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3.1. METHODS FOR COMPLEX DECISIONS ON AGRICULTURAL INVESTMENTS

Summary
Complex decisions on technical investments determine the activity and future success of the enterprises of the agricultural sector. The preparation and formation of the investment and the selection of the final version are essential for both the companies and the national economy. The primary objective of this paper is to develop the decision making process, particularly focusing on the investment efficiency aspects. Our Institute (Institute of Engineering Management) has been doing researches for several decades on agricultural investments. The earlier created theoretical model has been developed in several aspects. The new model will contribute to a more accurate foundation of the agricultural investments and hopefully to a more efficient utilization of the financial resources. One of the most difficult tasks of the enterprises is to find the right way and tools from the business strategy goals to the actual development plans. Most of the SME-s do not consider important to have a written plan. Determining the content, the volume and the quality of the project result requires great caution due to the agricultural particularities and to the multifunctional characters of the agricultural activities. This paper focuses on the new elements and the practical utilization of the developed model. The decision preparation model consists of seven steps which are briefly presented.

Keywords: agricultural investments, decision-making process, choosing assets

Introduction

The Hungarian agriculture can be improved by continuous technical development. The advancing quality standards set serious requirements against the technical means and resources of the sector. A significant portion of the production costs about 60-70% is spent for machinery. For this reason the efficient utilization of the amounts invested as equity capital, debt capital or state subsidy is of crucial importance (Illés et al., 2011).

The primary objectives of this paper are to overview and develop the decision preparation process, particularly focusing on the investment efficiency aspects. Several years ago a theoretical model was created (Daróczi, 2007) focusing on the following areas:

- finding the right way from the business strategy goals to the actual project result,
- justifying and determine the different development versions,
- purchasing vs. hiring,
- choosing the certain physical asset based on complex criteria,
- tendering the financial possibilities,
- justifying the investment from an economic point of view,
- taking risk into consideration.

This paper focuses on the first five elements of the earlier developed model. The aim of the improvement is to increase the practical use of the decision-preparation model. Clarifying the role of the different management methods applied for the project result determination (Meredith and Mantel, 2011).

The "structural plans" used in planning projects, the "weak-point analyses" as a useful management method and the proper use of the so-called "balance equation" can help to justify and to determine the different versions of development. The simplified "break-even analyses" offers a solution to choose between purchasing or hiring the given physical asset. The model indicates the quantity range of work above which purchasing or under which hiring is justified. Choosing the certain physical asset based on complex criteria is also part of the theoretical model. Technical, technological, economic, ergonomic, environmental and other considerations have to be made before selecting the actual asset. Tendering the financial possibilities, justifying the investment from an economic point of view will be presented in the last part of the presented model.

Material and methods

According to my objectives, I reconstructed a dynamic and symbolic model that can be applied more successfully in preparing decisions of investment. The functioning model contains the "structure plans", the "weak-point analysis", the "balance equation", and the simplified "break-even analysis". During the reconstruction of the model, I followed the below mentioned seven steps of the complex process of decision-preparation.

- The structure plans are used in strategy based project management as useful tools of project defining. The function targets of the project result and the necessary technical means can be determined by these structural plans (Görög, 2007).
- The weak point analysis as a management method is used to find solutions for complex problems in a structured way. It is a useful method when we evaluate the actual state of the existing, available technical resources from different point of view.
- The proper elaboration of the so-called "balanced equation" indicates the quality and quantity of work which can be done through the planned machines and means at a given time. The calculations can be based on the production structure and the applied production technologies of the enterprise.
- The classical form of simplified "break-even analysis" as a part of the dynamic model is a useful tool to choose between purchasing or hiring alternatives (Husti, 2011).
- For the complex comparison of the various technical, economic and ergonomic properties the different features have to be converted with mathematical tools in order to be comparable (Temesi, 2002).
- Basic equations and model calculations were created to evaluate the different financial versions based the purchase on equity capital, debt capital or leasing (Witney, 1998).

Combining the listed management tools the main parameters of the project result – quantity and quality dimensions, the time dimension and the budget can be determined. The functioning model runs under MS Excel, which is widely known and does not require a deep knowledge in computer science.

Results and discussion

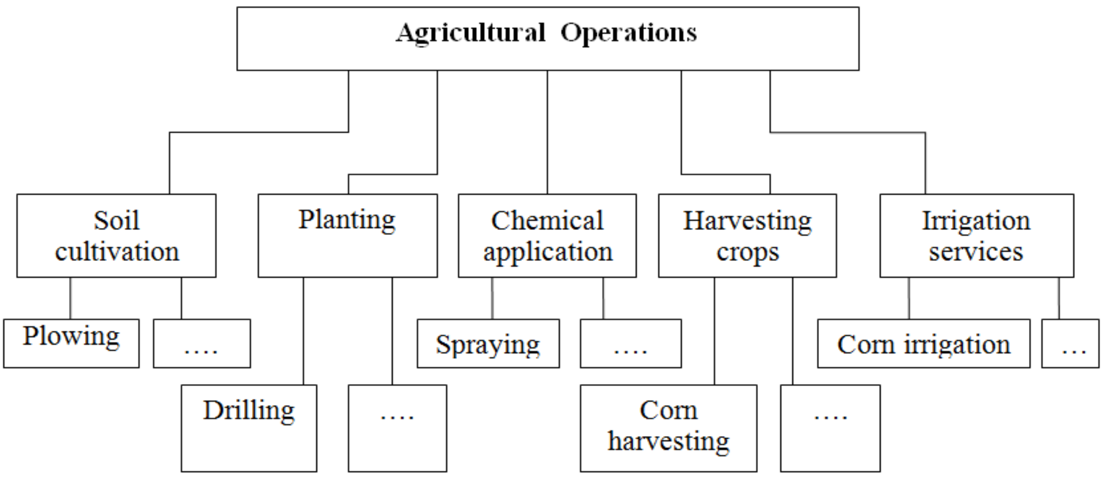
One of the most difficult tasks of managing an agricultural enterprise is to form the actual development versions and to make the decisions related to their realization. Determining the content and the volume of the project result requires great caution due to the agricultural particularities and the multifunctional character of the applied farming technologies.

It is critical to spend adequate time at the beginning of the project to study, discuss and analyze the given situation and the strategic goals of the enterprise. The complex process of defining the planned project result consists of several related steps.

Clarifying the functions

The first step of the decision-preparation is clarifying the functions of the given organization or department of the enterprise. These functions are basically originated from the market needs which depend on several aspects such as the economic and natural environment of the enterprise. The "function-target structure" is a useful management method which is widely spread in project management. It is a hierarchic system of certain functions and can help to determine the demanded functions. In the peak of the structure stands the project result followed by the main functions which can be further broken down to elementary levels.

Figure 1: The "function target structure" of the agricultural contractor



Source: own construction

As an example, Figure 1 shows a part of the "function-target structure" of an agricultural contractor. The examined agricultural contractor provides a number of services including agricultural operations such as soil cultivation, planting, widespread chemical application, harvesting crops and irrigation services. It means that all the demanded functions are listed in the structure.

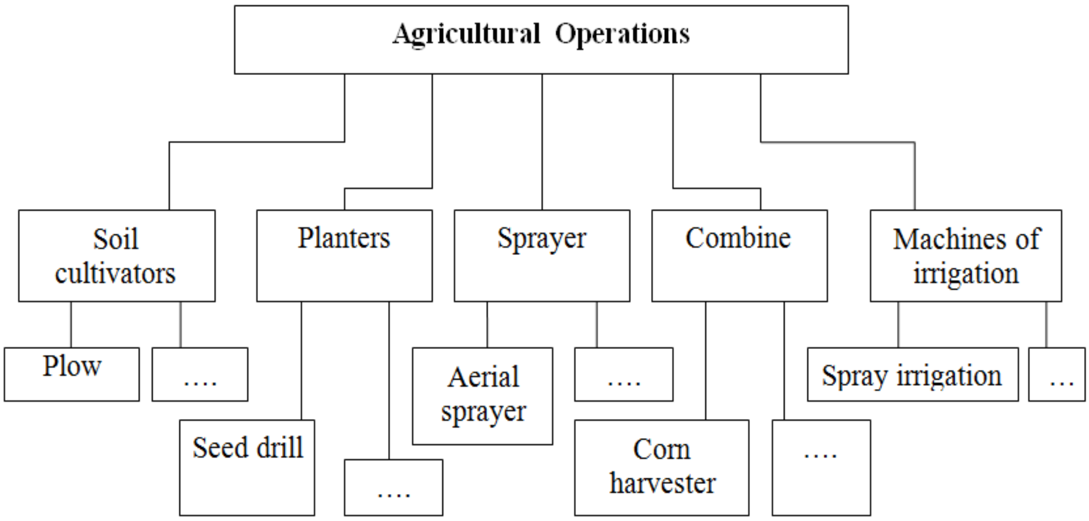
A completed hierarchic system shows all the farming technologies and different services which are demanded by the customers and other farmers in the region. In case of a newly established enterprise the structure has to be constructed from the basic functions and then can be developed with new functions according to the market needs and to the financial possibilities of the enterprise. The function-target structure should be broken down to a depth, where the capacity, the dimensions, the quality and the environmental requirements - necessary for being able to accomplish the project - become evident related to certain abilities.

Determination of the certain assets

The second step of the decision-preparation process, after the exact determination of the functions, is creating the "function-carrier structure".

The function-carrier structure is also a hierarchic system of machines, means and equipment which contribute to set the function in action or to keep it in action. The constructed function-carrier structure is capable of specifying the result of the project, in other words, to determine the required machines and means for the examined enterprise (Figure 2).

Figure 2: The "function-carrier structure" of the agricultural contractor



Source: own construction

As we have known all the demanded functions and machines the preliminary project definition can be completed, but the considerable part of the development projects are not realized as "green-field" investments but for modernization of the existing means, expansion of the existing functions, or creating new functions. Therefore, the planned developments should be fitted to the existing technical background, or rather examined if it is capable of serving its function.

The "weak-point analysis"

In the third step of the decision-making process, the quantitative and qualitative composition of the demanded machinery must be compared with the existing, available machines and equipment of the enterprise. It is a difficult and complex task because many aspects and specifications have to be taken into consideration. The "weak-point analysis" is a breaking-down method of the management techniques, aimed to examine complex systems in a structured way. It helps to structure the problem and to find the main reasons and right solutions (Susánszky, 1982). The examination of different agricultural operations and complementary activities by the tool of "weak-point analysis" is very useful for determining the current situation of a department or an enterprise from biological-, technological-, technical-, economic-, and human related point of view. The essence and also the advantage of this method is that the analysis can be extended to the complete innovation chain, or can be used just for a part of it (Assen et al., 2009). Complicated and complex activities can be observed more effectively at a necessary depth after breaking it down to smaller parts. To carry out a "weak-point analysis" or construct structure plans, the required breakdown depth should be determined which needs a serious theoretical knowledge and practical experience as well. Since there is no general rule for this, it is always determined by the actual target and the circumstances.

As an example, Table 1. shows a part of the "weak-point analysis" of the examined agricultural contractor. The rows of the matrix contain the technical, ergonomic and environment related reasons, causes of the development, while the columns represent the economic consequences coming from the given situation. The applied matrix can be replaced or extended with other or new reasons and consequences.

Table 1: The "weak-point analysis" of the agricultural contractor

Consequence / Reason	Quantity loss	Quality problems	Change/ replace	Extra costs	Less income	Missing function	....
Hazardous			M_1				
No more operation						E_1	
Pollute environment				E_2			
Technologically out of date		M_2					
High energy consumption				M_3,E_3			
Unreliable					M_4		
Economically out of date					E_4		
Low capacity	E_5				M_n		
Low performance			E_m				
....							

Where: M_1 – M_n machines, E_1 - E_m equipment
Source: own construction

For the successful analysis, the matrix should be extended to the whole range of machines and means of the enterprise, including each sector, branch, all the farming technologies, the activities and operations to be carried out. The weak-point analysis delivers the available means, while structure plans points out the required physical means. Comparing the two results makes clear which machines and means ought to be replaced, converted or obtained.

The "balance equation"

The fourth step of the decision-preparation process aims to determine the amount of farming operation which should be performed in certain duration of time. Beside the former "structure plans" and "weak-point" analysis, the "balance equation" method should be also used to determine the degree of supply of physical means. This "balance equation" or rather inequality method is well known in the related papers (Husti, 2011).

$$m \leq x * h * p$$

where:

m: quantity of the work to be done [shift-hours, nha]
x: number of the machines [pcs]
h: term available for the accomplishment of the work [shift-day]
p: specific capacity of a given machine or tool [ha/shift-hours].

The calculation was based on the production structure and the applied farming technologies. The proper elaboration of the equation indicates the quality and quantity of work which has to be done through the planned machines and means at a given time. Table 2. shows an example for the basic input data to the calculation

Table 2: Basic input data for the "balance equation" calculations

	Months					
	May	**June**				**July**
Decades	**…**	**1.**	**2.**	**3.**	**0.**	**…**
Shift-day/decade *(days)*	…	7	7	7		…
Shift-hours/day *(hours)*	…	10	10	10		…
Number of machines *(pcs)*	…	3	4	2		…
Machine capacity *(hours/decade)*	…	210	280	140		…
Capacity demand/decade *(hours)*	…	80	70	110		…
Capacity demand/month *(hours)*	…	110	240	90	440	…
+/- capacity demand *(hours)*	…	-20	**30**	**60**		…

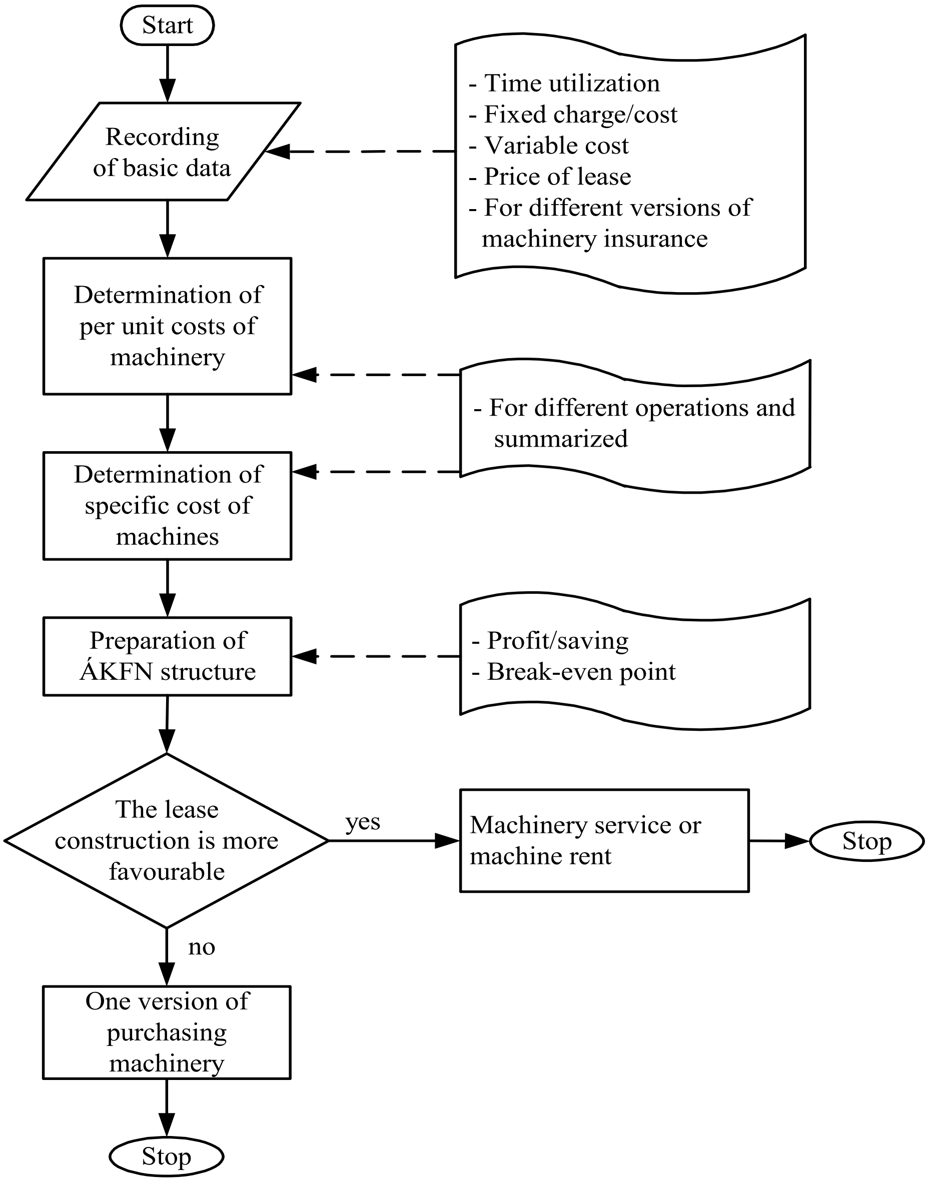
Source: own construction

Based on this information the actual project and development versions can be created. If the results of the analysis indicate that further machines or means are required for the enterprise, it should be examined which way they can be obtained.

The "break-even analysis"

In the fifth step of the decision-making process the simplified "break-even analysis" offers a solution for deciding between purchasing machines or hiring contractors (Sullivan et al., 2011). It indicates evidently the quantity range of work, above which the former, and under which the latter is more advantageous. Beside the arising fixed and variable costs, the model shows the realized savings as well. Figure 3. summarizes the process of revealing of the possible ways to meet the demanded physical means.

Figure 3: Break-even analysis for - purchasing vs. hiring machines



Legend: ÁKFN structure is used for calculating revenue (Á), costs (K), margin (F) and profit (N).
Source: own construction

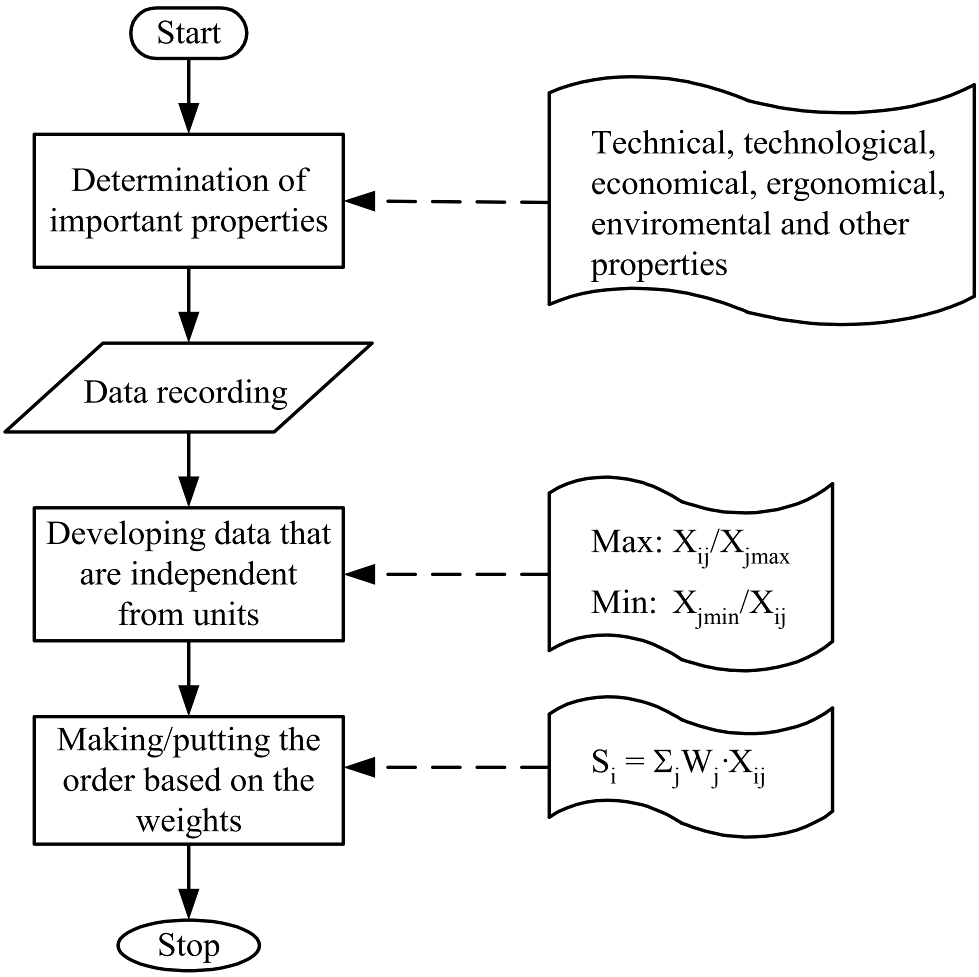
The comparing of complex criteria

This part of the model is for selecting the actual physical means and development version. On the buyer's market several dozens of means, equipments and technical solutions are available for the investor. Therefore, technical, technological, economical, ergonomic, environmental and other considerations have to be made before selecting an actual model.

For the complex comparison, the various features have to be converted in order to be comparable, i.e. the units should be eliminated and they must have the same direction. Generally, half of the characteristics (X_1- X_n) are correct if they reach the maximum, while the other half of them (X_n- X_m) if they reach the minimum value. But it can also occur that correct values are others then the extreme ones. Different characteristics must be converted to have the same direction.

If the single aspects cannot only be put in order of importance, but they can also weighted according to their importance, then the order among the possibilities will be defined by the weighted sum of the values (Figure 4).

Figure 4: Complex evaluation of the development versions, putting them in order



Source: own construction

The financing possibilities

This part of the model deals with the financing possibilities and their tendering which should be acquisitioned to provide the required means. There are more financing models that can be taken into account during the preparation of the investment decision (Table 3).

Table 3: List and denotations of the essential financing versions

Denotation	Name of the version		Denotation
A	Investment from own resources	Using subsidizations	**E**
B	Investment from credit	Using subsidizations	**F**
C	Acquisition through financial leasing	Using subsidizations	**G**
D	Acquisition through financial leasing investing own sources		
H	Acquisition through financial leasing using subsidizations and investing own sources		

Source: own construction

The following scheme of model calculation helps better understanding of the tendering process (Table 4).

Table 4: Basic data and quantities used in the calculations

Bé:	Market value (HUF)	**Lht:**	Repayment of leasing credit (HUF)
Se:	Own resource (HUF)	**Lhk:**	Interest rate of leasing (%)
B_0:	Total expenses (HUF)	**Tn:**	Increase of capital (HUF)
B_0*:	Present value of the total expenses (HUF)	**Tnk:**	Interest of the investments (%)
D_t:	Discount rate (%)	**T:**	Subsidization (%)
Ht:	Capital redemption of credit (HUF)	**Hkt:**	Interest rate subsidization of credit (%)
Hk:	Redemption of interest of credit (HUF)	**Lhkt:**	Interest rate subsidization of leasing (%)
Hkl:	Interest rate of credit (%)		

Source: own construction

The basic equations used in the calculations are summarized in Table 5.

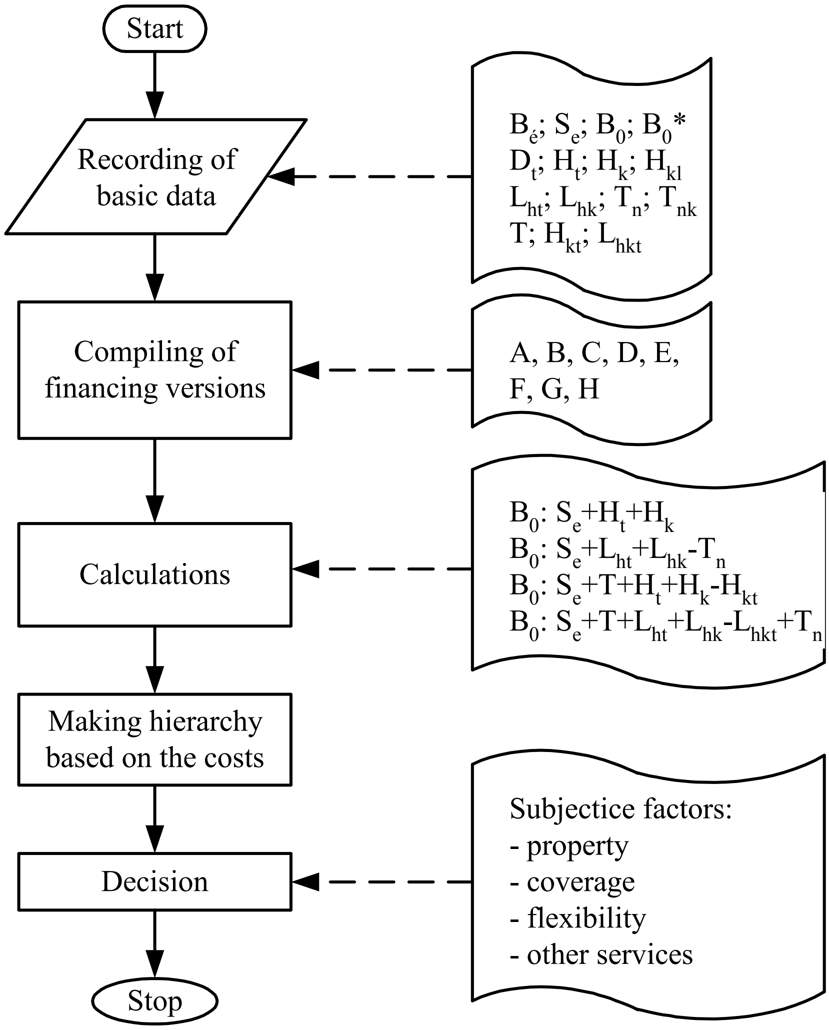
Table 5: Basic equations used in the calculations

Version	Equation	Version	Equation
A	$\mathbf{B_0}$ = Se	**E**	$\mathbf{B_0}$ = Se + T
B	$\mathbf{B_0}$ = Se + Ht + Hk	**F**	$\mathbf{B_0}$ = Se + T + Ht + Hk – Hkt
C	$\mathbf{B_0}$ = Se + Lht + Lhk	**G**	$\mathbf{B_0}$ = Se + T + Lht + Lhk – Lhkt
D	***B₀*** *= Se + Lht + Lhk – Tn*	**H**	***B₀*** *= Se + T + Lht + Lhk – Lhkt + Tn*

Source: own construction

The most favorable financing solution for the entrepreneur is the one that has the lowest expenses in the given situation and bringing the highest increase of income and having the most beneficial features for the enterprise (Figure 5).

Figure 5: Determining the financing method for the acquisition of means



Source: own construction

Conclusion

One of the most difficult tasks of managing an enterprise is to form the actual development versions and to make the decisions concerning to the realization.

The elaboration of a project means concretizing of the strategic plans creating a link between the activities of the strategic and the operative management. Special approach, knowledge of numerous management methods and a lot of experience are required for being able to solve this complicated task.

In my research, I have examined how problems related to forming of projects emerge in typically multifunctional agricultural enterprises, which aspect should be taken into consideration and which methods can be applied to solve them.

Due to the agricultural particularities and the multifunctional characteristic of the activities determining the content and volume of the result of the project is not simple, but the prudentially created plans of function-target and function-carrier structure throw light on the demanded physical means.

Most of the development projects are not realized as green-field investments, thus the planned developments should be fitted to the existing technical background or rather its function-performing capability should be considerately examined. This can be accomplished by the weak-point analysis which examines the already existing means.

Comparing the different features of the examined assets the most suitable one can be chosen based on the mathematical methods and the technical, economic and ergonomic aspects.

The financial versions can be evaluated by the created equations and model calculations. After the quantitative values the qualitative aspects should also be taken into consideration.

I proved that after the simultaneous use of the „structure plans", „weak-point analysis", "break-even" methods and the created tools together with confronting the results will clearly show which assets, machines and means should be replaced, converted, purchased or hired.

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