lower the production of the product. The initial investment has the potential to discourage potential producers. Each additional stage of investment reduces production by more than a million pieces of finished products ($r = -0.90122$).

The success of the sale of the overall production is also influenced by the required investments. Also, these conclusions are consistent with empirical research on the real environment (Khidirov, 2023). The simulation game shows the results that the higher the need for investment in know-how, the higher the percentage of products successfully sold. If a player must try to achieve a result, he appreciates this result more and does not allow inefficiencies. Specifically, each additional investment level increases sales success by 2.93 percentage points ($r = 0.946602$).

The number of ingredients in the final product is not such a significant factor in this regard. A higher number of ingredients reduces the volume of production and increases the percentage of success of sales, but these dependencies do not have such a strong effect as was observed in the case of the required initial investment in know-how.

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