
APPLICATION OF THE PERT METHOD IN THE AUDIT OF BUSINESS OF AGRICULTURAL ENTERPRISES

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ABSTRACT

The audit of agribusiness operations is present in companies with significant agricultural potential, which can be accepted as justified in our conditions. The agricultural sector is one of the development sectors in the Republic of Serbia, which necessarily represents a significant economic resource, and therefore the object of business audit. The factors of modern audit-based processes are conditioned by the complexity and subject specificities of the object being audited, which is expressed in the conditions of the agricultural sector. This paper will present the application of a quantitative planning method that is widely used in complex processes, and which can also be applied in the auditing processes of agricultural enterprises.

Introduction

The methodology of modern quantitative systems is designed with the aim of planning large, complex projects where it is impossible to determine precisely the duration of certain activities, but time limits are determined within which the realization of certain or all activities is possible. Almost all research and development projects that are carried out for the first time are discussed here. The most widely applied method of network planning in stochastic conditions is certainly the PERT method.

The possibility of applying the PERT method in the investigation of the audit process of agribusiness operations is particularly evident when it comes to designing a scenario for the eventual creation of an offer for a future potential audit (Majstorović A., 2020). In

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order to set up a network of scenarios, experts from the field of audit of the agricultural sector were interviewed. The scenario concerned the issue of determining future events in the auditing process itself, in the case of obtaining the job of auditing the operations of agricultural enterprises in the territory of the Republic of Serbia in the domain of medium and large enterprises.

Methodology

The PERT⁴ (Project Evaluation and Review Technique) method (Plebankiewicz 2015) is one of the two basic methods used to analyze time in a network model, in addition to the CPM method. The difference is in the representation of the mathematical model of the analysis of the time of realization of a project. We use the CPM method when we are able to determine the precise duration of each activity in the project, i.e. when it comes to the deterministic method, while with the PERT method we use the expected duration of the activity, i.e. we are talking about a stochastic model. (Tepavčević, 2021; Backović M., 2020; Pantić et al., 2021; Živković et al., 2019).

From the rules based on graph theory for the construction of the network diagram (Ljiljanić N., 2022), we know that each project activity must start and end with an event (i,j respectively), and for each activity we need an assessment of time intervals:

- “ a_{ij} - an optimistic rating that represents the shortest possible time for the realization of an activity,
- b_{ij} - a pessimistic rating that represents the longest possible time for the realization of an activity, and
- m_{ij} - the most probable rating that represents the most likely time for the realization of an activity.” (Backović, M., 2020).

If we hypothesize that the durations of the activities in the project are distributed according to the β - distribution, we can determine the expected duration of $t_e(i,j)$ of each activity and the dispersion $\sigma_{t_e(i,j)}^2$. (Herreri J., M., 2011) Due to simplicity and the widest application, the most commonly used formulas are:

$$t_e(i,j) = \frac{a_{ij} + 4m_{ij} + b_{ij}}{6}$$

$$\sigma_{t_e(i,j)}^2 = \frac{(b_{ij} - a_{ij})^2}{36}$$

In this way, the stochastic network model is reduced to a deterministic one. (Toljaga-Nikolić, DV, 2014). In the next step, we define the earliest possible time, the latest

4 The method was proposed by the Booz Allen Hamilton company in 1958 for the implementation of the Polaris program for the development of a submarine for the launch of ballistic missiles for the US Department of Defense.

allowed time, the time reserve and the critical path under the assumption that event j is the final event for multiple activities. (Hari Ganesh, A., 2021)

The Earliest Possible Time $T_E(j)$:

$$T_E(j) = \max\{T_E(i) + t_e(i,j)\} \quad i \quad \sigma_{T_E}^2(j) = \sigma_{T_E}^2(i) + \sigma_{t_e}^2(i,j);$$

$$T_E 1 = 0, (j=2,3,\dots,n), \quad i < j, \quad (j = 2,3,\dots,n)$$

The Latest Allowed Time $T_L(i)$

$$T_L(i) = \min\{T_L(j) - t_e(i,j)\}; \quad i \quad \sigma_{T_L}^2(i) = \sigma_{T_L}^2(j) - \sigma_{t_e}^2(i,j)$$

$$(T_L)_n = (T_E)_n, (i = n-1, n-2, \dots, 1), i < j$$

The Time Reserve

$$R_i = T_L(i) - T_E(i); \quad \text{gde } j = i = 2, 3, \dots, n-1$$

assuming that the time reserves of the first and last event in the network diagram are equal to zero.

The Critical Path

“The very definition of the critical path as consisting only of critical activities implies that only those events in which the time reserve is equal to zero belong to the critical path.” (Stošić, B., 2013).

$$T_L(i) - T_E(i) - t_e(i,j) = 0$$

Since this is a problem with stochastic quantities, it is necessary to calculate the probability with each particular quantity

$$(Z)_i = \frac{T_S(i) - T_E(i)}{\Sigma \sigma^2^{0.5}}$$

where Z represents the probability factor, T_S represents the planned deadline for the realization of event i and $\Sigma \sigma^2$ the sum of the variances of all activities that precede event i .

Results and Discussion

The first step in setting up this network is an exhaustive list of network elements and their connections. (Zhu, Z., 1994).

The second stage in the application of the PERT method is the value presentation of the time course of events, where the label AUDITOR'S REPORT = current time in the form of dates DD/MM/YY, and activities:

A = Determining the materiality level,

B = Assessment of control risk,

- C = Review inventory status reports,
- D = Confirming the internal control mechanisms,
- E = Determining the value and quantity of inventories,
- F = Calculate accounts receivable,
- G = Obtaining access to the data sources,
- H = Audit documentation,
- I = Preparation of the auditor's report.

Determining the materiality level - Assessment of the level of materiality/significance in practice is based on the application of appropriate, empirically determined percentages to the value of certain positions from financial statements, most often total income, total assets or financial results. (Edgley C., 2014; Staletović et al., 2021). The IAS 320 does not define materiality, but states the definition given in the Framework for the preparation and presentation of financial statements of the International Accounting Standards Board.

“The level of materiality/significance is assessed for the financial statements as a whole and serves as a criterion for choosing the appropriate opinion in the final stage of the audit.” (Milojević, I., 2020). The overall level of materiality is allocated to individual elements/components of the financial statements, most often on the basis of the relative importance or variability of the accounts (standard deviation of processed transactions), or the professional assessment of the audit team. In the planning phase, the auditor assesses the preliminary level of materiality, which, in combination with audit risk, determines the nature, timing and scope of audit procedures. At the same time, materiality and risk are in an inverse relationship. (Houghton, K.A., 2011) An estimated lower level/threshold of materiality requires performing more extensive and varied procedures and obtaining more audit evidence and vice versa. During the duration of the engagement, the initial assessment of materiality may be corrected, if the audit team finds new information that requires such correction.

Assessment of control risk - There is no practical way to reduce audit risk to zero. Therefore, auditors should provide sufficient evidence to reduce the risk to an acceptable level. Depending on the perception of risk and aversion to risk, the auditor carries out audit planning, determines the required time and level of audit evidence (Velte P., 2019). If the auditor estimates that the risk will be high, he will decide to collect more reliable evidence by observing a larger sample and increasing the number of audit procedures. The ultimate goal of risk assessment and determination is that, at the end of the audit process, the total risk is set at a enough low level or that the level of security is high enough so that it can be said that the financial statements do not contain materially significant errors. Audit risk is not a simple quantity, it consists of three elements. These elements are as follows: Inherent risk, Control risk and Detection risk (disclosure risk).

According to the definition, control risk is the risk of misstatements of account balances that, taken individually or cumulatively, can be materially significant, and which the accounting system and the internal control system will not detect, detect and correct in a timely manner. (Coram, P. J., 2021) No internal control system is perfect, in other words, it is difficult to find a control structure that is 100% perfect and that no error can slip through. Therefore, it is up to the auditor to assess whether the internal control system is functioning effectively. If the auditor assesses that the policies and procedures are carefully planned and functioning effectively, then he is able to conclude that the risk of misrepresentation is low and vice versa.

Review Inventory Status Reports - is an auditing procedure which is accepted worldwide, where an auditor states his opinion are the financial records of inventory represent correctly the real inventory and their accordance with the IAS 2 Inventories. (Majstorović A., 2020). Auditing inventory verify besides the amount of inventory also its condition and quality, and compares if the value of the inventory is correctly listed in financial statements. In accordance with IAS 41 "Agriculture inventories comprising agricultural produce that an entity has harvested from its biological assets are measured on initial recognition at their fair value less costs to sell at the point of harvest. This is the cost of the inventories at that date for application of this Standard".

Confirming the internal control mechanisms - There are several definitions, but they are all similar in that they determine that financial management and control (internal control) include the entire system of financial and other controls, including the organizational structure, methods and procedures, not only financial systems, but also operational and strategic systems of the organization. (Coram, P. J., 2021). Financial management and control represent the entire system of internal controls established by company managers, who are also responsible for that system. These controls, through risk management to a reasonable extent, provide assurance that in achieving the company's (organization's) goals, funds are used in a correct, ethical, economical, effective and efficient manner. This includes compliance with laws and other regulations, safeguarding funds against loss, misuse and damage.

The Sarbanes-Oxley Act introduces a model of corporate management that assigns responsibility to management towards stakeholders, especially in relation to financial statements. (Rosati, P., 2022) That model had significant consequences for the internal control system and the organizational structure of the company: namely, by assigning direct responsibility to management responsibility for published economic and financial data and for the ability of the internal control system to ensure the reliability of that data, the aforementioned law carried out the reorganization of the internal control system and the redefinition of the administrative body.

Determining the value and quantity of inventories – Recognition and valuation of inventories of unfinished production and finished products id done in accordance with IAS 2 Inventories and IAS 41 Agriculture. The mentioned accounting regulations requires inventories to be measured at the lower of cost and net realisable value (NRV)

and outlines acceptable methods of determining cost, including specific identification (in some cases), first-in first-out (FIFO) and weighted average cost. (Cordery, C. J., 2022). “Given the massive size of some inventories, they may engage in quite a large number of inventory audit procedures before they are comfortable that the valuation you have stated for the inventory asset is reasonable.” (Majstorović A., 2020).

Calculate accounts receivable – IFRS 9 Financial Instruments requires recognition a financial asset, financial liabilities and some contracts to buy or sell non-financial items. (Sultana, N., 2015). Accounts receivable is frequently the largest asset that a company has, so auditors tend to spend a considerable amount of time gaining assurance that the amount of the stated asset is reasonable.

Obtaining access to the data sources - The auditor is obliged to collect sufficient evidence in the audit procedure that enables him to form a competent opinion. (Milojević I., 2021). In the operational sense, the auditor in the audit process collects evidence using the following methods: 1. inspection 2. observation 3. examination 4. confirmation 5. calculation control and 6. analytical procedures. (Rosati, P., 2022)

Audit documentation or the working papers according with ISA 230 provide a documentary basis for forming an opinion and preparing an audit report on the client’s financial statements. (Milojević I., 2020) They are the link between the client’s accounting processes, internal controls and the audit report. There are no standard forms for the presentation of all working papers and they differ between audit firms. Even the physical form of the working papers differs. (Akther T., 2020). The formal form is not particularly important. However, they should be arranged in a logical sequence and indexed to allow easy access to the required information.

Preparation of the auditor’s report – “The audit process ends with an audit report that is submitted to the client’s shareholders’ meeting or the management body that appointed the auditor. The form and content of the audit report differs in nuances.” (Milojević, I., 2021), Since the audit report should express the overall audit findings and opinion in a concise manner, it is naturally sensitive to wording. The sensitivity of audit reports has encouraged audit theorists and auditors to search for the optimal form and content that will enable auditors to express their formed opinion in a concise and decisive manner, while at the same time providing users with clear, reliable and precise information. (Soltani B., 2002). The essence of the audit report is to express the auditor’s opinion on the financial statements, which is done in different ways in the world. ISA 700 - Forming an Opinion and Reporting on Financial Statements requires that an audit reports consist: Addressee (to whom the report is addressed), Introductory paragraph, Management’s responsibility for financial statements, Auditor’s responsibility, Auditor’s opinion, Date of the auditor’s report and Auditor’s signature. (Goicoechea. 2021)

The above-mentioned elements condition the required time of the auditor’s work to collect the evidence necessary for expressing the auditor’s opinion (Milojević I., 2020). Group of experts (Jasiukiewicz J., 2021). determined that it is most adequate to apply the PERT method - the critical path method, which requires the following activity times to

be determined, namely:

- pessimistic,
- medium, and
- optimistic.

Briefly note that the calculation of these items is as follows:

$$G = \text{variance} = (A(I) - B(I))^2 / 6,$$

$$F = \text{expected time} = A(I) + 4M(I)B(I) / 6$$

$$I = 1 \text{ do } 9 \text{ and } A(I) \leq M(I) \leq B(I)$$

where T - number of elements ie. activities.

A(I) = optimistic time,

B(I) = pessimistic time,

M(I) = most likely time.

Note that the rank values of A(I) and B(I) form a Beta distribution. Probability distribution ie. schedule with the law of probability, as follows

$$f(x) = \frac{1}{B\left(\frac{m}{2}, \frac{n}{2}\right)} x^{\frac{m}{2}-1} (1-x)^{\frac{n}{2}-1}$$

where the random variable varies X varies from 0 to 1, is called a Beta schedule. (Hahn, E. D., 2008).

It is necessary to calculate the critical times of the final events (which will provide information about the optimal offer for the possible engagement of auditors) by giving several alternatives of the limits of pessimistic and optimistic times, as well as in the actual occurrence of events, correct any wrong estimates and then recalculate the critical path (Milojević I., 2021). Thus, in the first assessment, we obtained the data shown in Table 1.

Table 1. Data on the duration of each activity

Activity	TIME				
	Pessimistic	Optimistic	Medium	Expected	Variance
A	4(2)	6	5(5)	5	.11
B	6(4)	8	7(6)	7	.11
C	13(11)	15	14(12)	14	.11
D	13(11)	15	14(13)	14	.11
E	9(3)	11	10(5)	10	.11
F	5(3)	7	6(6)	6	.11
G	4(30)	6	5(4)	5	.11
H	5(1)	1.5	1(10)	1	.027
I	6(3)	8	7(5)	7	.11

Source: Authors' calculations

When it comes to the earliest start by activities and shifts, we get the data shown in Table 2.

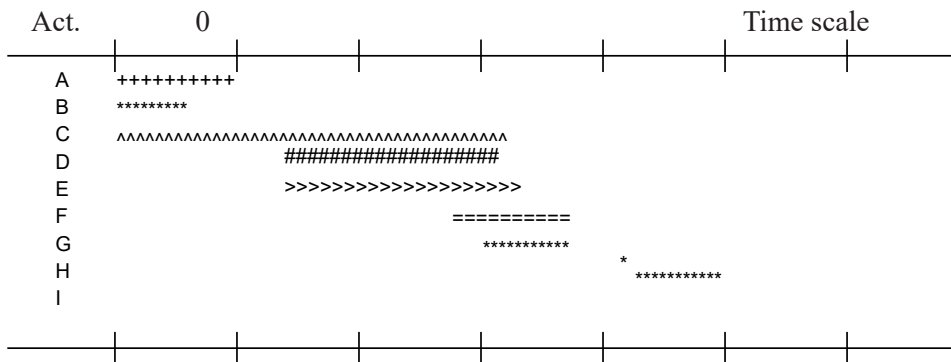
Table 2. The earliest start by activities and shifts

Events	Early start	Shift
A	0	2
B	0	0
C	0	2
D	7	2
E	7	2
F	14	2
G	17	0
H	22	0
I	23	0

Source: Authors' calculations

Critical path, ie. the time of occurrence of events according to the scenario, is 69 time units, as shown in Figure 1.

Figure 1. The timing of the event according to the scenario



Source: Authors' calculations

The second case of simulation refers to pessimistic time values, which were changed in several cases (see the next Table in which the values given in parentheses are now taken). In this case, the critical time is 66.95 time units.

Table 3. Data on the duration of each activity

Activity	TIME				
	Pessimistic	Optimistic	Medium	Expected	Variance
A	4(2)	6	5(5)	4.65	.44
B	6(4)	8	7(6)	6	.44
C	13(11)	15	14(12)	12.3	.44
D	13(11)	15	14(13)	13	.44
E	9(3)	11	10(5)	5	.44
F	5(3)	7	6(6)	6	.44

Activity	TIME				
	Pessimistic	Optimistic	Medium	Expected	Variance
G	4(30)	6	5(4)	4	.254
H	5(1)	1.5	1(10)	11	.006
I	6(3)	8	7(5)	5	.694

Source: Authors' calculations

When it comes to the earliest start by activities and shifts, then we get the following table 4.

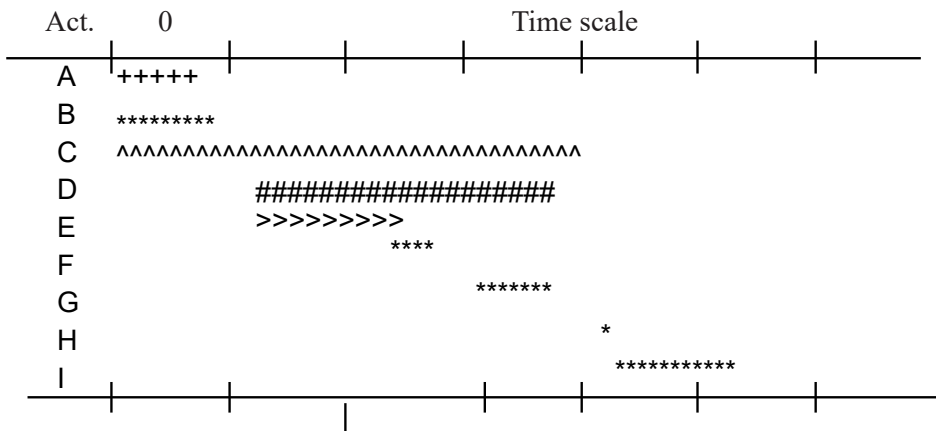
Table 4. The earliest start in terms of activities and shifts

Events	Early start	Shift
A	0	1.4
B	0	.8
C	0	0
D	6	0
E	6	2.8
F	12.3	0
G	11	2.8
H	18	0
I	19.08	0

Source: Authors' calculations

The Figure of this modified scenario is as follows:

Figure 2. The timing of the event according to the scenario



Source: Authors' calculations

Figure 2 shows (marked with asterisks) the critical path, which in this case is drastically smaller and amounts to 19.08 time units. (Weld, S., 1976)

Needless to say, all combinations of varying input data are possible. (Pavlović, M. M., 2021). Essentially, the pre-determination of input data (in our example) is done in two ways:

- a) one of the ways is to determine in advance the values for the pessimistic, optimistic and expected time and
- b) to programmatically solve the range in which all three times can move, and to calculate the possible combinations.

Conclusion

By applying the PERT method in the preparation of the auditor's offer for agribusinesses, an assumption is created by means of which the auditor's offer can be expressed financially. It can be concluded that the possibilities of applying this method are useful in many ways, primarily because agricultural companies are a specific type of assets that auditors can encounter, that the agricultural sector is one of the most complex sectors in terms of accounting balancing, and that the time component of business does not coincide with calendar year.

In addition to the many limitations of this method, it is clear that it provides a fairly clear representation, especially in cases where some audit activities are associated with a large number of accounting items due to the complexity of the business process.

This method should be understood as an aid to the decision-maker on possible timely and corrective actions in the field of drafting the auditor's offer.

Conflict of interests

The authors declare no conflict of interest.

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