QUANTIFICATION OF THE DECISIONS OF CONTROL AND AUDIT IN INVENTORY MANAGEMENT IN CEMENT INDUSTRY ENTERPRISES

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Abstract: Inventory management in enterprises of cement industry necessitates the assessment of the level of risk which is generated by production inventory. The processes of control and auditing allow for planning, monitoring and organization of inventory management in the analysed business entities. This paper is aimed at presentation of the phase of preparation of audit activities in the area of inventory and verification of model solutions for the processes of control and audit in terms of inventory management.

Keywords: control, audit, inventory, cement industry

Introduction

Proper inventory management in enterprises of cement industry necessitates comprehensive implementation of the processes of control and auditing. The goal of the paper is to verify model solutions for control and auditing in terms of preparation of audit in the area of inventory management in enterprises of cement industry. Inventory generates costs which might have important impact on property and financial situation in enterprises. Control in enterprises of cement industry plays the role of a verifier of accuracy of business decisions, which contributes to an increased effectiveness of the enterprise. Internal auditing investigates and assesses the system of internal control; its implementation in the case of inventory requires synthetic and comprehensive monitoring of particular procedures.

1. Theoretical Aspect of Control and Auditing

Control and auditing are the elements (subsystems) in the system of control in enterprises, which, apart from planning, motivating and organizing, performs the function of management system. Explanation of the role and place of both control categories will be the starting point for further considerations.
Separation of internal auditing was caused by the crisis of internal control [1., 2.]. Lack of trust among managers towards the effectiveness and efficiency of the system of internal control has caused the need for replacing it with another control mechanism, that is, internal auditing. The internal auditing investigates and assesses the system of internal control and is ‘increasingly often based on the procedures of internal control’ [3., 4., 5., 6., 7.]. The objective of internal auditing is control of the whole enterprise [8.], with particular focus on financial and operating areas.

Proper assessment of the internal control carried out by an internal auditor requires asking a number of detailed questions concerning its organization, control procedures, methods of work in individual areas. According to J. Stępniewski, 'internal control is a fundamental stage in audit, common for all the audits: internal and external' [10.].

Internal auditing differs from control with qualifications of auditors. In the literature on this subject one can find the requirements imposed on the people who are professional auditors. They relate not only to education level and skills, but also to respecting professional ethics.

Internal auditing is characterized by high independence, which, however, requires good knowledge of the principles which are used in the enterprise. From institutional point of view, internal auditing is a separated organizational unit in a particular enterprise. Internal control has an ad hoc character. At the functional level, it is responsible for control according to current standards and regulations. It is the set of control mechanisms which function at any level of an enterprise.

Apart from the character, the control differs from the audit with the role performed in the system of enterprise management. Audit provides objective and current information about operation of the enterprise, with consideration of the risk elements. Control reveals non-conformities which have occurred in the enterprise. Therefore, information obtained based on the control provides the picture of the past, whereas the role of internal auditing is to inspire future activities.

The result of work of internal control is the protocol. It contains the assessment and post-control conclusions and comments, based principally on the criterion of economy. The effect of work of an internal auditor is the report which contains the assessment of the investigated areas. The assessment utilizes quantitative and qualitative measures.

Forms of operation of both subsystems of control also differ. Internal control might be performed in the form of revision or inspection. Audit is based on 'interviews with employees at different levels of corporate hierarchy, analysis of existing procedures and methods of operation, including functioning of control so that analysis of systems and processes of organization can be carried out' [6., 7.].

An important element which distinguishes internal control from audit is the fact that the enterprises can operate effectively and properly without internal auditing, whereas no enterprise can exist without the system of internal control. Internal auditing approaches prevention and detection activities to be a priority. Internal control in the first place deals with elimination of non-conformities detected during control activities. K. Winiarska emphasizes that 'internal control is oriented towards future, finds mistakes, seeks responsibility and inflicts punishment, whereas internal auditing monitors current status, inspires for future, finds solutions and suggests preventive measures, provides guidelines and coordination' [6., 9.].

Control and auditing are regulated by virtue of the Act of Public Finance [15.] and the Accounting Act [16.]. Since the moment of Poland's accession to the European Union, the regulation of the Ordinance 1606/2002 of the European Parliament and the Council of 19 July 2002 on application of the International Accounting Standards and International Financial Reporting Standards. Polish legal regulations are the effect of adaptation of the law to the requirements which are in force in the European Union, where control and auditing are imposed by such regulations as:

- International Standards for the Professional Practice of Internal Auditing according to IIA (The Institute of Internal Auditors),
- INTOSAI standards (the International Organization of Audit Institutions), which have been translated and published by the Supreme Audit Office, concern external control; however, many of these regulations apply to internal control and auditing,
- ISACA standards (the Information Systems Audit and Control Association), which refer to IT auditing

- Standards by IFAC (the International Federation of Accountants), concerning financial auditing [13., 14.].

In Western concepts, auditing is frequently identified with control and vice versa. In Polish literature, both concepts are clearly divided. The reason for this situation is associating such concepts as control or revision not with operation of the enterprise but rather with social and economic reality in post-war Poland. Internal control and internal auditing today are the subsystems of the system of control in the enterprise. Internal control relates to conventional control activities set by managers in the enterprise, is aimed at ensuring credibility, effectiveness and efficiency of operation. Internal auditing, being an element of the environment of control, is a tool for management used for verification of control activities in the enterprise, facilitates and contributes with value added. Audit is a modern tool for management; therefore, the business entities prefer the decision-making aspects of this process.

2. Decision-Making in Terms of Control and Auditing in the Area of Inventory Management in the Enterprises of Cement Industry

Inventory management in cement industry enterprises is conditioned by the factors such as seasonal nature of activities, demand, or level of production capabilities. These factors have direct effect on inventory level in enterprises of cement industry. Seasonal nature of activities in these entities results from climatic conditionings, which form the demand for cements in construction industry. Demand for products in cement sector affect the inventory level of semi-finished products and materials [11., 12.]. Operation of enterprises in cement sector is limited by the production capabilities. These limitations in the enterprises concern in particular the number and capacity of silos for raw meal and cements, the number and capability of grinding mills, the number and performance of furnaces for burning clinker. Empirical investigations were carried out in four cement facilities which belong to one of the biggest cement concerns all over the world. The scope of empirical data covered by the investigations concerns the size of production, consumption and cost of sales of stock and inventory level.
In order to quantify the process of control and audit in terms of inventory management in enterprises of cement industry, the set of empirical data was presented in quantitative approach. The audit covered the period of twelve consecutive calendar months due to several reasons. Firstly, examination of inventory in twelve consecutive months demonstrates seasonality of production and sales of inventory in cement sector. Secondly, size of production, consumption and sales of inventory in consecutive years are formed similarly in all the companies from cement sector. Thirdly, the audit is expected to provide ex ante information, thus analysis of inventory within twelve consecutive calendar months will provide current information on formation of the level of inventory.
Empirical investigations focus on the implementation of the first phase of audit task and control activities in terms of inventory management in the enterprises of cement industry. The focus of the audit task is the *effectiveness of inventory management in the enterprises of cement industry.* The audit task distinguishes between three phases which are organizationally separated parts.

Phase of audit preparation:

a) Definition of the areas and objectives of audit
b) Identification of risk in the studied area
c) Analysis and assessment of risk

The focus of the present paper is on the verification of model solutions for the first phase of audit task. During the phase of audit preparation, the effect of inventory turnover on making decisions concerning the inventory level in cement industry will be demonstrated. The phase of planning, which considers the assessment of the system of internal control, will involve the variants of application of the model of control and audit in cement sector. Implementation of the planned investigations during the last phase of audit will become the basis for the assessment of economic consequences of implementation of the model of control and audit in inventory management in the enterprises in cement industry.

a) Definition of the Areas and Objectives of Audit

Definition of the areas of audit necessitates preliminary identification of stock in the entities included in the study. Fundamental materials for production of all the types of cements include: limestone, granulated furnace slag or siderite ores (granulated slag can be replaced with other raw materials e.g. dust and volatile ashes, basic raw materials for production of cement also include additions for product improvement).
Siderite ores (iron ores) are materials, which are included in raw meal. They originate from extraction of post-mine heaps. Proportion of iron in the composition of raw meal is insignificant (ca. 2%). Adding iron to raw meal in the form of siderite ore is necessary for the process of burning clinker to occur. Siderite ore inventory is maintained with respect to the consumption level.
Siderite ores (iron ores) are materials which are incorporated in raw meal. They originate from exploitation of post-mine dump. Iron proportion in raw material composition is insignificant (ca. 2%). Adding iron to the powder in the form of siderite ore is necessary for the process of clinker burning to occur. Siderite ore inventory level is maintained with respect to the level of consumption. Siderite ores are stored in open heaps.
Granulated slag is a waste material from production of blast-furnace pig iron in foundries. This raw material is a necessary component of production of raw meal (ca. 28%). Granulated slag is stored in open heaps. The level of slag inventory is considerably affected by production size. Maintaining excessive inventories for a longer period of time is connected with the possibility of agglomerating of the slag, which involves high financial expenditures of crushing the slag. Solution for this problem can be provided by the application of stepping dumping sites, which would prevent from agglomerating of the slag but it involves high investment expenditures.
Limestone is a basic material for production of cement. Cement is composed in 70% of the limestone. It is mined in enterprises' own mines. Pricing policies for limestone are based on manufacturing costs. The costs of manufacturing of this raw material depend largely on the following factors: thickness of barren rock (soil over the deposit), contamination in the deposit with sinkholes and stone hardness which determines the costs of the extraction methods.
Consumption of limestone per Mg of raw meal (being a semi-finished product) is a variable costs. There are a number of factors which affect consumption of the raw material and thus the level of costs. The first factor is the content of calcium carbonates in the stone. Lower levels of calcium carbonates correspond to higher limestone consumption during production of raw meal. Another factor which determines the amount of the consumed stone is its humidity. High level of humidity causes a rise in consumption of the material during production (this concerns only the dry method of clinker production). Next factor affecting the level of costs of material consumption is stone hardness. High hardness causes the necessity to utilize specialized equipment to crush it. Moreover, consumption of electricity necessary to grind it is also increased. Rise in stone hardness causes that consumption of grinding medium and dustification of raw material mills is also rising,

which results in reduced mill's performance. As results from these facts, costs of extraction and processing of limestone into raw meal considerably depends on geological factors.
Semi-finished products in cement industry enterprises are raw meal and clinker. These semi-finished products are obtained after completion of particular production phases. The raw meal and clinker are stored in transitional warehouses between phases. Raw meal is stored in closed storage facilities (homogenization silos) whereas clinker is stored in open storage facilities (heaps) or roofed open storage facilities(at present, the enterprises of cement industry included in the study are making investments in order to close clinker storage facilities to reduce dust pollution).
Raw meal is obtained by means of grinding limestone in the process of pre-homogenization. During burning of raw meal, another semi-finished product is obtained (clinker). Clinker is a basic component for production of any type of cements. The process of burning raw meal and clinkerization require high temperatures (ca. 1400^{o}C). A fundamental technological fuel in cement industry enterprises is coal. In order to protect natural environment, cement industry companies in recent years have increased the proportion of alternative fuels in overall structure of technological fuel consumption.
Final products in cement industry enterprises include all types of cement. Cement is usually sold to external customers; however, given that all the domestic cement enterprises are owned by international corporations, final products, semi-finished products and raw materials are becoming the products and can be resold to other entities.
The process of control and auditing in inventory management in cement industry enterprises included in the study will be made in quantitative approach. Due to quantitative proportion of individual types of inventory in cement sector, the investigations concerned:

- materials – limestone
- semi-finished products – raw meal and clinker
- final products – cement.

The research area of control and auditing of inventory levels of limestone, raw meal, clinker and cement include the processes of building, storage and depletion of the stock. Building the stock selected as a research subject is made during the production process. Storage of the stock is carried out in enterprise's own open or closed landfills. Depletion of the stock of materials and semi-finished products is made through transfer of this stock to be consumed during production process whereas final product inventory is depleted through sales. Empirical data were elaborated assuming the production capabilities presented in table 1.

Table 1. Simulation values of production capabilities of stock in the enterprises in cement industry included in the study [17.]

Cement:	
➢ cement silo capacity	– 72,000 Mg,
➢ maximal daily output	– 4,000 Mg,
➢ average daily output	– 2,200 Mg,
➢ maximal cement inventory	– 70,000 Mg,
➢ minimal cement inventory	– 23,000 Mg.
Clinker:	
➢ mean daily output	– 1,900 Mg,
➢ raw meal consumption	– 2,700 Mg,
➢ capacity of open storage facilities	– 70,000 Mg,
➢ maximal daily output	– 1,950 Mg,
➢ daily clinker consumption[1]	– from 0 to 2,200 Mg,

➢ maximal inventory [2]	– 60,000 Mg,
➢ minimal inventory	– 5,000 Mg.
Raw meal:	
➢ silos capacity	– 12,000 Mg,
➢ maximal daily consumption	– 2,700 Mg,
➢ daily consumption[3]	– from 0 to 2,700 Mg,
➢ maximal inventory	
➢ minimal inventory [4]	– 3,500 Mg.
LimesMge:	
➢ storage facility capacity	– 30,000 Mg,
➢ maksymalne dobowe zużycie	– 2,200 Mg,
➢ daily consumption[5]	– from 0 to 2,200 Mg,
➢ maximal inventory	– 20,000 Mg,
➢ minimal inventory [6]	– 8,000 Mg.

[1] depends on the type of obtained cement.
[2] in winter period, clinker can be additionally stored in the heaps with the amounts matching the expected demand in future periods.
[3] daily consumption depends on the number, capacity and operation time of furnaces
[4] minimal inventory takes into account the dead stock of ca. 10%.
[5] depends on operation time of the grinding meal.
[6] minimal stone inventory is defined for 4 days of operation of grinding mills with maximal capacity.

The objective of inventory control in cement industry enterprises is to obtain sufficient evidence to confirm that the inventory level is consistent with current demand, while record and documentation of stock is flawless and appropriately presented in accounting books, and inventory costs are maintained at optimal level. The objective of the audit is to obtain credible evidence that the inventory management is implemented properly, inventory management procedures are effective and the system of inventory control operates undisturbed. The goals at the level of audit preparation are of general nature and will be specified in audit program.

b) Identification of Risk in the Area of Cement Inventory

Identification of risk in the studied areas covers:
- definition of risk significance,
- determination of the risk of the examination,
- presentation of the factor which generates inventory risk as divided into categories,
- pointing to inventory risk measure.

Overall risk significance was evaluated as a weighted average of partial significance levels. In order to determine partial significance level for inventory in the studied period, production capacity of the studied entities, planned production, sales levels and inventory levels from previous years were taken into consideration. Partial significance for individual types of inventory and overall significance for cement inventory in cement industry enterprises is as follows:
- limestone (+/–) 1 – 2 days,
- raw meal (+/–) 1 – 2 days,
- clinker (+/–) 1 – 2 days,
- cement (+/–) 2 – 6 days,
- overall significance (+/–) 1 – 3 days.

Significance provides information about which deviation can be neglected during assessment of inventory management. This deviation results from the difference between the planned and real frequency of inventory replenishment. Overall significance was adopted at a very high level, which limits the level of risk of the examination. Examination risk is given by the following equation:

$$RB = RN \times RK \times RP \quad (1)$$

where:

RB –examination risk, which is the product of inherent risk, control risk and overlooking risk,
RN – inherent risk, which means susceptibility of the studied area to non-conformity,
RK – control risk, which concerns likelihood of occurrence of non-conformities in the system of internal control,
RP – overlooking risk, which concerns effectiveness of the employed procedures

It was adopted during evaluation of the examination risk in inventory auditing in cement industry enterprises that:
RN is high and accounts for 0.75; RK is high and accounts for 0.50; RP – is medium and accounts for 0.45.

$$RB = 0.75 \times 0.50 \times 0.45 = 0.17$$

Examination risk accounts for 1.7% and is found to be medium.
A basic factor which generates risk of inventory built by cement enterprises is the frequency of rebuilding stock. This factor is measured by means of inventory turnover ratio. Categories of risks caused by the frequency of replenishment of stock are presented in table 2.

Table 2. Risk categories in the studied area [17.]

SUBJECT OF THE STUDY	RISK FACTOR	RISK CATEGORY	RISK MEASURE
Inventory of: ➢ *materials* ➢ *semi-finished products and production in progress* ➢ *final products*	***Frequency of stock replenish-ment***	Risk of disturbances in the process of supply, production and sales	***Inventory turnover ratio*** *(cost of building the sold-out inventory /average inventory)*
		Risk of loss of financial liquidity	
		Risk of decreased profitability	
		Risk of rise in costs of capital locked up in inventory	
		Risk of rise in costs of warehousing	
		Risk of loss in functional value of inventory	
		Risk of rise in costs of building (ordering) inventory	
		Risk of rise in deficiency or surplus of inventory	
		Risk of rise in the old and redundant inventory	
		Risk of losing customers or suppliers	
		Risk of deficiency or surplus of inventory	
		Risk of disturbed supplies	
		Risk of rise in inventory costs	
		Risk of capital locked up in inventory	
		Risk of reduced competitiveness	
		Risk of reduced customers' satisfaction	
		Risk of decline in sales	

Inventory turnover ratio for limestone, raw material, clinker and cement will determine the order of auditor's activities. Inventory turnover in cement industry will vary in individual periods according to the seasonality of production and sales, therefore inventory turnover should be determined individually for materials, production in progress and final products each month.

c) Analysis and Evaluation of Risk

In order to carry out the analysis and evaluation of risk in the studied area, the analysis of the process of building, storage and depletion of cement, limestone, raw material and clinker inventory levels was performed. Average planned turnover of limestone in the studied year accounted to 7 days. Actual turnover of this raw material accounted for 9 days. This means that limestone inventory level is sufficient for 9 days of production of raw meal on average.

Limestone turnover in winter period was slower than planned, which contributed to the accumulation of inventory. In summer period, limestone inventory turnover was faster than planned. The accelerated turnover in the summertime allowed for maintaining limestone inventory at a relatively low level. Higher consumption of limestone in the 2nd and 3rd quarter of the year caused that the deviation of mean inventory turnover over the year ranges within standards.

It should be noted when analysing the limestone turnover ratio in summer and winter seasons that the turnover in winter season is slower since production of raw meal in 1st and 4th quarter of the year was lower than planned. In summer season, mean actual limestone turnover for two quarters equals the planned value and amounts to 6 days.

Slower limestone turnover in the winter period generates the risk of increase in costs of maintaining inventory. Accelerated turnover in the summer period causes the risk of increase in costs of extraction and transport of limestone. In the case of limestone, the risk of production stoppage does not exist since the enterprises have their own limestone mines (in longer periods of time, the risk of depletion of deposits occurs).

Another type of risk in the case of limestone, which does not have immediate relationship with its turnover but is closely related to cement production level, is the quality of extracted limestone (low stone, high stone). Insignificant value of deviation of actual from planned limestone turnover points to the conclusion that the risk in this area is low.

Expected average annual raw meal turnover in the studied period amounted to 3 days. Actually, average turnover amounted to 4 days. This means that average planned turnover in the area of raw material equals actual turnover. Deviation of actual from planned turnover is maintained within standard limits. Raw meal turnover rate depends on production capability of raw material grinding mills and capacity of storage silos.

When analysing turnover rate with division into two seasons, one should note that actual turnover of raw meal in winter period was twice slower than expected (planned turnover was 3 days whereas actual value was 6 days). Slowdown of turnover in the winter season results from lower level of clinker production. In the summertime, actual turnover was similar to planned levels (2 days), which contributes to maintaining constant level of raw meal inventory.

Overall risk resulting from the examination of turnover for raw meal is low. This assessment results from several reasons. Raw meal stock is limited with the capacity of silos. In the winter period, slower turnover generates the risk of an increase in the costs of maintaining inventory and capital lock-up. However, even turnover rate in the summertime reduces the risk which comes in winter, which, in annual terms, causes that raw meal turnover is stable. Figure 1. presents the frequency of replenishment of inventory levels for limestone, raw meal, clinker and cement.

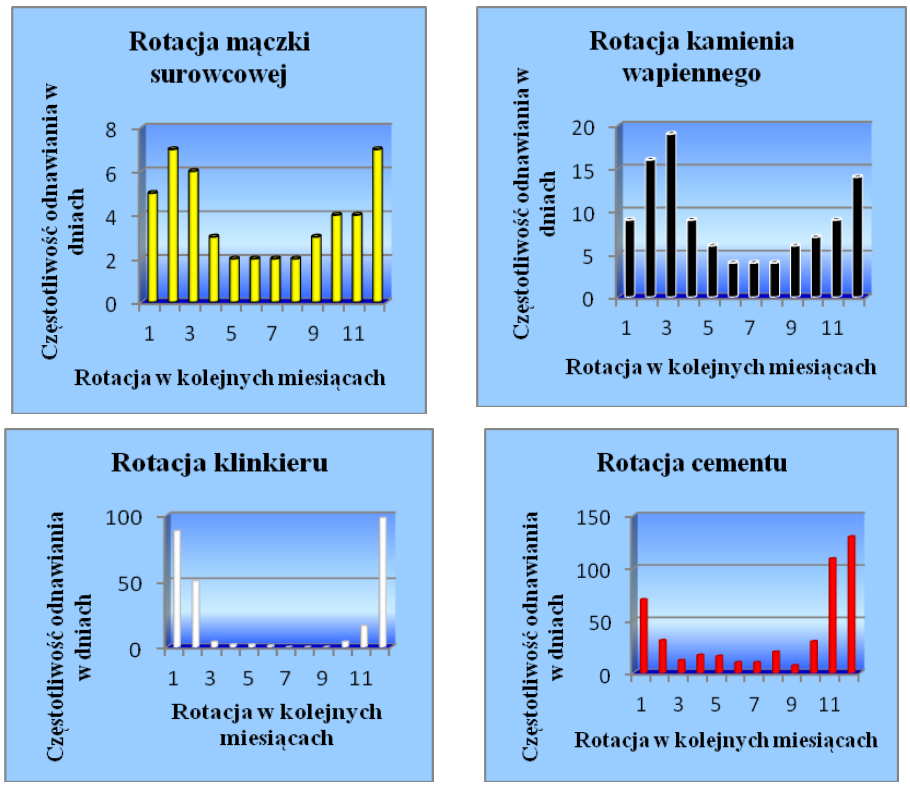

Figure 1. Frequnecy of inventory replenishment [17.]

częstotliwość odnawiania	– frequency of inventory replenishment in days,
rotacja w kolejnych miesiącach	– turnover individual months,
rotacja kamienia wapiennego	– limestone turnover,
rotacja mączki surowcowej	– raw meal turnover,
rotacja klinkieru	– clinker turnover,
rotacja cementu	– cement turnover

Mean clinker turnover rate planned in the period of the study amounts to 30 days. Actual mean turnover amounted to 22 days. This means that clinker consumption in the process of burning cement was higher than expected.

Increase in cement production in 2nd quarter of the year caused the decrease in the clinker inventory level in 3rd quarter of the year to zero level. It should be noted that the enterprises were supported with clinker from the outside. Low level of internal clinker inventory would have been depleted in April, which would have caused stoppage of cement production.

Clinker turnover in the winter season was slower than the expected level (planned: 37 days; actual: 43 days). However, deviation of actual from planned turnover remains within standard limits. In the summer season, actual clinker turnover was faster than planned. Mean turnover in the summer period amounted to 1 day with planned turnover of 23 days. In the 3rd quarter of the year, clinker inventory was continuously used for the process of cement production, exceeding the limits of safety stock.

Although low level of clinker inventory eliminates the risk connected with costs of maintaining inventory or locking up capitals in the inventory, it generates very high risk of occurrence of disturbances in continuity of the process of cement production. Assessment

of the inventory turnover rate reveals that clinker is the main area of disturbances in the process of production and sale of cement.
Mean planned cement turnover during the year covered with the study amounts to 22 days. Actual turnover amounts to 39 days, i.e. it is slower than the planned level (see figure 1.). Slower cement turnover ratio is the effect of lower than planned sales level.
Planned turnover in the winter period amounts to 36 days amounted actually to 64 days. Very slow turnover rate in the winter period caused the accumulation of cement inventory in the enterprise. During the summer period, actual turnover amounted to 13 days and was also slower than planned (9 days), however deviation of cement turnover in summer period ranges within standard limits.
Slowdown in cement turnover in the winter period generates the risk of locking up capitals in inventory, losing financial liquidity, decrease in profitability, increase in inventory costs, decline in functional value of stock and risk of increase in inventory surplus. Overall risk resulting from the analysis of cement turnover is medium since mean deviation of turnover amounts to 16 days. The analysis of cement inventory turnover confirms close relationship between the level of cement inventory and obtained sales level.
Inventory turnover ratio in enterprises of cement industry reveals a number of threats which occur during management of production inventory in this sector. A characteristic feature of enterprises in cement sector is the necessity of having inventory in order to maintain the continuity of the processes of production and sales. The presented investigations demonstrate that the highest risk is generated by clinker inventory. Clinker deficiency causes occurrence of such risk categories as the risk of disturbances in the process of production and sales, risk of decreased competitiveness, risk of decline in performance, risk of decline in inventory levels.
Clinker is an inventory which generates the highest risk. Therefore it will be subjected to detailed auditing activities as first. The charts below present the frequency of replenishment of the studied types of inventory.
Secondly the study will concern cement inventory levels. Cement turnover in cement industry enterprises provides information about the effectiveness of the system of inventory management. Improper turnover of cement inventory provides information about the opportunities of occurrence of risk: risk of disturbances in the process of sales, risk of loss of financial liquidity, risk of decreased profitability and risk of losing customers.
Raw meal and limestone inventory levels generate low level of risk. Limestone inventory level is defined as optimal. Capability of extraction of limestone entirely covers the demand for this raw material. Inventory level for raw meal is limited with the capacity of storage silos. Both limestone and raw meal inventory stocks generate inherent risk connected with possibility of technical, technological and geological problems (breakdowns of stone crushers, raw material grinding mills, depletion of documented stone deposits), which was taken into account and does not change the results of the investigations.

3. Summary

Inventory level depends on the decision by the auditor. Using the index of inventory turnover for analysis and assessment of risk of inventory, auditor makes decision about the choice and order of the investigations of audit objects. This means that:

- choice of objects subjected to the investigations is a variable $\boldsymbol{x}$ which depends on auditor's decision,
- inventory level in the period of the study is a variable $\boldsymbol{y}$ which does not depend on auditor's decision,
- inventory turnover ratio is a parameter $\boldsymbol{a}$ which allows for determination

of the relationship between the level of individual types of inventory in the enterprises of cement industry and the choice and order of analysis of audit objects.

Quantification of control and auditing decisions supports the evaluation of risk of inventory. Definition of inventory turnover ratio in the enterprises of cement industry increases the number of variants of models of control and auditing in the area of inventory management. Existence of bottleneck effect in operation of enterprises in cement industry causes that planning and production are performed with considerable advance with respect to the expected sales figures. In summary, processes of auditing detect and eliminate disturbances in flow of information about inventory, whereas processes of control allow for improvement in effectiveness of inventory management in cement industry enterprises.

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