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FEATURES, CHARACTERISTICS AND METHODOLOGY OF INTERNAL CONTROL OVER NANOTECH MANUFACTURING AND NANO-PRODUCTION IN FOOD INDUSTRY

Over the last years, the rapid pace of development of the nanotechnology industry has placed it as one of the leading industries, which occupies a significant part of the total world production share. The specific technology used in the nanotechnology industry, the distinctive features and characteristics of the final nano-production are prerequisites to seek for the proper mechanisms and methods of the implementation of internal control in nanotechnology enterprises. Therefore, the main objective of this study is to present the major control problems that exist and can be found in a nanotech company and the main control stages, procedures and methods for the implementation of internal control. Based on everything stated hereto, it can be assumed that the main objects of internal control in food-related enterprises which apply nanotechnology are: nanotech production; nanoproducts and products of nanotechnology development. Regarding the research problem of internal control of nanotechnology manufacturing and nano-production and internal control of research and development, the following main conclusions and recommendations can be drawn: 1) Internal control of the research control objects - nanotechnology manufacturing, nano-production, research and development - has not yet been established as the main means of revealing the behavior and modification of these objects; 2) No particular attention is paid to the analysis as a means of internal control. With the help of the analysis, the control process achieves a better diagnosis of the actual state of the controlled object, its planned and expected state. Applying the approved methodology of the internal financial analysis, together with the published data from the management accounting, the controllers can determine the reasons and the factors that influence the change of the controlled objects; 3) There is no interaction between internal control and controlling in the control practice, which in turn targets management and optimization of expenses, revenue management and management of the financial result of the enterprise. The two control concepts concerning internal control and controlling are still considered in isolation from each other. Because of the complexity of intertwining these two types of control (internal and controlling), the scope of the report has not been studied for their mutual application.
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In recent decades a dynamic change has been seen in all spheres and fields of knowledge due to the introduction of many new cutting-edge technologies on the one hand and the attainment of good results and achievements in the scientific field on the other hand. The European Union contributes to progress in the development of nanotechnology, consequent to which the nanotechnology industry has been financed by various European programs and funds since 2004. According to *O. Mamedov* (Mamedov, 2011), one of the main reasons for this is that "Nanoscience and nanotechnologies have the potential to lead to more growth and more jobs in Europe and their development should not slow down, distort or leave without control". These events affect the development of accounting and auditing practice in the following areas:

1. There are new accounting and control objects, one such object being nanotechnology, which is a prerequisite for the formation of a separate new industry – the nanotechnological industry, requiring relevant legal regulations covering its specifics and peculiarities.
2. The establishment of new business units in the form of companies or centers, which shall adopt and approve the relevant accounting system and financial management and control system.
3. The availability of highly qualified staff, which requires promoting educational training programmes for maintenance and further development in the respective field.
4. The introduction of high-tech machinery and equipment, which may consist of individual production components considered as a separate reporting and control object.

Taking into account all the above, the ***objective*** of this study is to present and investigate the major problems and characteristics of the methodology of internal control over nanotechnology and nanoproduction in the food industry. To achieve such a set objective, we are addressing the following tasks:

1. To clarify nanotechnology process and nanoproduction as an object of internal control in the food industry.
2. To present the methodology of internal control over nanotechnology process, nanoproduction and objects (assets) resulting from research and development activities.

1. Nanotech manufacturing and nanotechnology products as objects of internal control

Nanotechnology as a modern, cutting-edge technology was introduced by the physicist Richard Feynman from the California Institute of Technology (CalTech). On December 29, 1959 during a scientific conference, he described a process in which scientists could manipulate and control individual atoms and molecules. Later in 1969 professor Norio Taniguchi coined the term nanotechnology and in 1981 with the advanced development of the microscope individual atoms were examined. In 1989, in Warsaw, a Congress of the Polish Psychotronic Association was held, where Assoc. Prof. Ivo Lozenski, PhD together

with Slava Sevryukova (Lozenski, 1991) and other Bulgarian scientists introduced a new atom model in their report "A Psychotronic model of the atom and atomic nuclei", which gave a strong impetus for the development of nanotechnology."

In terms of control, nanotech manufacturing processes and nanoproduction are relatively new control objects. From the standpoint of control, within the scope of object control, nanoparticles that are the basis for the realization of this production can be included in the scope of control, but may not be involved as well. This is due to the specific characteristics of nanoparticles (also called quantum dots), which are objects smaller than 100nm and some scientists consider that they are "all around us" (Treder, 2004) In terms of internal control, to characterize things as *objects of internal control* they should meet the following requirements:

1. *They must be available and really exist for an enterprise* – for manufacturing and production itself, undoubtedly they must be present and exist for the relevant enterprise. From the perspective of nanoparticles, when they are available to the enterprise and actually owned by an entity they are considered as objects of internal control. Otherwise, they are not subject to internal control, as the requirement for belonging is not satisfied.
2. *They must be measurable and comparable* – in the control practice, the measurability and comparability of objects are essential to determine the deviations and changes in the inspected object. In the control practice, natural, labour and value measures are applied, but this cannot be accomplished if the objects themselves are not natural, labour or value visualized and reflected. Accordingly, the connection and relationship between accounting and control practice are seen when an object is accounted for using quantitative and value metrics, then in the control practice the object will be also audited and analyzed with the help of these measures.
3. *They must be distinguishable from all other controlled objects* – distinguishability of the control object is a current condition, it is determined by the specific characteristics of the controlled object by identifying the object itself, but also the right to use and the ownership of the object itself.
4. *The object must be part of the operating cycle of the enterprise* – the accurate determination of the operating cycle duration in nanotechnology activity is essential, rather than the duration of the reporting period. According to IAS 1, the operating cycle of an entity is the time between the acquisition of assets for processing and their realization. The standard specifies that when the operating cycle is not clearly identifiable, it is assumed to be twelve months. In internal control, when the form of preliminary control is concerned, it can be determined whether the object is part of the operating cycle or not, which is the responsibility of internal auditors or internal control authorities. But when it comes to determining the term during which an economic advantage is gained from the relevant object, this is entirely an organizational and management decision, therefore in IAS 1 it is specified that the available objects (current assets) of an entity shall be grouped as current when:

a) the entity expects to realise the asset, or intends to sell or consume it, in its normal operating cycle;

b) it is held primarily for the purpose of trading;

c) it is expected to be realized within 12 months of the balance sheet date; or

d) the asset is cash or a cash equivalent (as defined in IAS 7 *Statement of Cash Flows*) unless the asset is restricted from being exchanged or used to settle a liability for at least twelve months after the reporting period.

All other assets should be classified as non-current.

5. *The object (asset) is within the scope of internal control* – when the object is within the scope of internal control, this means that it can be monitored by control actions, which represent a combination of different processes involved in the direct implementation of the control function.

Taking into account the above requirements, it can be assumed that the nanotech manufacturing process and nano-production in one nanotech company are subject to internal control. The *Nanotech manufacturing process* is a combination of all the actions, procedures and processes that take place in the nanotech company and are directly or indirectly related to the creation of a nanoproduct. Accordingly, the *nanotech manufacturing cycle* is the time needed to accomplish the production process (i.e. the period from the start of the production to the completion of finished products). Nanotechnology products may be in any form and variety, such as cosmetic products, medical products, food products, clothing and fabrics (such as water repellent fabrics, do not pollute the environment, or maintain a certain body temperature). Today, these products are widespread and used in the aerospace environment and military activity.

In recent years, nanotechnology has been rapidly introduced into the food production industry. One of the main reasons is that food resources worldwide are limited in their quantity. For example, in third world countries, food supply apart from being limited, is also of poor quality and not fit for human consumption. In terms of the food industry, more and more applications are being found for nanotechnologies using biologically engineered molecules and nanomaterials that have properties and functions other than the already known biological and natural molecules. It is by these biologically engineered molecules that qualities and properties of the food products are improved. On the other hand, "nanomaterials allow better encapsulation and release efficiency of the active food ingredients compared to traditional encapsulating agents, and the development of nano-emulsions, liposomes, micelles, biopolymer complexes and cubosomes have led to improved properties for bioactive compounds protection.

Nanotechnology also has the potential to improve food processes that use enzymes to confer nutrition and health benefits. For example, enzymes are often added to food to hydrolyze anti-nutritive components and hence increase the bio-availability of essential nutrients such as minerals and vitamins. To make these enzymes highly active, long-lived and cost-effective, nanomaterials can be used to provide superior enzyme-support systems

due to their large surface-to-volume ratios compared to traditional macroscale support materials.

Other benefits of nanotechnology in the food industry are:

- The processing of nanostructured food or supplements. The aim of this processing is to reduce fat and enzymes in products. For example, the fat used in mayonnaise, which is a high-fat product, is reduced by various emulsifiers.
- The application of biopolymers that improve nanoacid environment in the body for the delivery of nutrients and supplements in the form of liposomes or nanoencapsulated substances.
- The application of inorganic additives for the manufacture of food products that enhance the health benefits of the final food products. For example, food additives such as silica, titanium dioxide, selenium, platinum, calcium, magnesium, etc. are often included in the production of health foods.
- The application of degradable polymers, i.e. so-called bio-compostable plastics. For these plastic polymers containing or coated with nanomaterials for quick and organic decomposition, an increasing number of areas of application are being found in the food industry.
- The application of nanoscale sensors for food labeling - thus monitoring more easily the shelf life of the products.
- The decontamination of water resources. Many Western companies, especially those in the production of baby foods and drinks, such as Nestlé, Acorelle, Alphanova, Babybay etc., apply various nanotechnologies to reduce the content of heavy metals in the water, which is one of the main resources for baby food production.

The food industry is the largest manufacturing sector in the world, and statistics show that the annual net turnover from the sale of food and food products amounts to over $ 4 trillion. This sector has an enterprising and innovative nature from the perspective that it combines chemical and pharmaceutical industries, introducing new technologies and the implementation of innovative methods for processing food raw materials. The specific feature of the food industry lies in the fact that, globally, a considerable amount of food is consumed after being processed (thermal or non-thermal), such as fruits, vegetables, grains, etc., which changes their natural qualities. Another specific feature is that the majority of companies in the food industry are still low-tech, are small and medium enterprises and do not apply advanced nanotechnologies.

Whether food industry entities apply high-tech nanotechnology or not, they have one thing in common – their activity has three main stages, which have an impact on the implementation of the internal control, namely:

- The first stage is the delivery of the raw materials needed for production.
- The second stage is the production activity.
- The third stage is the realization of finished products.

The differences between high-tech and low-tech entities in the food industry are in the level of technological production risk. Nanotechnology, however significant and beneficial, still has "knowledge gaps" regarding the safe use of these technologies in the food industry. The safety of each potential use of nanotechnology in food products should be demonstrated and evaluated by the European Regulators before they can be used by food production entities in the European Union. In this respect, the European Food Safety Authority annually issues risk assessment guidance on nanotechnology in food and the feed chain (EFSA, 2011).

Nanotechnology enterprises have an essential feature that affects the conduct and implementation of internal control - nanotechnology-manufacturing activity makes it possible to produce a relatively new technological product that can be considered as a product as from development. In other manufacturing industries (energy, chemical, forestry, wood, etc.) such end production results cannot be seen or are relatively limited.

Based on everything stated hereto, it can be assumed that the main objects of internal control in food-related enterprises which apply nanotechnology are: nanotech production; nanoproducts and products of nanotechnology development.

2. Methodology of internal control over nanotechnology process, nanoproduction, research and development activity

In the previous part of this study it was clarified that nanotechnology process, nanoproduction and products that result from research and development activities are three different objects of internal control. What they have in common is that the control activities follow the successive stages of the control process. The stages of the control process are: identifying the object of control; determination of control requirements; determining the current state of the controlled object; comparison and collation of the state of the controlled object with the control requirements (rate); deviations in the nature and the result of the object of control from the control rate; and the final stage is the implementation of an impact system, just in case there is a deviation between control rates and the established state of the controlled object. The presence of three different objects requires a set of specific procedures, techniques, tools and methods for the implementation of internal control. Using various methodologies for control makes it possible to clarify the current problems of controlled objects, as well as to improve the entity's activity, through the opening of new production and management capabilities.

Taking into account the significant differences between the control objects under consideration, it can be assumed that the methodology of internal control differs in terms of:

1. identification of the essential characteristics of the controlled object;
2. determination of the qualitative and quantitative modification of the controlled object under the influence of various factors;

3. establishing and determining the irregular deviations and changes in the controlled object from the pre-planned and normally defined conditions;
4. application of different techniques, approaches and control procedures to the specifics of the controlled object;
5. the selection of appropriate controllable parameters that distinguish, characterize and describe the individual controllable objects;
6. the control tool needed to achieve the predetermined control tasks.
7. providing relevant information about the control process – for various control sites, as in the case under consideration, the information process will differ in terms of collecting information that is sufficient in volume and quality. It is necessary for the collected information to be synthesized and processed in a suitable and convenient manner to obtain the most accurate and precise control decision. This process does not end until the control decision is taken, proper identification and subsequent dissemination of information to affected and involved parties by control actions is necessary.
8. the complexity of the control process - the applied methodology shall depend on the technical security of the control process, as well as on the qualifications and professional training of controllers.
9. the interaction between the units and the elements that make up the organization and control environment in which the organization operates.

2.1. Methodology of internal control over the nanotechnological production process

The methodology of internal control over the nanotechnological production process represents a set of techniques, procedures, means and methods of control that help to properly ensure the legality and expedience of the production process. The main task of controlling the nanotechnological production process is to verify that the requirements for the production of the relevant nanotechnology product are properly applied, by checking and controlling all stages and activities in the production chain (process). According to *M. Dinev* (Dinev, 1984), the control over the production activity is carried out in relation to a production program and in this connection, it is necessary to carry out both the control of the production program and to control the realization and the implementation of the production program. Other researchers assume that control over the production process should not only be limited to the development and implementation of the production program, but should also cover how the cost of finished products is determined (Belov, 1988). We stick to this opinion, as cost is a monetary expression of the means actually used for the production of the respective finished products. The cost is a monetary representation of the expenses for raw materials, energy, labor costs, etc. incurred by a given nanotechnology entity for the production of a certain product. The cost is also an indicator for determining the profitability of manufactured goods and is one of the main indicators of production efficiency. The production profitability is calculated as "the ratio of the profit to the cost" (Pehlivanov, 1988).

In terms of better clarification of problems, namely control of nanotechnological production and control of the cost of nano-production, the two control processes shall be examined successively and separately from each other. The production process in the food industry is divided into three main stages, namely planning and organization of production, technological production and production management. Each stage is important, so much so that the raw materials and materials needed to produce the product shall be properly identified. Usually, nanomaterials and nanosupplies, if they are not produced by the entity itself, cost much more than normal substitutes or alternative materials and supplies. This is a prerequisite for requiring greater accuracy and precision in planning the quantities of raw materials delivered, as well as proper planning of their subsequent input into the production process.

Therefore, ***the tasks of internal control over the nanotechnological production process are:***

1. ***To inspect the elaboration of the production program*** – From a historical point of view, the approaches to achieving this task have significantly changed over the years. This is due to the fact that the two parties, namely the higher authorities (ministries, departments and the respective economic associations) and the organizations themselves (entities), actively participated in drawing up the production programs until 1990. Since 1990, when the transition processes for the accession of Bulgaria as part of the EU and the consolidation of the market mechanisms and the achievement of a stable market economy was carried out, the elaboration of a production program is within the competence and scope of the respective production entity. The state, as an institution, represented by the relevant organizations, agencies, ministries, departments, etc., is not involved in the individual development of the respective production entities, and therefore it is not a party that participates in and controls the production program. In the case of state-owned entities, which are formed by competent state bodies (municipalities, ministries, etc.) with the respective state-owned property, the state can influence the development processes of production programs by an approved management system or through the appointed supervisory board or the board of directors, only in cases where the production program concerned may affect the change of state-owned property.

The production program, as part of the business plan of the company, includes a system of quantitative and qualitative production indicators, the defined production objectives, the planned production volume, the planned assortment, the time set for production and the approaches for the realization of the production under a particular nomenclature. Therefore, in order to inspect the development of the production program, each constituent element shall be checked.

When inspecting the nanotechnology production program, it is essential to first determine whether it is product-oriented or market-oriented. In the food industry, the two approaches are frequently applied in the development of the production program, as for some products a market-oriented production program is applied and for others it is product-oriented. In nanotechnology production, the production program is product-oriented, as it is mainly aimed at creating new products with new uses or products with significantly improved

quality. Therefore, internal control over the development of the nanotechnology production program should mainly aim at assessing the production considerations concerning the production volume and assortment. There are cases in practice where the nanotechnology production program is market-oriented. In terms of internal control, much more information is needed in these cases - in the form of enquiries, reports, etc., concerning the needs of the market for which production is intended. This internal control information is needed to determine the intended use of the finished product, to define the scope of the production program, and to identify the raw materials needed to produce the type of production concerned. In addition, when it comes to controls on the production of nanotechnological food products, unlike the production of other food products, its scope and purpose is much more important. During the "inspection of the development of the production program for nanofood products " (IRGC,2011), internal control shall consider:

- the planned uses of nanomaterials in the production of food products;
- how the indicators for the ongoing risk assessment of the use of nanomaterials and raw materials in the production of food products are determined;
- the comparison between different assessments of acceptable levels for the presence of nanomaterials in food products.
- whether the production program allows for ongoing risk management and a review of approved regulatory activities on the current production of food products.

2. ***The second main task is to inspect the implementation of the production program*** – According to *M. Dinev*, the technological control over the implementation of the production program refers to the examination of the predetermined and defined volume indicators (quantity, range and volume) (Dinev, 1984). The initial stages of the control relate to the comparison of the actual results obtained for the volumes produced with the plan, i.e. it is necessary to draw up an estimate of the finished goods produced, of the goods sold and of the work in progress during the period. This information should be duly documented by the accounting departments of the entity, the warehouses and the production departments (especially as regards the determination of the volume of work in progress). When analyzing the indicators of finished goods and work in progress, the established data on the implementation of the production program may have the following meanings:

    - when the indicator for finished goods produced is above the defined rate specified in the production program, it means that the production program is overachieved. Which in turn means that further analytical and managerial clarifications shall be made, namely: whether this overachievement of the plan results in finished goods being stored too long in warehouses or whether this production is distributed in good time and together with planned production.
    - when the indicator for work in progress exceeds the previously planned rate for the relevant controlled period, this means that there is a substantial delay in the production process, which in turn can lead to additional production costs and subsequent losses of the production plant. This, in turn, is a condition for the indicator of finished goods produced to be below the defined production rates,

which may, in turn, slow down the current production revenues generated by the enterprise.

Therefore, on the basis of the above, it can be assumed that taking into account the indicators of finished goods produced and work in progress, the production program will be implemented in terms of quality and quantity only in cases where the relevant controlled indicators have reached the predetermined rates. In the manufacture of nanotechnology foods, when inspecting the implementation of the production program, internal controllers, in addition to indicators of finished production and work in progress, whether the relevant production program complies with a number of international regulations and requirements should be inspected, such as (Cross, 2010):

- Global Core Principles of Responsible Care
- European Commission Code for nanosciences and nanotechnologies research.
- A code of conduct for responsible nanosciences and nanotechnologies research (***Code of Conduct for Responsible Nanotechnology***: (***Responsible Nano Code***) – the code was approved in 2006 by three non-governmental organizations, namely ***Insight Investment*** *(one of the largest global investment management companies), the* ***Royal Society*** *(the Royal Society of London for the Improvement of Natural Knowledge and the international* ***Nanotechnology Industries Association***. The Code is based principally on the achievement of a responsible and safe nanotech production.
- The established nanoproduction framework (***The Nano Risk Framework)*** **–** The framework focuses on engineered nanoscale materials that exhibit novel properties of nanomaterials and consist of particles or physically discrete entities, that are below 100 nanometers (nm) in one or more dimensions. The term "nanomaterial", as used in this document applies to such components, either in their original form or as ingredients in products from which they could be released during the activities.

These four statutory requirements shall be observed during the nanotechnological production process. Otherwise, it is assumed that the finished nanoproduction is harmful and significantly endangers human health. In order to verify that the regulatory requirements for the implementation of the production program have been complied with, it is necessary:

- To verify that the established safety principles of production have been followed.
- To inspect the specific direct actions taken to examine the inputs of nanomaterials, as well as to review the risk assessment.
- To verify the information provided on the individual production units in view of the adequate dissemination of the results of the research carried out in the enterprise itself (in the cases where the enterprise also performs research).
- To verify the existence of new production processes, whether they are included in the approved production program or it is necessary to adopt an individual production program, respectively.

- To ensure compliance with the requirements of Standard ISO/TS 27687:2010 regarding standard requirements for nanotechnology production.
- To ensure compliance with the approved ISO 22000 standards on the implementation of the Food Safety Management System as well as compliance with the recommendations of the standard on the production of food products that are safe.
- To ensure compliance with approved Occupational health and safety management systems for nanomaterials, as required by ISO 18002:2008.
- To ensure compliance with the uniform criteria for contaminants in foodstuffs under Regulation 420/2011, which sets maximum levels for contaminants in foodstuffs. It is permissible to allow the presence of contaminants in foodstuffs within the limits of the production program, i.e. "substances which are swallowed with foodstuffs have no nutritional value, are not typical of the products concerned and have a detrimental effect on the organism“ (Dineva, 2016). In the food industry, the permitted levels of contaminants, which may be contained in a ready-made food product, are preliminarily prioritized in the production programs. With the aid of laboratory analysis, as a means of control, it can be ascertained whether there are deviations from the predetermined contamination limits.
- To inspect the levels of radioactive contamination in food products. Such contamination may occur in the presence of a nuclear accident or radiological contamination, as "the maximum permitted levels of radioactive contamination in foodstuffs are determined in accordance with Commission Regulation (Euratom) No 944/89 of 12 April 1989“ (Dineva, 2016). The last nuclear accident was in March 2011 in Fukushima. According to the physicist *Uwe Stoll*, "16,700 PBq (Petabecquerel) and xenon-133 (1PBq equals one trillion becquerels) were released into the atmosphere for the period from March 11th to March 15th. This is the largest leak of radioactive noble gases in history that is not related to military nuclear experiments" (Dineva, 2016). In recent years, scientists have agreed on the idea that even the smallest radioactive contamination levels are conditions for the presence of cancer diseases among the population.

The main internal control tool to determine the performance of the production nanotechnology program in the nanotechnology manufacturing process is analysis. In this regard, internal controllers should perform an analysis of the production program in the following order:

- *Analysis of the change in finished goods produced*– the analysis of the change in finished goods produced allows for timely determination of the state of the production program in terms of change in the production capacity and change of inputs and raw materials. The absolute change in finished goods produced can be defined as the difference between the ***finished goods actually produced (Fgap)*** *and the planned quantities of* ***finished products defined in the production program (PqFpdpp),*** i.e. ***P= Fgap - PqFpdpp***.

Accordingly, the relative change in the production program can be determined in relation to the relative change in finished goods produced. The exact relationship and dependence between the two indexes – ***finished goods actually produced (Fgap)*** *and the* ***planned***

quantities of finished products defined in the production program (PqFpdpp) shall be determined by the indicator for relative change in finished goods produced. The indication shall be calculated as the ratio of ***Fgap*** to ***PqFpdpp*** multiplied by 100, i.e. ***Po = (Fgap: PqFpdpp)*100***

- *Analysis of the rhythm of the production activity* – the rhythm of the production of finished goods is subject to a separate assessment by the controllers. Production is rhythmic when an equal production volume is manufactured at equal intervals. Rhythmic production is a prerequisite for the efficient and qualitative input of resources and materials. When controlling compliance with the production program, controllers should analyze the rhythm of production activity in relation to the defined indicators in the production program. For this purpose, it is necessary to apply the comparison method by distinguishing the production activity of separate periods that shall be further compared with the data and indicators laid down in the production program. According to *M. Dinev*, "the comparison between the plans and the reporting data for the individual interim periods shall be combined with the comparison of the volume of the finished goods and the volume of goods to be sold. The difference between these dimensions will point to some inconveniences that need to be carefully and thoroughly examined“ (Dinev, 1984).
- *Analysis of the production intensity* – In order to analyze the implementation of the production program, a general assessment of the production intensity is required, as for this purpose it is necessary to "calculate the intensity coefficient of the production program“(Sokolov, 2006) according to the following formulas:

$$Cpi = \frac{Pvgp}{Nvgp}$$

$$Cai = \frac{Avgp}{Nvgp}$$

Where:

Cpi – planned intensity coefficient;

Cai – actual intensity coefficient;

Pvgp – planned volume of goods produced;

Avgp – actual volume of goods produced;

Nvgp – normative volume of goods produced, determined according to the normal production capacities of the enterprise.

The intensity coefficient of the production program has its technical and economic importance as it is based on the actual production capacity of the plant and not on the maximum allowable power. Determining the intensity of the production program depends on the organizational and technical production conditions, the methods and the type of technical organization. Controlling the intensity of the production program is entirely within the power of internal control. The intensity of production compared to the normal

production capacity of the plant is also relevant in order to determine the production efficiency. In control practice, the audit is the main method of actual control, establishing the status and implementation of the production program. When monitoring the implementation of the nanotechnology production program, the audit can identify:

1. The technological organization of the overall nanotechnological production process.
2. Provisioning of nanomaterials and nanoresources for the manufacture of nano-products.
3. The state of the technical and laboratory control, especially as regards compliance with the normative requirements for safe working conditions.
4. The state of the technical and laboratory control, regarding the compliance with the normative requirements for the production of quality and harmless nanotechnological food products.
5. The normal and maximum allowable production capacity required for the manufacture of nano-products.
6. Staffing for nanomanufacturing of nanoproducts.

3. ***The third main task of internal control over the nanotechnological production process is to achieve an optimal combination of production factors*** *in terms of minimizing inputs of raw materials and utilization of production capacities and staff* (Simeonov, 2004).
4. ***The fourth main task is to minimize the utilization parameters of staff and production capacities*** (Simeonov, 2004).
5. ***The fifth main task of internal control is to considerably minimize the volume of defective goods,*** *and if there are such defective goods, they should be properly used either in the same main production or in other ancillary production activities*.
6. ***The sixth main task is to achieve the required quality standards for the production process.***
7. ***The seventh task of internal control over the nanotechnological production process is to achieve a consistent execution of operations*** within the technological process, including the optimization of the process for obtaining the intermediate goods.
8. ***The eighth main task of internal control over the nanotechnology production process is to promote an accurate and precise definition of nanotechnological expenses of raw materials in the cost of finished products.***

The most common infringements found while monitoring compliance with the nanotechnology production program are:

1. Failure to periodically update amendments to the Nanotechnology Production Program.
2. The planned production results are not achieved or maintained, because the planned quantitative and qualitative indicators are not achieved.

3. Substitutes of the raw materials and resources are used in the manufacturing process instead of nanomaterials and nanosciences determined in accordance with the technological requirements and plans.
4. The minimum standard production volume is not maintained and in most cases the production volume is below or above acceptable limits.
5. Additional raw materials and resources, that are not planned and determined, are used in the production.
6. Incorrect storage of raw materials and resources, as well as improper maintenance and observance of certain sterile requirements for the nanotechnology production.
7. A large quantity of unfinished production for the period under review or increased quantity of manufactured finished products.

Based on the above, it can be assumed that internal control over the nanotechnological production program is a good management mechanism for compliance with the production rules that are regulated by relevant internal and external regulatory instructions, regulations and laws. With the help of internal control over the nanotechnology production program, the long-term strategic objectives and tasks of the food industry can be defined. In addition, internal control allows for an industrial monitoring of emissions, pollution and sterility levels in production facilities. The complex nature of internal control over the observance of the production program is manifested in the simultaneous application of the means of documentary and factual control, and is revealed in the complex interaction between the different control bodies and individuals.

2.2 Methodology of internal control over nano-production

Internal control over nano-production reveals the links between the implementation of the predetermined production program, the company's current priorities and the relationship between costs, the volume of goods sold and the profit of the enterprise. On the other hand, the sales of finished products are one of the important mechanisms for the realization of the circular turnover of the existing capital of the enterprise. The qualitative transformation of the available capital into the production process and its realization in commodity capital is possible through the realization of the finished products in the sphere of the circulation. Therefore, not only the production of finished products but also their realization must be subject to ongoing internal control in order to ensure the efficiency and effectiveness of the circular turnover of the available production capital.

The main tasks of controls over the production and the realization of nano-production are:

1. *To establish compliance of the production nanotechnology plan data and the implementation of the finished nanotechnology production cost plan* - In order to accomplish this objective, controllers should have good professional and theoretical knowledge of the production of nano-products, including good knowledge of the approved admissible regulations for the consumption of nanoresources, nanomaterials

> and nanosciences. Therefore, internal controllers should comply with regulatory requirements. The regulatory bodies in each country, respectively the regulatory bodies of each industry and in each production plant, shall adopt their normative requirements for the consumption of nanoresources and nanomaterials, according to the European directives and decisions. In all cases, the main purpose of "each authority is to establish a regulatory framework and maintain/enforce regulations to ensure that food consumed and sold within their respective countries is safe. There is a move towards harmonization of food regulations, as illustrated by Australia and New Zealand and by Mercosur"(Magnuson, 2013).

The European Union has also laid down rules applicable to all Member States, to establish a general authorization procedure for direct food additives, flavorings and enzymes which are considered as nanomaterials and nanoresources. Although the path of approval of the different categories of food additives varies due to the different jurisdictions of the countries concerned, there are still many common data and safety considerations among them for assessing the safety of the use of food supplements, including the use of positive lists of approved substances. Each regulatory authority should approve the production of a nanotechnology product before it is placed on the market and this decision can and must be based on scientific decisions (otherwise the health and lives of consumers of food products would be endangered) and should be separate from the political decisions on the introduction and expansion of the state's productive activity.

In Bulgaria, the main regulatory authority empowered to control food safety and quality is the Bulgarian Food Safety Agency (BSAF). BSAF is the primary agency that has the power of an external control body (for companies within the food industry) to control the use of nanomaterials in the form of additives, flavorings, enzymes, etc. in the production of food products. Under the Food Act in Bulgaria the use of nanoresources, nanomaterials and nanosciences is only allowed in cases where the need for their use has been proven to achieve a certain technological effect, there is no danger to the health of consumers in the quantities in which they are used and their use also does not mislead the consumer as to the type and characteristics of the food. In the cases when BSAF carries out external control, the internal controllers approved by the company itself should assist in the performance of the control activities.

From the point of view of internal control, the inspection of the implementation of the cost plan of the finished product is part of the inspection of the implementation of the nanotechnological production program. The planned cost of the finished nano-production is included as a component in the overall planned production program. Therefore, both the plan calculations and the plan parameters determining the change in cost are the subject of the inspection. The comparison of the planned data with the actual established data is carried out by comparative analysis. The existence of a discrepancy between the planned production nanotechnology program and the cost performance may be due to a number of factors, such as: changes in the volume of manufactured goods; change in the rate of cost savings; changes in the assortment variety of produced finished products; change in the supply price of used raw materials, incl. changes in the cost of nanoresources and nanomaterials.

In order to control the execution of the planned cost, at all stages of its determination, internal controllers should implement the analysis as a means of control. *In this regard, it is necessary to perform:*

- *Analysis of production (direct) cost* – the production cost is determined by the value of the raw materials and supplies used, the processing costs and other costs related to the manufacturing of the products (Dimitrov, 2015). In the Additional Provisions to the old Accountancy Act in Bulgaria (i.e. until 2016), cost was defined as "the measurement of assets produced (created) at an enterprise not including any administrative expenses, sales expenses, financial or extraordinary expense". In other words, from a normative point of view, the legislator has determined that the goods manufactured by the enterprise shall be assessed by the production cost. The new Accountancy Act in Bulgaria (effective as of 2016) does not provide a normative definition of the concept of cost. Article 26 of the new Accountancy Act states only that "the measurement of items which are recognised on the financial statements is carried at cost, which may be the purchase price or production cost, or by some other method when this is required by the applicable accounting standards".Therefore, the legislator presents the cost as not only the valuation of assets produced (created) at an enterprise but also as an option to measure the items presented on the financial statements. One important advantage of the new Accountancy Act is that, once it has not been specified what the legislator implies under the notion of cost, it might be acceptable to include the items in the financial statements through each of the approved types of cost (production, trade and total cost). From the point of view of national accounting standards, the latest **Decree No 394 of the Council of Ministers 2015** for the Amendment and Supplementation of the National Financial Reporting Standards for Small and Medium-sized Enterprises adopted by Decree No 46 of the Council of Ministers of 2005 (promulgated, SG 30/2005, amended and supplemented 86 of 2007), specifies that the measurement is "a process of determining the values by which the enterprise recognizes its assets, liabilities, income and expenses on its financial statements. The measurement includes a selection of measurement bases. **Measurement bases may be*: purchase price, cost or fair value***". Pursuant to that Decree, the term "cost" means " the measurement of assets and services produced (created) at an enterprise, which is determined by the value of raw materials and supplies used, the processing costs and other costs directly related to the manufacturing of the product concerned or the service rendered. Costs do not include administrative, financial, storage, sales and other costs not directly related to the manufacturing of the product concerned or the service rendered". Therefore, from the point of view of the National Financial Reporting Standards for Small and Medium-sized Enterprises, the valuation of the goods produced by the enterprise should be carried out at their cost, and in the preparation of the financial statement according to the requirements of Accounting Standard 2, the inventories (to which the goods produced also refer) should be measured at the lower value between the historical cost (purchase price, cost or fair value) and the net realizable value, the difference being accounted for as current operating expense. By comparing the requirements of IAS 2 and Accounting Standard 2, it is found that the International Accounting Standard does not use the term value added (i.e. historical cost) but the term cost. For this reason, IAS

2 states that the inventories shall be measured at the lower of either the cost or the net realizable value.

As the object of the control is the production cost of the nano-production, it is necessary to identify and distinguish the expenses that are directly related to the manufacturing of the respective nano-production, from the costs that relate to the total and the trade cost. In this respect, in the control process, expenses shall be grouped and analyzed by economic elements if this is not done by the enterprise itself. It is also necessary to group the expenses by stage of calculation, those related to the manufacturing of the respective nano-production, namely: expenses for basic raw materials and supplies; expenses for nanomaterials and nanosupplies; the salaries and social security expenses of staff employed in the manufacturing of nano-production; depreciation costs of machinery and equipment employed in the production of the relevant nanotechnology product; other production expenses related to the manufacturing of the relevant nano-product.

- *Commercial cost analysis* – obtained when the sale and realization expenses are added to the production cost (Dimitrov, 2015). According to *R. Ivanova* (Ivanova, 2016), „on grounds of the "*Production sale expenses*" item, the absolute and relative economy is determined, or over-expenditure of costs on individual calculation items in the sales activity. On the grounds of this information, their influence on full cost dynamics is determined on 100 levs of production, the profits from production sale and sale profitableness".

- *Full cost analysis* – obtained when the administrative expenses, i.e. the organization and management expenses, are added to the commercial cost. According to *R.Ivanova*, ***the full cost index on 100 levs of production*** „describes the cost of production sold, borne by 100 levs of net income from production sales to industrial enterprises. It is calculated as a percentage relation between the full cost and the cost of production sold, presented by net sale prices". In control practice, there are cases in which full cost is determined out from the accounting, i.e. no calculation accounts are applied, but calculations for the accounting of production sale are applied directly. This vicious practice is observed in cases when enterprises have concluded preliminary contracts for sale and the entire planned production quantity is accounted in advance as already sold.

- *Analysis of the absolute sum of economies from cost reduction* - When determining the amount of the absolute sum of economies from cost reduction, the following is required:

- *First,* to distinguish the meaning of value and cost. The main difference between these concepts is that "value is measured in time, while the cost is determined indirectly through the prices of the means spent for the manufacturing " (Timchev, 2011). This means that not the value, but the prices of the means used for the manufacturing exercise a permanent influence on the cost level and dynamics.

- *Second,* during the control process it is necessary to determine if the production manufactures is comparable (with a previous period of accounting) or if it is incomparable (i.e. the respective assortment and type have not been manufactured in the previous periods)).

- *Third,* in order to determine if there is an economy from cost reduction, the accounted production volume must be multiplied by the previous cost (from a previous period of accounting) and compared with this production which is exactly accounted but determined by the accounted current value. The difference between these creates an economy by accounting, i.e. when the difference is positive and at the same production volume, this creates a positive economy, as during the previous accounting period the cost was higher than the cost during the current accounting period. And vice versa, if the difference is negative, this means that the cost during the previous accounting period at preserved production volume was lower in value than that of the current period of accounting.
- *Fourth,* determination of the absolute sum of the economy from cost reduction as the difference between the manufactured production volume, determined by value according to the actual cost during the accounted period, and the same manufactured production volume, but determined by value according to the planned cost. From the point of view of the enterprise itself, the absolute cost economy is a prerequisite for increasing the current company profit, increasing the manufacture profitability, and prerequisites are created for expanding the manufacturing capacity. In addition, systematical reduction of cost leads to releasing raw materials and energy, it is a precondition for the better use of equipment and other means of work and leads to accelerating the working capital turnover and to releasing financial resources.
- *Analysis of the relative size in percentage of the economies from cost reduction* - this index is obtained by dividing the absolute sum of cost economy by the planned cost and the result is multiplied by 100 (i.e. to get a %). The internal controllers should take into consideration the fact that the relevant change of cost reduction may be due to some impermanence due to enterprise factors, such as for example a temporary change of manufactured production volume, a temporary change of production capacity etc. In this connection, the controllers can indicate to the enterprise management, how and in what way this relative economy size can be preserved against a permanent cost reduction.
- *Analysis of the cost index per 100 levs of production* – this index is determined as a percentage relation between the full cost of the production and the production cost per sale prices, not taking into consideration the indirect taxes. From the internal control point of view, the results determined from this index for the respective year shall be compared to the planned production cost, determined in the production program. Thus, during the nanoproduction manufacturing, by the analysis of the cost index per 100 levs of production, it will be determined if there is a negative trend for cost increase compared with previous accounting periods. This index is directly related to the production profitableness, since the profitableness represents the profitability, and by the cost index per 100 levs of production, the company profit is determined from the respective production sale. For more qualitative and effective control on the ready nanoproduction cost, the controllers should make a factor analysis of all the three (3) basic factors influencing the index change, and namely: To determine and to analyze change in volume and assortment of ready manufactured nanoproduction; changes in raw materials prices and changes in a single article cost, respectively.

- *Product structure analysis* – During the last years, increased interest in internal control of manufacturing structures has been observed, as a possibility for the development of manufacturing enterprises. Product structure is a component of the management structure of a given enterprise. Its implementation and approval is suitable for large corporations and enterprises which have a significant market share and which are present in many market segments in various geographic regions. Companies such as *Coca-Cola, Danone, Nestle, Mondelēz International etc.* have an approved product structure. Product structure is always oriented to the consumer himself, it is created to cover the needs of respective consumers of products under the required product quantities and terms. According to *Philip Kotler* (Kotler, 2009), items in the product structure are united in a product series, which consist of groups of products, closely related because of their similar function. These products are sold to the same groups of customers, they are offered in the same way or are grouped according to their similar price range.

Disposal analysis – Disposal is "an aggregate of functions for the provision and realization of the sale (exchange) of manufactured goods and services," (Simeonov, 2004) i.e., disposal can be considered as an aggregate of actions and relations between market subjects relating to transferring the ownership of manufactured production from manufacturer to consumer. It can be accepted that disposal is the final stage of the manufacturing process, by which the return on invested raw materials is achieved, by cash revenues from the sales and ready products realized. In the nanotechnological manufacturing process, unlike the other types of manufacturing processes, the enterprise should develop and implement relevant disposal policies. This requirement must be maintained as the nanoproduction value is much higher than the other types of manufacturing productions that are offered by the food industry enterprises. With the aid of disposal policies, the distribution policy is regulated as well, which includes the entire activity of the distribution, delivery and transfer of the ready product to the final consumer.

2. *The second main task of the internal control is to check if the method chosen for cost calculation is suitable for the respective type of nanoproduct* – in order to fulfil this task, the internal controllers shall:

    - *determine the specifics of the finished nanoproduction* – i.e. whether the manufactured production is monocomponent (simple) nanoproduction or multicomponent (complex) nanoproduction. When determining the cost of a monocomponent production, it is not necessary to use a complex method, since usually, a single product is manufactured (regardless of the fact that it may be intended for mass consumption), for which only one calculation is made. In multicomponent production, consisting of individual components, a calculation of the individual components is carried out. In the food industry, „85% of manufactured production is monocomponent. Only 15% of manufactured production is considered as multicomponent, for example, the manufacturing of infants' purées and foods for which the package (glass pot, glass bottle etc.) are accepted as a second component".

- *to determine the manufacturing cycle duration* – in the individual manufacturing sectors, the duration of the manufacturing process differs, from several hours to several days. For example, in machinery construction, shipbuilding etc., the manufacturing process could be months, for other manufactured products, the manufacturing process could be years, for example the creation of humanoid robots etc. The woodworking industry presents a seasonal manufacturing process. In the food industry, the years-long manufacturing process has changed, especially with the introduction of new technologies and the use of additional imported half-finished raw materials. Thus, for example, the brewery industry used to have a seasonal character because of the seasonal character of the raw materials (barley, hops and leaven), of which the beer is made. Today, the manufacturing process in the brewery industry is from several hours to several days, since the necessary quantities of raw materials are delivered both from Bulgarian manufacturers and, in winter, a significant part of the raw materials required are imported from abroad. Under this principle, enterprises such as Crosspoint EOOD, Kamenitsa AD, Zagorka AD, Carlsberg Bulgaria AD and others operate.

The duration of the manufacturing process is one of the main factors that influence the approval of a method for the calculation of the ready production cost. Hence, the internal controllers should examine very closely the influence and impact of this factor, since the cost calculation methods for productions received during manufacturing processes with a prolonged manufacturing cycle (months, years or seasons) is much more complicated than the calculation methods for manufactured productions whose duration is days or even hours. The complexity is determined by the large volume of uncompleted production obtained during the prolonged manufacturing process. During the control process, it has to be monitored if the administrative expenses, management expenses and expenses for the manufacturing process servicing are to be correctly distributed, as well as the expenses of a seasonal character when they refer to the manufacture of the respective product.

In the control practice, enterprises must implement not one but several methods for calculating the ready production cost, since various ready products are manufactured in the enterprises. For example, during the manufacture of homogeneous products that do not involve semi-manufactured goods, the direct method of calculating the cost of the ready products is used. During the manufacture of mass and serial production involving various and complex productions (consisting of multiple details and components), the normative method is used for calculating the cost of the ready items. A particular character of the "normative cost calculated during the normative method of calculation is the fact that its basis involves the norms of expenses sustained at the beginning of the period, which correspond to the manufacturing techniques and technology used at that moment" (Pehlivanov, 1988).

In nanofood production, mainly in the food industry, two methods for calculating the cost of the ready products are used. The first method is the phase method, which calculates the cost of the production of nanofood which is for mass consumption, since for its manufacture, physiochemical and thermal manufacturing processes for turning the nanomaterials into ready production prevail. The manufacturing process has several subsequent and permanent phases. Sometimes these phases are separated as individual

independent manufactured products. During the phase method, "the expenses for manufacture are formed in each workshop (phase), separated and calculated independently, including in each subsequent stage, the costs of the semi-manufactured components obtained from the previous workshop (phase)" (Pehlivanov, 1988).

The second method, which is frequently used for calculating the cost of ready nanoproducts manufactured, is the order method. This method is applied in the case of individual production and or the production of small series. From the internal control point of view, the contracts, by which the respective orders are placed, shall be examined; the nature of the order, and its technological and implementation time shall be determined, and the accounting of this order shall be checked. During the control of the execution in the order method for the calculation of the ready product cost, it has to be taken into consideration that „the performed manufacturing expenses for the particular order are accounted separately and approved calculation items are applied, and the expenses for raw stuff, materials, fuel and energy are in individual groups. For products for which no such detailed calculations are required for their actual cost, the expenses accounting can be performed only by calculation items without a detailed decoding of materials per groups" (Pehlivanov, 1988). According to the order method, the actual cost for each single product is calculated after the manufacturing of the entire order has been completed, whereas the total sum of the expenses is divided by the quantity of products manufactured for this particular order.

3. *The third main task of internal control is to help distinguish direct from indirect costs, as well as differentiating between constant and variable costs* – solving the problem of properly identifying production costs is not only within the power of internal control but it is mainly within the powers of business executives and accountants. The integration of the ERP and SAP systems has helped to solve this problem in production plants, and it can be assumed that it is now outdated. For example, the direct costs and indirect costs for the production of different products (Shumensko, Touborg, Erdinger, Karlsberg, Pirin, etc.) can be easily distinguished through the established ERP system in Carlsberg Bulgaria AD.

Direct costs explicitly and unambiguously refer to the cost of the finished product, as well as the costs of materials, salaries, social security, etc. In other words, these are expenses that are directly related to the production and the creation of the product concerned. Due to its specificity, indirect costs cannot be uniquely attributed to the production of a product because they are common or refer to several calculation items (Brezoeva, 2005). The ERP system provides a very good option for including indirect costs in the cost of the finished production by automatically allocating these costs to a specific production basis (man-hours, machine hours, processed meters, etc.) or distributing them equally between all units produced during the time period. Indirect costs can be production costs (such as maintenance, repair, depreciation, insurance, etc.), organizational and management costs, distribution costs (when different assortments are delivered to the respective customers at the same time), and advertising costs (for example, when different products offered by the same producer are simultaneously advertised by one and the same media) etc.

Another specific feature of internal control is that it is necessary to determine what part of ***the indirect production costs are variable*** and what part are ***constant***. With regard to ***direct cost control***, its realization is significantly easier in view of the fact that the **direct costs**

are always variable because their value directly depends on the change in volume of goods produced. Unlike direct cost control, *the control over indirect costs of production* requires the monitoring and control of the processes by which the indirect costs are distinguished as variable (i.e. costs that are dependent on changes in production volume) or constant (i.e. costs that remain relatively constant irrespective of the volume of production, such as: depreciation costs (if the linear depreciation method is applied), maintenance costs of the factory buildings, etc.) and various methods, such as mathematical methods, planning methods, accounting methods, etc., can be applied.

4. *The fourth main task of the internal control of the finished nanofood products is to inspect the contractual relations between the manufacturer (the seller) and the recipient of the finished goods produced* – in order to accomplish this objective, controllers shall examine the content of the concluded contracts, in addition to inspecting the fulfillment of the contractual obligations. The contract may contain a set of rights and corresponding obligations. Thus, in the sale and purchase agreement, the "right of the buyer to request the delivery of the goods and the corresponding obligation of the seller to deliver the goods" can be identified " (Ivanov,2009). From a legal perspective, this is the first contractual obligation between the two parties. Under the relevant contract, the seller has the right to demand payment for the goods and the buyer has the obligation to pay for them. In this sense, this is the second contractual obligation between seller and buyer. In the contracts between the parties, there may be a provision for the transfer of the claim if the payer cannot cover it. Normally, the whole procedure is governed by a separate contract (cession) for transferring the claim from one holder to another. Accordingly, the time limits and methods for the payment of the receivable between the new holder and the manufacturer shall be legally defined.

5. *The fifth main task of internal control is to react promptly in the event of detected violations and infringements relating to the production and sale of the finished products* – The proper application of methods, approaches, methodologies and control instruments by the internal controllers is a prerequisite for establishing deviations in the actual state of the controlled object from the pre-established and defined standards. The application of methods such as analysis, synthesis, induction, deduction, testing, etc., in internal control practice, are often interrelated and used to detect infringements, misuses and mistakes. This is one of the meanings of internal control, which has been assigned the task of regulating the behavior of the controlled object by developing a correction program. The internal controllers cannot impose sanctions and hold liable the persons guilty of the incorrect and poor quality (deviation) of the controlled object. The corrective program shall contain prescriptions, guidelines and also a description of the legislative and appropriate procedures for regulating the status of the controlled object. At the core of the correction program is the information feedback between the controlled entities and the management of the enterprise, regarding the formulation and adoption of the right organizational and management decisions.

6. *The sixth main task is to provide methodological assistance to the financial and accounting department of the enterprise regarding the provision of timely and accurate information on the results of the control activity*. For this purpose, the reports that are prepared during the control activities shall not only contain descriptive information

about the controlled object but also the information that is derived using the mathematical and statistical control methods.

The main sources of information for the internal control of finished nano-production are:

1. Nonaccounting sources of information: distribution policy; strategic estimates for sales policies; information on competitive products; graphs and charts for the competitiveness of manufactured products - nanofood; agreements with contractors; certificates of quality of the manufactured finished goods (nanofood) and other documents.
2. Accounting sources of information: schedules for the sale of the finished nanotechnology products; reports and references of customer payments; chart of accounts of production plants; the spending norms of reference for the direct costs of raw materials and supplies; protocols for finished products; protocols for the acceptance and delivery of finished goods from the production workshops to the warehouses of the enterprise; information from the accounting records; inventory book; inventory list; comparative lists; documentation of the availability of the finished products; invoices; documentation of the waste of finished products; goods received note; warehouse receipt note; protocols for the free receipt of raw materials; sales report; a cost-accounting registry; annual depreciation plan of the assets engaged in the production activity; payroll for the persons employed in the production and sale of the finished products; a book on inventories and other reporting sources of information.

The most common and detected violations in the control of finished nano production are:

1. The method for calculating the cost of finished products is incorrectly applied.
2. The direct and indirect costs, as well as the variable and constant costs, are incorrectly distinguished.
3. The incorrect distribution of accrued costs according to cost centre, i.e. whether they fall within the scope of cost centers for the manufacturing of nano-products (respectively the production of nanofood) or within the scope of cost centers for the other types of finished products.
4. Indirect costs are improperly allocated between cost centers for the main activity and costs centres for the ancillary activities.
5. The indirect cost allocation bases, which allocation is a cost-determining component of the finished nano-production, are incorrectly applied.
6. The production costs involved in determining the cost of the finished nano-productions are improperly grouped.
7. The planned production cost of the manufactured nano-production has not been correctly determined and the cost plan has not been properly drawn up - the plan calculations have not been drawn up based on the system of technical and economic norms and standards for the use of the production machinery and equipment. In the valuation of the nanomaterials necessary for the production of the planned nano-production, the delivery prices of the nanomaterials are not determined and not used

properly, since the value of the waste generated in the production of the nano-production is not deducted.

8. The object of calculation and the unit of calculation are not properly defined for each type or group of produce according to the particularities of the produced nano-product.
9. The sub-product segments and product groups are not properly defined, which therefore negatively affects the defining and implementation of the distribution policy.
10. The relationships between the parties involved in the purchase and sale of nano-production are not properly negotiated or regulated.
11. Business transactions relating to the production and sale of the finished nano-production are not accounted for.
12. Business operations relating to the production and realization of the produced nano-production are not documented.

3. Methodology of internal control of products from research and development

The manufacture of nanoproduction, in the form of nanofood and nanoproducts, cannot be carried out without the existence of well-established research and development departments in the enterprise. The research and development departments have a definite purpose and the departments' powers are limited in terms of the production process itself. The main purpose of the departments is:

1. The development of an optimal innovation idea and realization of this idea in the form of an exemplary model that shall serve as a sample during the production process. The execution of separate tests and examinations on the new product according to the proposed new model (product).
2. The creation of new innovative technology and the technological production line.
3. The design of tools, fittings, installations that would otherwise not be applicable. The design and creation of new materials and supplies.
4. The execution of analyzes, drawing up various innovative options for improving the quality of production.

In control practice, one of the requirements is to first determine the specificity and nature of the controlled object, to then begin the control process itself. This is a necessary condition to ensure the safety, consistency and creative performance of the control procedures. The main problem in control practice is to determine what will actually be the subject of control when it comes to research and development. In particular, whether the object of control will be the overall research process or the results obtained from the development and research activities. With the help of research and development activities, additional facilities for the enterprise can be created, that meet the requirements of an intangible asset, or objects can

be created that cannot be recognized as an intangible asset. This is a second major problem, namely, what are the specifics of the controlled object, whether the object under control meets the requirements for an accounting object and whether an economic entity falls within the scope of control. The clarification of these problems and their quick resolution is important, in order to determine the correct methodology and methods for control.

The differentiation of accounting objects from economic objects, from a theoretical and practical point of view, is not so clear, and the majority of practitioners consider it unnecessary in most cases. From the point of view of control practice, however, this is essential in order for the control process to take place swiftly and without delay and waste of significant resources. Accounting objects are primarily economic entities that meet the economic and accounting requirements set out in the accounting standards and in the Financial Reporting Framework. According to the Conceptual Framework for Financial Reporting, accounting objects shall meet the following requirements:

1. They must act as elements that directly relate to the measurement of the entity's financial position (such as assets, liabilities and equity).
2. It must be possible to reliably measure and determine their value.
3. They must evidently be resources that are controlled and owned by the enterprise.
4. They must be obtained as a result of past events or arising from past events, the expense of which is expected to give rise to an outflow of resources from the entity which outflow results in economic benefits.
5. They must be received as a residual interest on the assets of the entity after deducting all of its liabilities.
6. They must be a prerequisite for obtaining another resource or a prerequisite for reducing the economic resource that is available to the enterprise.

It should be clarified that if an economic object does not meet the requirements for classification as an accounting object it is not excluded and not ignored by the scope of the accounting. The accounting theory has proven the place and importance of economic objects, and it is determined that they are part of the subject of accounting together with the accounting objects. The legislator also examines the economic and accounting objects together, as the financial performance of the enterprise and other events or transactions affect the change in the economic resources available to the enterprise. From the legislative point of view, the reasons for this amendment shall be faithfully presented to the users of the information on the financial statements. Therefore, information on economic objects shall be reflected in the notes to the financial statements and the information on accounting objects shall be reflected in the components of the financial statements.

This distinction between economic and accounting objects, from the point of view of control practice, is represented by the variety of types and forms of control that can be applied on the respective controlled object. When it comes to controlling an accounting object, it is of utmost importance to determine the scope, type and form of control according to the established legal frameworks for the recognition of the object as an accounting object. In controlling economic objects, due to the diversity of the existing types

of economic objects in practice, it is not always possible to apply all types and forms of control on the controlled object. For example, an internal audit of an economic object might be carried out depending on the audit engagements undertaken, as well as when the object has an impact on the financial position and financial performance of the entity.

The internal control over the development and research activities of the food industry, which is considered above all as continuous and consistent in terms of the actions and procedures, is carried out in the following order:

1. Preparatory actions and preliminary investigative actions to determine the specifics of the controlled object.
2. Preparing and issuing an order to entrust internal control over the implementation of the development and research activities of the enterprise. The order shall specify the scope, the term (i.e. the duration of the inspection) and the controllers assigned to carry out the internal control.
3. The implementation of the control itself, as a sequence of control actions, includes:
    - control of authorization and approval of research and development costs;
    - control of the selection and quality of research and development personnel;
    - control of the administrative actions taken by the persons responsible for the storage and preservation of the assets of the enterprise.
    - control, management and risk analysis in the controlled department in order to achieve the objectives and tasks of the said department.
    - control of information received and that generated by research and development activities;
    - performance of arithmetic control, in terms of the quantity and quality of the business operations that are carried out and which affect research and development activity.
    - control of the implementation of the approved internal regulations, which affects the fulfillment of the tasks and objectives of the research and development activity.
    - consistent documentation of control activities and processes by controllers. The presentation of duly drawn up documents proving the control actions taken. The presentation of evidence of detected violations and irregularities.
4. Completion of the control process - preparation of protocols of findings, findings reports and suggestions for improvement of the activity and quality of the implementation of the research and development activities in the enterprise.

2.3.1 Methodology of internal control over the results of the development activity

The research and development activity applied to the production of finished nano-products, in the form of nanofood and nanoproducts, is determined by the predefined objectives and tasks of the enterprise. Since the research and development activities may create reporting items that meet the requirements for accounting objects, the nature of these two separate activities is regulated in IAS 38 and in AS 38 in Bulgaria. Pursuant to IAS 38, Intangible Assets under Development, the activity is understood to be the application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, processes, systems or services before the start of commercial production or use". The same standard specifies that research is an "original and planned investigation undertaken with the prospect of gaining new scientific or technical knowledge and understanding" In view of the established national accounting standards for the financial reporting of small and medium-sized enterprises, according to AS 38 Intangible assets in Bulgaria - research is considered to be "original and planned research activity to achieve new scientific or technical knowledge". Examples of research activities are:

a) activities aimed at obtaining new knowledge;

b) the search for, evaluation and final selection of, applications of research findings or other knowledge;

c) the search for alternatives for materials, devices, products, processes, systems or services; and;

d) the formulation, design, evaluation and final selection of possible alternatives for new or improved materials, devices, products, processes, systems or services.

According to the requirements of the same standard AS 38 in Bulgaria, development is the "practical application of research findings or other knowledge in a plan or scheme for the production of new or substantially improved materials, devices, products, processes, systems or services before the start of commercial production or use in the business of the enterprise". Examples of development activities are:

a) the design, construction and testing of pre-production prototypes and models;

b) the design of tools, jigs, moulds and dies involving new technology;

c) the design, construction and operation of a pilot machine that is not of a scale economically feasible for commercial production; and;

d) the design, construction and testing of a chosen alternative for new or improved materials, devices, products, processes, systems or services.

Therefore, taking into account the definitions set out in the relevant standards, it should be assumed that another object with a physical form can be created in the implementation of the research and development activities. However, they should be considered as intangible identifiable assets because the material prototype or model is a secondary product of knowledge, and the corresponding prototype is the primary result of that activity.

Referring to the precautionary principle, "accounting laws restrict the scope of intangible resources that can be recognized as such," (Petrova, 2012) this particularity is a prerequisite for the divergence of objects created as a result of research and development - some of them are recognized as accounting objects in the form of intangible assets and others are recognized as economic objects that do not meet the requirements of intangible assets. It is permissible not to recognize the expense immediately incurred as an intangible asset and capitalize these costs to the value of the asset. The precautionary principle should be adhered to and strictly applied when it comes to research and development, because the investment risks are high and are likely to fail. Therefore, from the point of view of internal control, there are two differences in the essence and meaning of objects that control bodies and persons shall inspect and for which an appropriate methodology and methods of internal control shall be applied.

From the point of view of internal control, controllers in controlling development activities should take into account that it is possible to account for the recognition of an intangible asset during (and not only after) the development phase according to IAS 38, provided that the enterprise can demonstrate ***all*** of the following:

- the technical feasibility of the project (completion of an intangible asset) so that it will be available for use or sale;
- the intention to complete the project and use or sell it;
- the ability to use or sell the intangible asset;
- how the intangible asset will generate probable future economic benefits;
- the availability of adequate technical, financial and other resources to complete the development and to use or sell the intangible asset;
- the ability to measure reliably the expenditure attributable to the intangible asset during its development.

In the food industry, intensive research efforts are focused on the development of polymeric materials from natural sources such as cellulose, lignin, plant pectin, plant and animal proteins, and polyesters from bacteria or plants, etc. They are aimed at developing materials that are persistent, biocompatible and biodegradable. The development of such materials usually requires "difficult and complex methods of processing the biological resources and there are specific characteristics in terms of their extraction, development and making them functioning, which can be costly, time-consuming and which do not yield significant returns for the enterprise itself" (Johansson, 2012).

The latest findings in the field of biotechnology, suitable for the food industry, which is the result of years of work, is the development of combined biomaterials with qualities that can be controlled and adjusted during their growth, that would be ready for use without the need for costly and complex methods of processing. This discovery is based on the basic qualities of mycelium, which is the lower vegetative part of a fungus. Mycelium is identified as the Earth's largest living organism. The patent for the production of these

combined biomaterials meets the requirements for an intangible asset because it is a distinct non-monetary asset without a physical substance.

The following discoveries and achievements relate to nanotechnology-based development in the food industry:

- Design and development of product lines for the production of food supplements - enzymes, minerals, silicon dioxide (to support youth), titanium dioxide (most commonly used in candy production, as well as in the cosmetics industry (e.g. in the production of toothpaste) and others.
- In recent years, the production of encapsulated active ingredients, which contain a mycelium, has been patented. These active ingredients are even used in the production of yoghurt as the mycelium is stable in terms of pH and temperature changes, i.e. they are used as a stabilizer. Also, the mycelium "is an optimum carrier system of hydrophobic substances for higher and faster intestinal and dermal resorption and it facilitates easier penetration of the other active ingredients" (Semo, 2006).
- Design and development of production lines for biodegradable packaging.
- Design and construction of a new information system for the users of nano-products and their producers;
- Design of sensor systems in food packaging, where sensors shall control moisture, gas permeation in packaging and the temperature conditions of the vacuum-packed food.
- The introduction of nano-biotechnology in the food industry, which involves the use of nanoparticulate vectors for carrying foreign DNA into cells. There is evidence that for the first time nanobiotechnology has been applied in the US food industry using tungsten particles, but at the level of microparticles. (Friends of the Earth, 2008). Based on this technology, cellular "injection" with carbon nanofibres containing foreign DNA has been used to genetically alter golden rice. (Chaudhry, 2008) Golden Rice is the result of the work of *Ingo Potrykus*, a professor at the Zurich Technical University and his colleague *Peter Beyer* of the University of Freiburg (Beyer, 2002). The rice that they have produced contains β-carotene - provitamin, which can be converted by the human body to vitamin A, a vitamin which influences the metabolic processes in the epithelial tissue, the deficiency of which leads to a number of health issues such as dry skin, brittle nails and fragile hair. However, this rice type has not been approved for mass production as it was developed with the help of genetic engineering.
- Development can also be related to designing tools and devices, as well the design and testing of new and improved production systems, etc.

All these discoveries and achievements are the result of the development of the food industry. They meet the requirements for recognition as Intangible Assets because: these discoveries and achievements are ready for use; the enterprise can reliably measure (assess) the costs associated with their development; the enterprise has sufficient technical, financial and other resources to complete the development activity; there are future economic benefits from the respective discoveries and achievements. Consequently, the final result of

the development activity is an intangible asset when the development activities are carried out according to the preliminary plans and the realization of the development activity is not influenced by unforeseen events and factors, namely:

- the enterprise does not transfer rights to the use of resources for the remuneration of third parties. Resources used in the development are intended, that is, to realize discoveries and innovations for the needs of the enterprise itself;
- investment costs are focused on development, producing good, high-quality results;
- interested competitors do not have information about the enterprise's innovative technologies, the new unknown knowledge, phenomena and processes are treated as a trade secret;
- discoveries and achievements can be duly evaluated, and future benefits for the enterprise can be determined;
- the enterprise controls the entire development process.

Objectives of internal control regarding the development results

1. To identify the stages, processes and procedures of the enterprise's overall development.
2. To identify any non-documented business operations related to the company's development.
3. To identify any non-reported intangible assets received in the development phase. In this respect, it should be checked whether the intangible asset actually meets the internally generated intangible asset criterion, in which case the research and development activity should therefore be divided.
4. To check whether the innovative idea uses resources and technology for single production rather than for mass production.
5. To ensure that the entity wisely assesses the degree of certainty attached to the flow of future economic benefits from research and development.
6. To inspect the assessment of the recognized intangible asset after its recognition. In this case, it should be checked whether the entity complies with the requirements of the accounting legislation, namely that in IAS 38 "after its initial recognition, intangible assets are measured at:
    - the cost of acquisition (i.e. acquisition cost less any accumulated amortization and impairment losses); or
    - according to the revaluation model (i.e. fair value at the date of revaluation less any subsequent accumulated amortization and revaluation losses)".
7. Where irregularities, inconsistencies or misconduct are identified, an appropriate system of impact based on the findings shall be suggested.

Problems, weaknesses, mistakes and deviations found in internal control regarding the development results

1. Incorrect determination of the cost of the internally generated intangible asset received during the development phase. As required by accounting standards, cost should be determined using the same principles that apply to the acquisition of tangible assets. The cost should include all costs that may be directly related to the creation, production and preparation of the asset for its intended use.
2. Identify irregularities regarding the approach adopted to determine the exact timing for discontinuing the capitalization of costs. According to the accounting standards, termination of capitalization of costs occurs when the intangible asset becomes ready for use in a manner provided by the management. For this purpose, a Protocol for commissioning shall be issued. This document is missing, or even if issued the date of its issue is not taken into account by most enterprises.
3. An intangible asset may be generated and created through the approved development activity in the enterprise, but in cases where the cost of creating this asset cannot be reliably measured, the value of the intangible asset cannot be reliably determined. For example, the good reputation of the enterprise among competitors is seen as a good center for the implementation and the development of new technologies.
4. One major problem is that the inherent administrative and other general costs that can be allocated to the intangible asset and included in its cost are not properly determined.
5. Internal control determines that not all resources involved in the creation of the respective intangible asset are included in the cost of the asset and accordingly do not participate in the capitalization of costs. Such resources are, for example, the quality and competence of the research and development personnel. This means that the enterprise has not implemented a system for determining wages by assessing the qualities and competencies of those engaged on development.

On the basis of all of the above, regarding the research problem of internal control of nanotechnology manufacturing and nano-production and internal control of research and development, the following main conclusions and recommendations can be drawn:

1. Internal control of the research control objects - nanotechnology manufacturing, nano-production, research and development - has not yet been established as the main means of revealing the behavior and modification of these objects. These objects are not considered as being interconnected, i.e. as bundle variables that generally affect the financial position and financial change of the entity.
2. No particular attention is paid to the analysis as a means of internal control. With the help of the analysis, the control process achieves a better diagnosis of the actual state of the controlled object, its planned and expected state. Applying the approved methodology of the internal financial analysis, together with the published data from the management accounting, the controllers can determine the reasons and the factors that influence the change of the controlled objects.

3. There is no interaction between internal control and controlling in the control practice, which in turn targets management and optimization of expenses, revenue management and management of the financial result of the enterprise. The two control concepts concerning internal control and controlling are still considered in isolation from each other. Because of the complexity of intertwining these two types of control (internal and controlling), the scope of the report has not been studied for their mutual application.

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