Design of the diversification classifier for agricultural entrepreneurs activities

Návrh klasifikátorů diverzifikace činnosti zemědělských subjektů

J. Hron, T. Macák, J. Huml

Czech University of Life Sciences, Prague, Czech Republic

Abstract: In current business management, diversification strategy is often connected to the possibility of creating a competitive advantage, based mainly on a wide range of production benefits. One of the critical factors to initiate diversification is the increasing frequency of changes in a company's environment, and also an increase in competitive pressure expressed by shortening a product's life cycle. As a result, the advantages resulting from both vertical and horizontal process integration are reduced. Because there are usually more innovative ideas to widen a business' activities than it would be normally possible to implement, it is essential to choose the ideas with the largest potential for commercial success. This article focuses on the design of classifiers that would enable the selection of designs for diversification, with the potential for commercial success.

Key words: diversification, classifier, agriculture, integrated system

Abstrakt: V současném podnikovém řízení je strategie diverzifikace často spojována s možností vytvoření konkurenční výhody založené zejména na výhodě z rozsahu produktů. Jedním z kritických faktorů pro inicializaci diverzifikace je zvyšující se frekvence změn v okolí firmy, a také zvyšování se konkurenčního tlaku, který se projevuje zkracováním životního cyklu produktů. Díky tomu se redukují výhody vzniklé při uplatnění strategie (vertikální i horizontální) integrace procesů. Protože inovačních nápadů na rozšíření portfolia podnikatelských aktivit je obvykle více než kolik z nich je ve zdrojových možnostech organizace prakticky realizovat, je potřeba vybrat ten s největším potenciálem komerčního úspěchu. Tento článek se zaměřuje na návrh klasifikátoru, kterým je možné selektovat koncepční návrhy diverzifikace s potenciálem komerčního úspěchu.

Klíčová slova: diverzifikace, klasifikátor, zemědělství, integrovaný systém

In order to ensure efficient resource utilisation, managers of small and medium-sized businesses constantly have to apply their production inputs and methods as best they can. The decline in their income over the last decade, has led to a reassessment of some commonly-used strategies, focussing on one particular kind of business that previously ensured large scale production benefits.

The Common Agriculture Policy reforms decreased the number of guaranteed prices of agricultural products and also increased the number of means accessible for the new businesses' support, let us say, new segments of agribusinesses. Therefore, many farmers got into a situation when they cannot count on their guaranteed sales for their recent production anymore and thanks to that, it is no longer efficient to execute a higher level of the processes' integration (including the vertical forward and backward integration).

Diversification strategy is commonly considered as growth strategy. Ilbery et al. (2006) also tried to define the term "diversification in agribusiness", moreover, they help themselves to understand by introducing the term "pluriactivity". Pluriactivity incorporates all profitable activities done by a farmer as a supplement to the conventional agro production, whereas the diversification incorporates only such profitable activities that are done within a farm.

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Ilbery (1991) sees diversification as one of the applicable strategies that could be used by agribusinesses. He ranks among the diversification activities only ”based on farm” business activities, that are not directly linked with crops´ and animals´ production and that are directly linked with production outside the agro production. He also sees farmers as businessmen, but emphasizes on the usage of the production factors, originally used for agro production in terms of non-farm business activities.

McNally (2001) has a similar point of view, he links diversification with development of the non-farm, or more precisely, the non-food production.

The most often determination is diversification of income sources. The second approach is focused on production factors of agribusiness and sees their usage more in other area than conventional agriculture. The third approach emphasizes on farmer as a businessman (Hron et. al. 2007).

Porter (1994), based on analyzing many diversified businesses, describes the possibility that diversification leads to the counterproductive effect – namely to lowering instead increasing the profitability of a business. The key factor of the commercial success of diversification is the relative high so-called administrative (temporary) costs. The main reason for the diversification commercial failure is that the temporary costs are higher than the value raised from diversification.

There are several ground reasons that lead private farmers to search for various income sources through the production diversification. During 2007–2009, there was a research based on the issues on which the most common agricultural diversification impulses are determined (Hron et. al. 2008):

- Interest in further business development, where there are already used all possibilities from the recent production intensification.
- A natural need to use production factors that have not been used hitherto.
- Problem to sell the recent agro production.
- Aim to obtain state supports.

For example, it is possible to state the most common examples of similar agro production diversifications realized by farms, according to Prag (2002), which are: cycling, agro-tourism, fishery, helix-culture, alternative crop-plants, riding stables, sailing and windsurfing, sport and recreation, farm retail activities.

OBJECTIVES AND METHODOLOGY

The classifier for evaluating the fundamental presumptions for successful diversification will be created based on the ground methodology for the logical management (using synthesis of logical function), as a tool for determination of the measured reality. Based on this theoretical basis, an integrated system that would be used as a system to decision support will be designed.

Before the actual usage of the classifier, it is proper to meet the factors that will most likely influence its usage (the identification of opportunities for the possible diversification), the preparation of a diversification project, the diversification realization and projects’ evaluation (in more detail, Hron et al. 2008). Data sourced from the post-audit could be used for simulating the already existing projects of agro-diversification on the designed classifier. This simulation is possible to be adjusted for the classifier trouble free function.

Therefore, the main purpose of this contribution is to create a classifier – an integrated system for decision supports – that would enable to automatically differentiate the perspective intention for diversification from the non-perspective ones. The need for such classifier creation results from the fact that there are usually more diversification ideas when it comes to the particular private farmer but there are just few that are possible to realize afterwards. Therefore, if the vision for the strategic diversification aims to be successful, its generator has to choose first the one which is most likely to have a commercial success (more likely the one with the best lay-out of business risks) and then he/she has to negotiate the suitable realization conditions.

RESULTS AND DISCUSSION

We have to establish four binary variables for the oral formulation of the classifier’s function to differentiate the perspective vision of strategic diversification.

First, we will define the system inputs to evaluate the strategic diversification potential and its binary association:

Diversification criteria (coefficient):

$$K_i, \quad \text{where } i \in \{1,2,3\} \text{ and } K_i \in \{0,1\}$$

Innovation coefficient:

$$K_1 = \prec \begin{matrix} 0 \\ 1 \end{matrix} \succ \textit{coefficient ZPKI} \prec \begin{matrix} \text{occur between } \langle 0;\ 0.5 \rangle \\ \text{occur between } \langle 0.5;\ 1 \rangle \end{matrix}$$

Criteria (coefficient) K_1 – Residual potential of commercialized diversification (ZPKD) represents the actual potential in the product competitiveness that was created thanks to the product's portfolio diversification by the particular private farmer. This is caused by two factor aggregation: The product (business plan) residual time created within diversification t_R, that is expressed through the time rate between the time of the used change in the producer's portfolio and the assumed time of diversification lifecycle (time that the farmer has the production capacity available for production during the diversification activities). The other factor is the so-called Product Residual Unsaturation created within diversification n_R, which is characterized by the relation among the number of producers that already commercialized similar products and the number of producers that (not only within their activities' diversification) use the market opportunity (or are motivated by grants) to modify their production portfolio during the lifecycle of the private farmer's diversified activities life cycle.

In case we want the ZPKD to be the quantity with growing values preferences, it is essential to subtract the residual time t_R and the residual saturation n_R from 1. Then we count the residual diversification time t_R as:

$$t_R = 1 - \frac{t_i}{t_n} \tag{1}$$

where:

t_i = the time of the product usage that is created within the activities diversification (in years)

t_n = assumed time of the realized diversification lifecycle (in years).

The residual innovation unsaturation n_R is expressed as:

$$n_R = 1 - \frac{n_i}{n_n} \tag{2}$$

where:

n_i = the number of producers that already commercialized a similar product (to the product created within the diversification activities)

n_n = the estimated number of producers that use a similar product to modify their product portfolio during the diversification life.

Due to the fact that both t_R and n_R are ratio quantifiers, it is possible to fuse them or to intersect them. If we define the domain of definition for ZPKD as: $ZPKD \in \langle 0,1 \rangle$, it is necessary to define the residual potential of commercialized diversification by the intersection between t_R and n_R:

$$ZPKD = \sqrt{t_R \times n_R} = \sqrt{\left(1 - \frac{t_i}{t_n}\right) \times \left(1 - \frac{n_i}{n_n}\right)} \tag{3}$$

ZPKD is formed by the square power because variations t_R and n_R are being multiplied from the maximum values. Therefore, it is essential to extract the square root of these variations to make the ZPKI representative as a one-dimensional quantifier (as a geometric average). For instance, a product, made thanks to the farmer's business activities diversification, hit the market one year ago and has the supposed 5-years long lifecycle's length. A similar product has been produced by 2 out of 4 competitors.

According to (3) ZPKD is equal to:

$$ZPKD = \left(1 - \frac{1}{5}\right) \times \left(1 - \frac{2}{4}\right) = 0.632 \approx 63\% \text{ from } \max(ZPKD)$$

If we assume a linear growth in number of producers in time, using the particular market urge (state grant policy, supply leakage in the particular market segment, etc.), the reference value of the ZPKD will occur between ⟨min *ZPKI*, max *ZPKI*⟩ and it is in value 0.5. The question is, whether the ZPKD should occur in front of the 0.5 borderline or behind. Of course there is an answer that the ZPKD should be higher than the reference value 0.5 (ideally equal to maximum that is 1). However, this single-valued definition does not respect the differentiated business strategies that use besides diversification strategies also integration strategies. Exactly those agro-businessmen that use for instance vertical integration (forward and backward) to create a competitive advantage could be advantageous to establish a product that has the ZPKD value smaller than 0.5. This contribution focuses mainly on evaluating the efficiency of strategic diversification that is applied on its production portfolio. Someone, who tries to set a competitive advantage based on business activities risks lay-out, will a priori assume that the ZPKD value should be above the 0.5 value (max = 0.5) for the positive innovation judgment.

Criteria (coefficient) K_2 – Financial evaluation of the necessary investment to diversification realization

$$K_2 = \prec \begin{matrix} 0 \\ 1 \end{matrix} \succ NPV \prec \begin{matrix} \text{has positive value, 0 included} \\ \text{has negative value} \end{matrix}$$

There are many of various dynamic methods used for investments evaluations (concerning the development and implementation of the particular product portfolio diversification), such as the discount time of return, the internal profit ratio etc.) NPV method – Net Present Value – which enables the immediate recognition of non-profitable investment (it commonly equals to 0). If the investment is financially non-profitable, this method enables to clearly compare it with other innovation alternative which will be more profitable. Net Present Value is calculated as:

$$NPV = \sum_{i=1}^{n} \frac{CF_i}{(1+r)^{t_n}} - IN \tag{4}$$

where:

CF_i = Cash Flow in i-time of commercialization of a product created within diversification

t_n = assumed time of commercial usage of a product from the diversified processes

IN = total investments necessary to create a new product

r = discount coefficient.

Coefficient (criteria) K_3 – Risk of the innovation commercial success

Business risk, connected to commercial success of the offered product, is commonly defined by probability factors We estimate the empirical record that is helpful while recognizing these. We divide those into the relative percent occurrence through the histograms and the additive curve. Based on the probability division law, we try to find the probabilities of the particular values of the random quantity. Discrete quantities characterizing the risk of the new product's/service's development are usually described by this law. By a certain level of abstraction and fulfilment of the condition of the "properly short" period of marking the monitored quantity (for example product's demand), we are able to mould the discrete quantity upon the probability volume $f(x)$ – as the following relation:

$$P(x_1 < X \leq x_2) = \int_{x_1}^{x_2} f(x)\, dx \quad (5)$$

Random quantity X reaches values x and particular probability $P(X = x_i)$ for each x_i reaches values $p(x)$. Furthermore, this random quantity X reaches values x in the interval (x_1, x_2) with the probability that equals to $f(x)$ integral after increments dx when the following conditions are fulfilled:

$$x_1 \leq x_2 \text{ and } \int_{-\inf}^{+\inf} f(x)\, dx = 1$$

The probability of risk factors actions could be also described by the distributional function $F(x)$ that refers to $P(X \leq x)$.

This article aims to provide the ground methodological outputs for the common recognition of the non- prospectiveness of diversification activities that could occur based on the business failure of new products. While materializing causally the not successful diversification, its output products will represent the not useful stress for the possible future development of an agribusiness. The main approaches for the common evaluation of diversification risks (without the less known distributional function) are grouped in terms of the expert systems methodology (mainly the diagnostic ones as declared and the procedural knowledge updated in the managing mechanism).

That is why the diversification risks – K_3 coefficient will be expresses by the fundamental analysis.

$$K_3 = \prec \begin{matrix} 0 \\ 1 \end{matrix} \succ NPV \prec \begin{matrix} \text{change in two or more fundamental factor} \\ \text{change in two or more fundament risk factor} \end{matrix}$$

To ensure that the risk of the commercial success of products made within diversification activities of an agribusiness was not very high, only one fundamental factor could be changed in the time interval from the beginning of a development to the time of commercial usage of diversification outputs. These factors are:

1. The value of gained revenues from production that was raised within diversification activities – it is smaller that the value planned (predicted) by more than the allowed variation (represented for instance by the minimal profit margin for the company's maintainable development).
2. Proper parameters influencing the product demand size – that is a diversification outcome representing constants in the particular time interval.
3. Environment defects as substitutes – resulting in the customers' diversion, or as a new competitor entrance – resulting in the market share decrease of new introduced product, did not occur in monitored time period.

Now we can define an output from the system managing mechanism for classification of the commercially perspective and non- perspective diversifications (more likely to support the decisions and efficiency of the particular diversification type):

$$\text{Y} = \prec \begin{matrix} 0 \\ 1 \end{matrix} \succ \textit{diversificationactivities} \prec$$

$$\prec \begin{matrix} \text{fundament of supposed commercial failure} \\ \text{fundament of supposed commercial success} \end{matrix}$$

Table 1. Summary of possible criteria values influencing successful composition of diversification activities

Stav	K_1	K_2	K_3	Y
1	0	0	0	0
2	1	0	0	1
3	0	1	0	**0 !** (the worst combination)
4	0	0	1	0
5	1	1	0	0
6	0	1	1	0
7	1	0	1	**1 !** (the best combination)
8	1	1	1	1

We have to search the following function:

$$Y \approx f(K_1, K_2, K_3)$$

of three input variables and we want them to fulfil all possible situations that could occur. The number of maximum possible situations that could occur, if there are n input variables, results from the total of combinational numbers:

$$N = \binom{n}{0} + \binom{n}{1} + \ldots + \binom{n}{n} = 2^n \qquad (6)$$

Therefore, the maximum number of situations for n = 3 is 2^3 = 8. The summary of all possible situations is pictured in Table 1 that characterizes the situation whether in the appropriate criteria combination (coefficients – factors) $K_{1,2,3}$ meets the fundamental hypothesis of the commercial new product ($Y_{1,2,3}$ = 1) or whether there is a causal hypothesis of a commercial failure ($Y_{1,2,3}$ = 0).

Combination function for *Y* output

As we can see from Table 1, the synthesis in the form “total of products” affects only 3 combination rows in comparison to 5 synthesis rows in the forms “product of totals”. To make it easier, we will note just the second, seventh and eight row of Table 1. The combination function characterizing the causal presumption of commercial success/failure of a product incurred thanks to *Y* diversification. The can easily get is from adding the requirements stated in rows 2, 7 and 8:

$$Y \approx f(K_1, K_2, K_3) = \left(K_1 \times \overline{K_2} \times \overline{K_3}\right) + \left(K_1 \times \overline{K_2} \times K_3\right) + \left(K_1 + K_2 + K_3\right) \qquad (7)$$

The technical system realization for decision support is pictured in Figure 1. The integrated circuit combines two universal elements: the NAND (Sheffer’s function: negation of a product) and the NOR (Pierce’s function: negation of a total). The scheme pictured in Figure 1 enables the classifier program for instance in the language in block schemes or use it as a ground for programming in another (higher) language.

CONCLUSION

The main reason for the current implementation of the diversification of activities, not only in agricultural

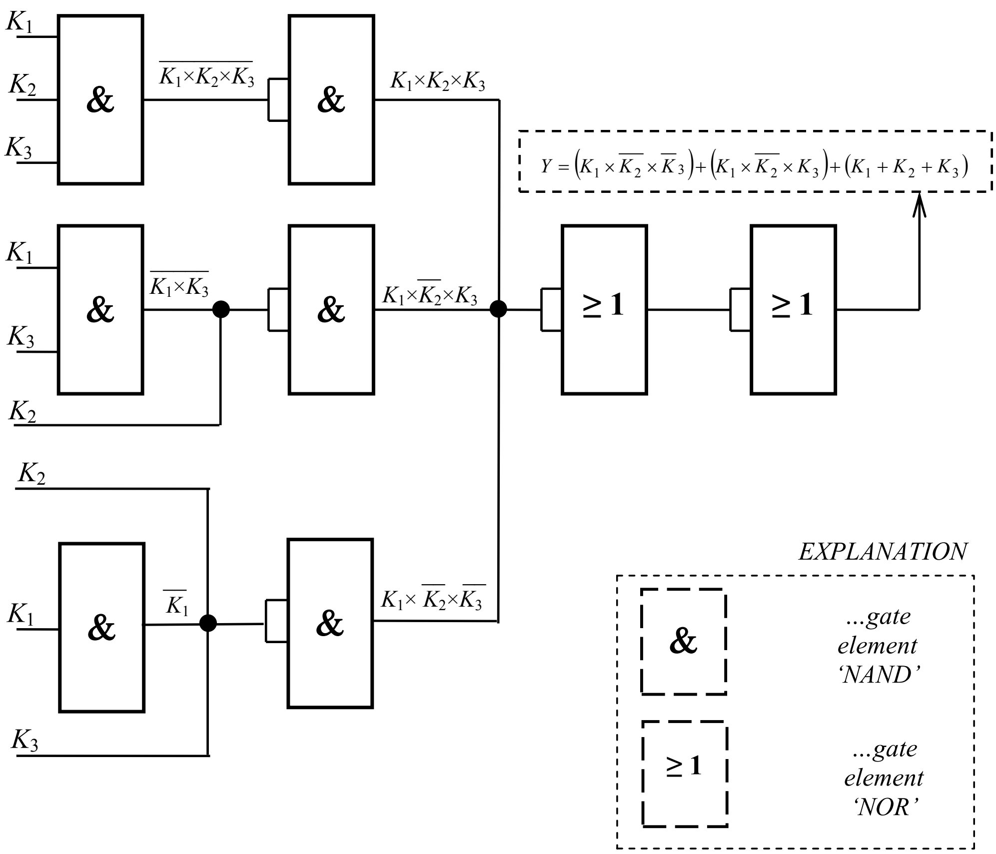

Figure 1. The designed integrated circuit represents a technical realization of the diversification classifier according to 3 criteria influencing the commercial success of the new offered product

production is to reduce investor risk through a broad portfolio, which allows one to relativise the impact of fluctuations in the value produced. In other words, if there is one part of product portfolio temporarily ineffective, it appears in the total on a little; the revenues from other product portfolio compensating for the loss. The correlation rate of particular products of a producer's portfolio is a limiting factor of this compensation. If there are substitutes in the producer's portfolio, the correlation among these products is positive and it is essential to sense it positively (from the producer's investment risks point of view). If there is a preference diversion (e.g. change in consumers behaviour) of one of the products, the decrease is often compensated for by the increased demand for its substitute (mainly in case of a non-essential product). Conversely, negative correlation in demand behaviour could be advantageous if the producer's portfolio is non-essential (i.e. its products have big price elasticity).

The designed classifier illustrates principles on which is possible to create tools to support decision-making, based on the effectiveness of the diversification of production processes. However, it is not able to involve all the factors and their connections that could influence the quality of the decisions. Therefore it must be understood that this classifier is a supporting and methodological instrument, whilst the final word has to be given to the manager or owner of the particular agricultural business who can evaluate the decision situation using his experience, knowledge and intuition as well as from the formal logic.

REFERENCE

Hron J., Štůsek J., Arnošt M., Huml J., Platilová-Vorlíčková L. (2007): Diversification – strategy of building the competitive advantage in agribusiness, Agriculture Economics – Czech, *53* (12): 531–553.

Hron J., Štůsek J., Arnošt M., Huml J. (2008): Diversification strategy in small and medium size agribusinesses in the Czech Republic – impulses for searching business opportunities. Agriculture Economics – Czech, *54* (11): 505–509.

Ilbery B.W. (1991): Farm diversification an an adjustment strategy on the urban fringe of the West Midlands. Journal of Rural Studies, *7* (3): 207–218.

Ilbery B., Maye D., Watts D., Holloway L. (2006): Research into the potential impacts of CAP on the diversification activities of tenat farmers in England. Baseline study EPES 0405/05.

McNally S.: (2001): Farm diversification in England and Wales – what can we learn from the farm business survey? Journal of Rural Studies, *17* (2): 247–257.

Prag P. (2002): Rural Diversification, Estate Gazette, London; ISBN 0 7282 0371 5.

Porter E.M. (1994): Konkurenční strategie (Competitive strategy). Praha, Victoria Publishing; ISBN 80-85605-11-2.

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Contact address:

Jan Hron, Tomáš Macák, Jan Huml, Czech University of Life Sciences Prague, Kamýcká 129, 165 21 Praha 6-Suchdol, Czech Republic
e-mail: hron@pef.czu.cz, macak@pef.czu.cz, huml@pef.czu.cz