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### MODEL OF PRODUCT QUALITY MANAGEMENT

*In this study, the authors have researched the role of quality in the macro and micro levels of management to ensure the efficiency of the enterprises of the printing industry. Three main ways to increase the efficiency of enterprises by improving the organizational structure of management, improving the product competitiveness and modernization of material-technical base have been identified. The need of modelling the process of adoption of management decisions as a result of activity of enterprises specialists that influences the quality of end products of the enterprises is defined. The authors found that these trends may be the basis for the model of product quality management for printing enterprises, which will determine the prospects for the development of enterprises by improving both the quality of products and activities of enterprises in general.*

*Keywords: efficiency, quality management, model, printing enterprises, management decisions, economic-mathematical modelling, Ukraine*

### МОДЕЛЬ УПРАВЛІННЯ ЯКІСТЮ ПРОДУКЦІЇ

**Гуткевич С.О., Пунчак Л.А.**

*Дан аналіз якості продукції, яка є основою ефективності діяльності підприємств, в тому числі поліграфічних. Визначено три головних способи підвищення ефективності підприємств: покращення організаційної структури управління, підвищення конкурентоспроможності продукції та модернізація матеріально-технічної бази. Визначено потреби прийняття управлінських рішень як результату діяльності фахівців підприємств, що впливає на якість кінцевої продукції підприємств. Представлена модель управління якістю продукції поліграфічних підприємств, в основі якої напрями підвищення ефективності діяльності.*

*Ключові слова: ефективність, управління якістю, модель, поліграфічні підприємства, управлінські рішення, економіко-математичне моделювання, Україна*

## МОДЕЛЬ УПРАВЛЕНИЯ КАЧЕСТВОМ ПРОДУКЦИИ

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*Дан анализ качества продукции, являющейся основой эффективности деятельности предприятий, в том числе полиграфических. Определены три главных способа повышения эффективности предприятия: совершенствование организационной структуры управления, повышение конкурентоспособности продукции и модернизация материально-технической базы. Определены потребности принятия управленческих решений как результат деятельности специалистов предприятий, влияющих на качество конечной продукции предприятий. Эти тенденции могут быть основой для модели управления качеством продукции предприятий. Представлена модель управления качеством продукции полиграфических предприятий, в основе которой направления повышения эффективности деятельности.*

*Ключевые слова: эффективность, управление качеством, модель, полиграфические предприятия, управленческие решения, экономико-математическое моделирование, Украина*

**Introduction.** The development of economy branches needs new approach increase of efficiency of enterprises functioning by the evidence-based changes in the modern conditions. The improvement of product quality is one of the main directions of increase of efficiency of a social production and the separate enterprise. It is the basis for the satisfaction of needs of people; thus, its public, economic and social importance is defined. Product quality is one of the main objectives of business activity. Ensuring its performance directly influences the economic results of activity of the enterprises. However, the quality of functioning of the enterprise directly does not satisfy the established requirements and needs of society and only provides process of creation of a product that is capable of it. Therefore, in the scientific economic literature, it is offered to determine the quality of management, work and activity of the enterprise through the quality of production.

Production is a result of process. Each type of production as an object with a certain appointment is characterized by the set of inherent properties and differently satisfies the needs of consumers. Hendricks [10] states that the degree of compliance of properties of production to certain requirements determines the level of its consumers cost. With the advent of new requirements, consumer properties of production will change. The parameters of production can remain invariable; however, according to Sallis, Deming [5] and Juran the pleasure degree will change and that will affect the perception of product quality. There is obsolescence, a process of

gradual relative loss of product quality at the preservation of absolute value of its parameters. Quality, as the dynamic phenomenon, constantly changes with the change of consumers' needs, which depend on the level of development of productive forces and relations of production.

Ensuring the necessary values of technical and aesthetic parameters of production for consumers and producers is not enough, because the producer can incur unfairly high expenses. According to Sadikoglu, Zehir, the level of product quality, which will be able to satisfy the needs of consumers at the minimum production costs or for the price, which is accepted for the consumer, is optimum. The quality of production is a way of satisfaction of demand, which is based on the achievements of science and technology. Aubert, Hooper, Schepel [1] noted that it provides a gain of useful effect through the satisfaction of undetected requirements and economy of resources of production. Thus, the quality is a source of economic effect and promotes the realization of the purposes of development of productions by obtaining competitive advantages.

At the micro level of management, the quality of production influences the efficiency of use of labour means by providing the growth of their productivity and durability [8]. It influences the reduction of needs for reserve equipment, decrease in volumes of repair work and, as a result, the achievement of economy of capital and operational costs. The growth of quality of objects of the labour is displayed on the decrease in expenses, reduction of labour input of processing of raw materials and materials, the increase in an exit and improvement of quality of end products. Foster [7] and Zaitseva noted that cut in expenditure of resources influences the product cost and creates conditions for the reduction of price and profitability increase.

Ensuring the quality at the micro level defines the development of a social production at the macro level. The modernization of production and introduction of innovative processes are shown in the production efficiency growth, more rational consumption of resources, reduction of waste, emergence of a new level of quality of production that together with appropriate service and observance of conditions of contracts form the competitiveness of domestic production in the international market, promote export growth of production and improvement of its structure. The dynamics of macroeconomic indicators (such as nominal gross domestic product, consumer price index, balance of foreign trade, etc.) influence the increase of welfare of the population, the solution of social problems due to the increase of life quality.

In modern conditions, the improvement of product quality is predetermined by:

- requirements of scientific and technical progress;
- limitation and insufficiency of natural resources;
- need for the solution to a problem of increase of a standard of living of the population (saturation of the market production strengthens requirements to quality and the range);

- the growing role of material stimulation: growth of the income causes increase of a consumer demand for the high-quality production;
- need for the increase of efficiency of foreign trade.

Thus, with the development of economy and an aggravation of the competition, the theoretical essence of category of quality, its role at the enterprises, including the printing branch, in national economy and in the international division of labour extends. By the scientific study by Simenko (2009) the quality needs continuous improvement, providing and management.

The activity of printing enterprises is directed on receiving economic effect of printed materials production because they are insufficiently financed by the state, are not priority for the investors and operate on the market of printing services in high extent of the competition. Thus, the question of effective management and, first of all, product quality management as bases of enterprises competitiveness, according to its features, is especially actual. According to the important role of quality in the development of modern enterprises, including the printing industry, the authors have established the following objectives of this paper:

- 1) to review and summarize the development trend of printing companies in Ukraine;
- 2) to define the role of the quality of not only products but the management in enterprise development for the characterization of the main ways of increasing the efficiency of their operations as well;
- 3) to build a model of quality management of enterprises, which allows making the management decisions taking into account the features of enterprises and determines the prospects for their development.

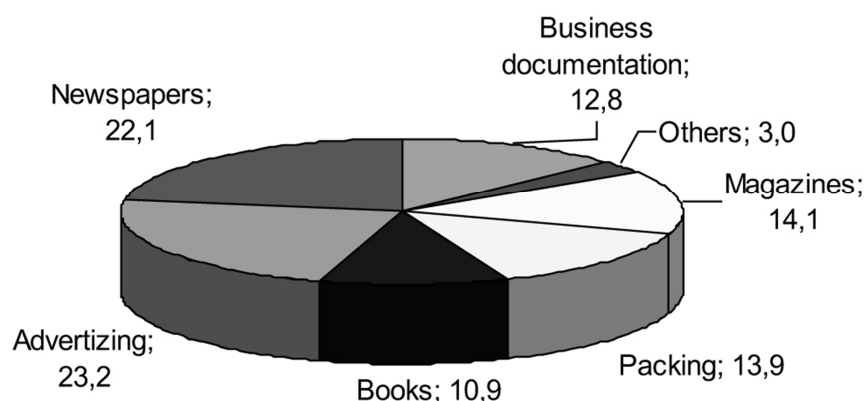
### **1. Role of Quality in Development of the Printing Enterprises**

The publishing and printing complex is a difficult organizational and economic system, which includes different branches: publishing, printing, book trading, production and social infrastructures. The relationship between publishers and printing enterprises provide a creation of printed materials, and the relationship between publishers and distributors provide product sales. The production infrastructure of the enterprises is carried out by ensuring the production and technological service of branches (printing mechanical engineering, production of the main and auxiliary materials, etc.), and the social infrastructure creates the necessary conditions for a renewal of labour and effective use of a manpower by the enterprises.

Based on a method of forecasting, it is certain that the income from sales of products of the printing enterprises will decrease. In the conditions of increase in the number of subjects of publishing, it will influence the growth of the competition in the market of the printed materials, which will as well amplify the changes in the sphere of mass communications. With the distribution of digital means of information processing, including the e-book readers, the competition becomes

relevant not only between the producers, but as well between the editions of different forms: printing and electronics that creates new opportunities and new risks for the enterprises.

Based on data of Association of printed materials distribution, the authors defined the structure of product range of the printing enterprises (Figure 1).



**Figure 1. Structure of Production of the Printing Enterprises in 2013**

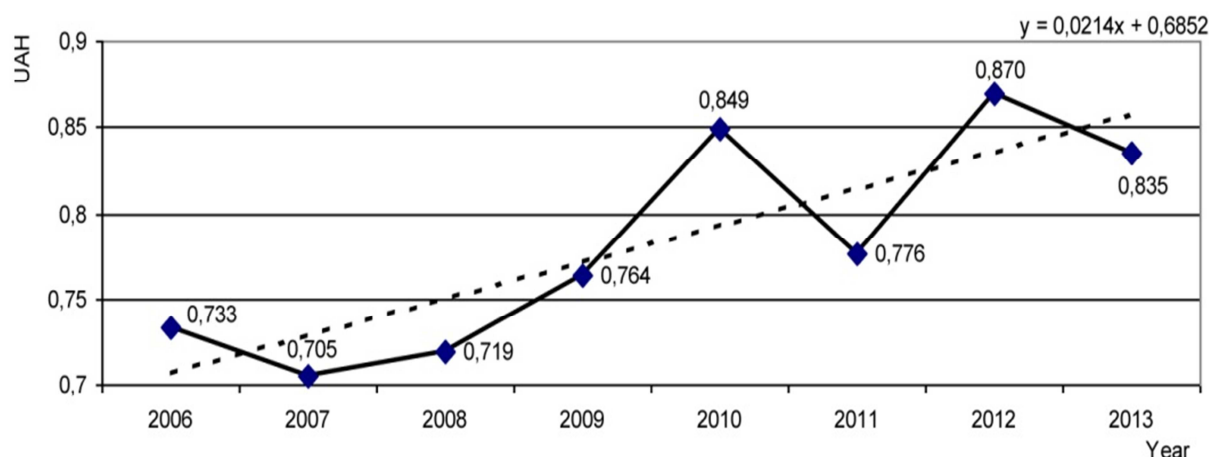
*Source: Statistical information of State Statistics Service of Ukraine*

Figure 1 shows that the highest risk of replacement with electronic means of information processing has printing book, journal and newspaper production. It is connected with the growth of material expenses, reduction of outputs, discrepancy of the range and quality of printed materials to the available demand. However, the results of researches of some scientists show that the production of journal and newspaper production will remain high risk, but as well a highly profitable activity, due to such advantages as ensuring quality and addressing the advertisements. Moreover, many consumers of printing and electronic forms think that they do not replace but complement each other.

The analysis of statistical data of GfK Ukraine showed that from 2011 for 2013, the volume of release of book production in a paper form grew by 1.56% and in the electronic by 92.7%. The growth of the expenses connected with the production and the wide range of literature in an electronic form available through the Internet is the main reason for such difference in growth rates. The dynamics of expenses on 1 UAH of the sold production shows that from 2006 for 2013, they grew up from 0,733 UAH to 0,835 UAH, i.e., for 1392%, and according to trend lines, they will continue to grow (Figure 2).

The preservation of demand for production is possible on condition of effective use and advance of advantages of printing books in the market of printed materials, namely: portability,

availability, quality of internal filling and its reconstruction through the press, taking into account the features of target consumers.



**Figure 2. Dynamics of Expenses on 1 UAH of the Sold Production**

*Source: Statistical information of State Statistics Service of Ukraine*

The analysis showed that the prospects of development of the publishing and printing enterprises are connected with, first of all:

- reduction of expenses on a unit of production of literary and art editions due to the reduction of material expenses and modernization of production, because for this type of editions, the main competitive advantage is quality of internal filling;
- reduction of expenses on unit production and improvement of quality of printing implementation of specialized editions, because for them, the long period of storage and high frequency of use is characteristic.

The current state and prospects of development of the printing enterprises as showed the analysis depend on a condition of supply and demand on different types of production and the reaction of the enterprises to the changes of environment. Printing houses can promote increase in demand for publishing production due to the expansion and ensuring the quality of printing services, which will affect the increase in volume of release and product sales, reduction of prime cost and growth of net profit. Especially actual it is for the enterprises at the present stage of development, as according to statistical data, in 2012, the part of the profitable enterprises of branch did not exceeds 20%; a half of printing houses are in a zone of zero profitability, and the number of unprofitable productions continues to grow.

## **2. Directions to Improve the Product Quality of Printing Enterprises**

Effective enterprise management depends on many components: innovative processes at branch, degree of production motivated workers, quality of production and raw materials, labour

productivity level, standard and legal base and the use of achievements of the international experience. Based on the analysis, it was founded that the efficiency of enterprises are affected by:

- the increase of level of production competitiveness;
- the organizational structure of product quality management;
- the modernization of material base of the enterprise.

These directions allow increasing the efficiency of enterprises activity based on growth of product quality. The first direction is connected with the decisive influence of product quality and its price on increase of supply and demand, competitiveness of production. It is very important to take into account the requirements of production for satisfaction of customers in forming its qualitative characteristics. The improvement of quality can be carried out by the improvement of technical characteristics of production and the adaptation of production parameters to the requirements of customers. It will allow expanding the sales market of production and increase the share of enterprise on a target segment of the market and the enterprises market value.

At the present stage of development of society, as showed the analysis on the functioning of the printing enterprises, the role of quality grows and needs a fast response of heads of the enterprises to change the influence of factors of environment. For this purpose, the expansion of functions of quality management that are carried out by the specialists of checking department is necessary [4]. Addition of functions of exclusive entrance and initial quality control, planning, motivation and coordination of all work of specialists in formation and ensuring quality predetermines the introduction of staff of the personnel with the position of the department conducting to the specialists and reorganization of checking department in the department of quality management. It as well will allow avoiding the increase in the maintenance costs of additional department.

Based on the list extension of the kinds of enterprise specialist activity, the changes occur in both structure of department and organizational structure of business management, the improvement of which is the second direction of activity efficiency increase of the printing branch enterprises.

Yarmolka suggested that personnel training and retraining are as well important, because according to the education tendencies in the world, the study should occur throughout the lifetime. For workers involvement, in order to ensure the quality, the authors of the article offer holding seminars for the acquaintance of workers with the product quality policy of the enterprise with the main tasks, strategic and tactical targets of the enterprise in this direction. According to Flynn [6] the increase of workers level of knowledge will promote the growth of productivity; therefore, the implementation not of separate actions of professional development of workers and the development of plans of professional development of workers of all levels is expedient. The main purpose of carrying out this study is the improvement of quality of work, the reduction of turnover

of staff, the increase of labour productivity, the reduction of idle times of production, the encouragement before the development of a creative initiative and an increase of flexibility of product quality management. The program of study provides the differentiation directed on study: heads of structural divisions, experts of an average link and workers.

Thus, the improvement of process of motivation will affect the quality of work and performance of management functions of personnel at the enterprise involved in providing and forming the product quality. The informing of workers is important because they find out for what they get an award and what responsibility is established for the violation of requirements of product quality management. The revision of awarding systems is aimed at providing the achievement of aim of the enterprise quality policy and the increase of efficiency of quality management, the decrease in probability of emergence of defect and the hit of production not respectively to the quality of the customer.

The product quality management depends on the efficiency of management decision adoption. Different types of decisions need different processes of their acceptance, for example, individual or joint. At individual quality management, which takes place at linear submission of workers, the head acts without consulting with the collective. The risk connected with such approach is that there is a probability to miss important information and knowledge and not to get appropriate support of subordinates in the course of implementation of the decision. However, the processes, which need general participation of a large number of persons at functional organization structure, tend to disperse decisions: decision-making process lasts long, never coming to the end. Moreover, if the decision is made, often it is compromised with the smallest common denominator.

Between these extremes, there are such decision-making processes as consultations of both decisions and consensus. They provide the address of the head of the department of quality management to the subordinates (or functionally connected specialists from the other structural divisions), according to the information or council, i.e., individually or a group, on the purpose not that much to receive the consent of all but to get the support of majority by storing the right independently to make the final decision.

The validity of the administrative decision needs uses rather full and reliable information about the condition of the enterprise and factors of environment, degree of compliance of the decision to problems of development of the enterprise. Head has to make the decision based on the exact mathematical results; intuition and experience serve as their essential addition. Thus, the purpose of adoption of the management decision has to be accurately concretized, for example, due to the improvement of product quality, to provide a gain of gross profit for 3%.

The economic efficiency of improvement of product quality management as result of the management decision is calculated at different stages of its acceptance and realization:



- analysis stage for the determination of expediency of change implementation;
- stage of optimum version choice of the project decisions (settlement efficiency);
- functioning stage when the actual efficiency is defined.

For its assessment, the following approaches are widespread: 1) the formation of one indicator (additive or multiplicative), which depends on the partial indicators of efficiency. The use of this approach will allow compensating the lack of one indicator of quality by the other, which is important when the decisions are made in the conditions of uncertainty [2]; 2) one of the indicators is optimized depending on what actions for increase of efficiency are planned to carry out and what subsystem of management they concern at the adoption of management decision (for example, maximizing of profit).

The question of a choice of optimum version of the decision, which is carried out in the conditions of uncertainty and is characterized by variability and high risk, can be solved with the use of method of economic-mathematical modelling. The authors offer the modelling of decision-making process in product quality management. The adoption of management decision concerning the implementation of the chosen plan of action directed on maximizing the profit as well depends on the dynamics of other indicators of activity, which will characterize the reaction of object of management on action of the subject. Collection, accumulation and processing of these enterprises responsible for the performance of functions of quality management given by the experts in the automated information systems of the printing enterprises will provide experts with the information necessary for management. The formation of databases needs a regular assessment of current state of quality management that is carried out by the specialists of department of quality management, for which the authors of the article offer the Balanced Scorecard of Kaplan of the assessment of effective product quality management.

The method of economic-mathematical modelling of adoption of management decisions in product quality management allows to make the decision with high degree of reliability about the distribution of resources, gives the chance to estimate the product quality not only as in compliance with the requirements of standards and normative documents but as well as the efficiency indicator of functioning of all the enterprise divisions. It is established that the decrease in effective management of product quality happens due to the lack of positive dynamics of productive indicators of the printing enterprise activity on certain directions.

The main lever of the Balanced Scorecards is the motivation to development and the implementation of comprehensive programs of improvement of quality, which determines the main actions for providing and improving the product quality and quality management. It combines the purposes, tasks, functions of management with resources, and the end results at all levels of

management and stages of life cycle of production, which at the same time increases the efficiency of product quality management.

### **3. The Model of Product Quality Management for Printing Enterprises**

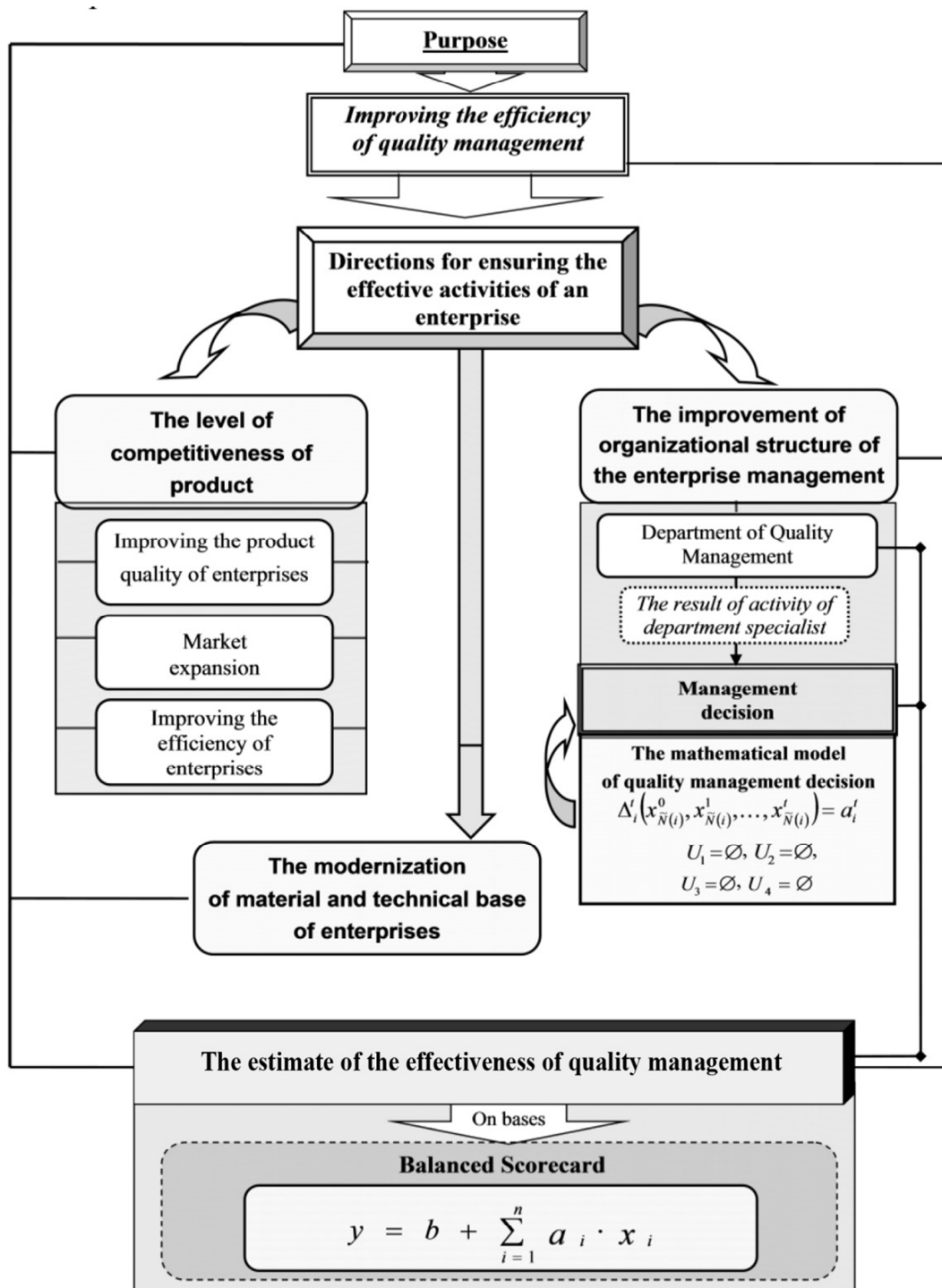
Enterprises management has to understand the importance of product quality in the development of the printing enterprises. For this purpose, based on the analysis of theoretical bases and practice of product quality management of the printing enterprises, the authors offer the model of product quality management for the enterprises of printing branch (Figure 3).

The purpose as an element of model is the increase of efficiency of product quality management. On the basis of the model, the direction of increase of efficiency of enterprises activity includes the growth of level of production competitiveness, the improvement of organizational structure of management, the modernization of material base as a component of innovative development.

The authors of this article considered three main directions to achieve the management purpose. The first direction consists of the increase of product competitiveness level of the printing enterprises on the basis of formation of such product quality, which is capable to provide profitability of the printing enterprises as a source of competitive advantages. The competitiveness of printed materials as an ability to make profit in the conditions of the high competition is determined on market and not only the market of printing service, but the market of electronic information processing devices as well.

Based on the analysis of organizational structure of enterprise management and functions of product quality management, as the second direction the authors offer the improvement of organizational structure of enterprise management. In this structure, the department of quality management instead of checking department is provided. The number of workers and maintenance costs of department will remain invariable; however, the functional rights and duties of specialists of department will extend. At the level of enterprise management, the created list of functional duties and the rights of leading experts of division will allow to increase the quality of management decisions as the result of management, which directly influences the quality of end products as a condition of its competitiveness.

It has been suggested to provide the efficiency of product quality management through the modelling of process of adoption of the management decisions directed on the achievement of management purposes, in particular by the criterion of arrived maximizing that is described in Chornei. The implementation of the analysis of the effects connected with the changes in the activity of the enterprise allows to predict the dynamics of results of enterprise activity in the future.



**Figure 3. Model of Product Quality Management for the Printing Enterprises**

*Source: created by the authors*

The offered direction from modernization of material base of the enterprise provides the updating of the equipment park and the applied technologies, implementation of progressive forms of the organization of warehouse economy, which are especially relevant for such material-

intensive productions as printing. The innovative orientation of development will affect the investment appeal of the enterprises. The use of technological innovations will allow to reduce processing's laboriousness of entrance raw materials, to increase the exit and to improve the quality of end products, to expand and update the product range that are competitive both on internal and on external markets. The introduction of small-sized electronic printing machines will allow printing limited editions at a bargain price, in short terms.

The innovative development of the printing enterprises is due to the investment of financial assets. In modern conditions, the main source of investment of productions is the owned funds, i.e., profit and amortization. Profit increase is the result of increase of efficiency of product quality management based on certain directions, and it characterizes the overall effectiveness of enterprises activity. The higher is the profit, the more opportunities for development has the enterprise, the less is its dependence on the foreign organizations (creditors) and there is more independence in making decisions on the distribution of resources and introduction of projects of development of the enterprise.

The estimation of product quality management is a model element by which specialists of department of quality management define the correctness of management decisions and requirement of their adjustment. The authors of this article offer to introduce and use the Balanced Scorecard at the printing enterprises. With this scorecard, the specialists of enterprise can estimate the current state of product quality management as well as the degree of satisfaction of customer's requirements keep account of the expenses and effects from the actions of product quality management and define the factors which influenced the changes of indicators. This gives the chance to the printing enterprises truly and in due time to define the priority directions of activity development and to find additional reserves of economy or attraction of financial resources.

The authors of this article have calculated the effect from the use of offered model of product quality management. The expenses that are necessary for the realization of the directions of model can be classified as the expenses directed on the prevention of production not respectively to the quality. The analysis of losses from defect showed that these losses at the enterprises grow (Figure 4).

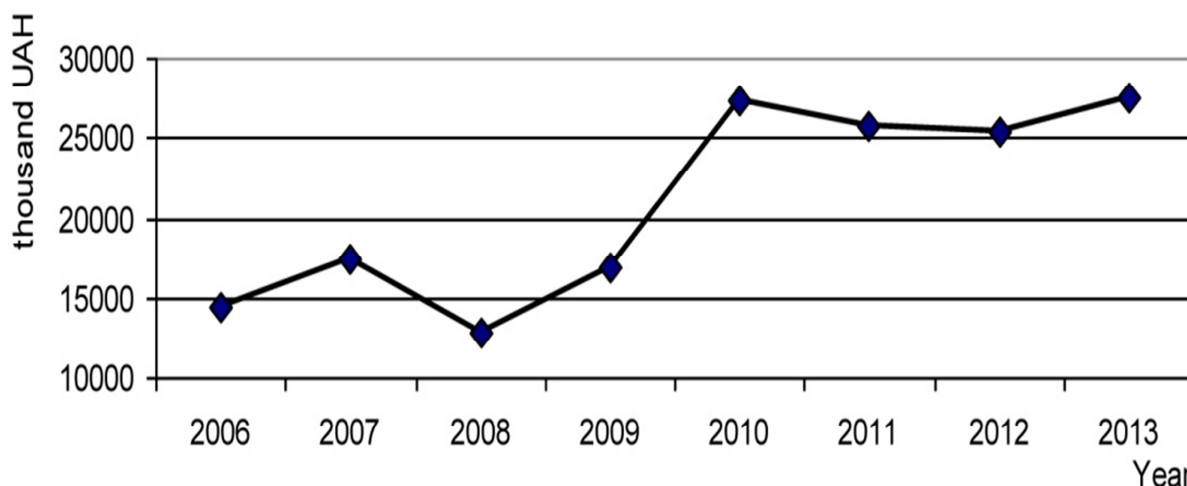
The analysis of structure of expenses on quality of production of the printing enterprises showed that on average it is as following:

- losses from defect - 93.5%;
- expenses on precautionary actions - 6.5%.

Part of the costs ensuring the quality in total sales is about 0.0754%. The calculated coefficient of elasticity of expenses on quality showed that at increase in expenses on ensuring quality by 1%, losses from the defect decrease on average by 0.71%. Thus, if at the expense of

increase in volume of precautionary actions to the increase expenses on ensuring quality is up to 0.15% of revenue, then the structure of expenses will be next:

- losses from defect - 88.4%;
- expenses on precautionary actions - 11.6%.



**Figure 4. Dynamics of Losses from Production not Respectively to the Quality (Defect),  
Thousand UAH**

*Source: Statistical information of State Statistics Service of Ukraine.*

In absolute expression, the economy of funds due to the reduction of losses from defect will make about 6388,9 thousand UAH for a year and the additional expenses on ensuring quality - 469,9 thousand UAH. The increase in funds for the prevention of emergence of production not respectively to the quality will allow to release the additional amount of money and to aim them at the development of the enterprise.

The efficiency of activity of the enterprise and product quality assurance provides the appropriate organization of production, rhythm of work of the equipment, control of entrance and the initial streams of raw materials, implementation of motivation of workers to high-performance work, etc. The quality of the received results is a consequence of the quality of administrative decisions degree of its compliance of character of solvable problems of formation and ensuring the quality of production, set of parameters of the decision, which satisfy specific consumers and provide reality of its realization.

The condition of quality improvement of administrative decisions is ensuring their diversity, i.e., the justification is not less than three organizational and technical options of the actions directed to the achievement of organization objectives. The choice of the best version of the

decision from several possibilities is a sign of the scientific organization of management and methods of work of heads.

The effect from the use of model of product quality management has manifestation in the improvement of economic indicators, such as profitability, net profit that characterize the economic efficiency of activity of the printing enterprises. It provides the rational choice of actions for the management efficiency increase based on aiming at business activity of both specific needs of consumers and the perspective development of the enterprise.

The increase of efficiency of product quality management based on certain directions will allow providing the growth of:

- economic efficiency of the enterprise activity due to the ensuring high profitability of activity;
- resource efficiency due to the decrease in material expenses and according to the expenses on 1 UAH of products;
- social efficiency - through the increase of qualification level and degree of satisfaction with work of the personnel, reduction of risks of delays in payment of a salary and psychological intensity.

**Conclusions.** The study of value of production quality on macro and micro levels of management of enterprises showed that in the modern conditions, it is important to research the quality of production at the micro level as the bases for ensuring the efficiency of use of resources, improvements of business reputation of the enterprise, competitiveness of a domestic production in the international market, which promotes the export growth of production and improvement of its structure. It is certain that the product quality management is a specialized type of business management, which is defined by its functions, principles and methods that are carried out by the specialists. The administrative decision, on which the quality of end products depends, is the result of management.

The improvement of activity of the enterprises covers not only production, but the extra production stages of providing printing services as well. Due to such interaction and expansion and acceleration of innovative processes in production and enterprise management, it has reached much more labour productivity, and the quality of management decisions grows.

On the basis of the analysis of a current state of functioning of the printing enterprises define that the main directions of increase of efficiency of their activity are the increase of level of competitiveness of production, the improvement of organizational structure of management on the basis of change of management functions of specialists of the quality management created department and the improvement of quality of the administrative decision as a result of their activity, the modernization of the material base. The growth of effective management of quality of

production is as well provided through the modelling of process of adoption of administrative decisions on alternative actions, which are directed on the improvement of quality of production. The implementation of the analysis of the effects connected with the changes in activity of the enterprise allows to predict the dynamics of results of activity of the enterprise in the future. The authors united all these elements in the models of product quality management of the enterprise.

The elements of model of product quality management provide the analysis and the assessment of the condition of product quality management, consider its tendencies of development and feature behind certain components, which give the chance to define the prospects of development of the enterprise by the increase in product quality and activity quality in general. It will promote the improvement of quality of management decisions on formation, choice and realization of development alternatives of product quality management systems in the conditions of changeable environment by taking into account all the sets of interconnected technical and economic processes at the printing enterprise. The growth of the expenses directed on the improvement of quality of production and the prevention of emergence of defect predetermine the change of structure of expenses on the quality of production, in particular, the reduction of part of losses from defect for the sum of about 6388,9 thousand UAH for a year, which will allow to receive the annual economy of 5919,0 thousand UAH.

The achievement of the management purpose based on the directions of increasing the effectiveness of the activity, sources of financing will provide the efficiency of product quality managements and business management in general as well as deeper awareness of the value of quality of management and end products by ensuring the competitiveness at both separate enterprises and national economy in general.

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