

Quality Management based on Labor Efficiency Improvement

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Abstract

Background/Objectives: The objective of this study is to develop a conceptual model for improving the quality management system based on increasing the levels of the labor efficiency factors in companies. **Methods:** Methodological basis of the scientific investigation is represented by the expert evaluation method that implies determining the competences of the expert team and identifying the significance of the labor efficiency factors in the company. Based upon the dependency model, the model of the effects produced by the labor efficiency factors on the product quality in the company was developed. **Findings:** Based on the synergism coefficient, the key factor of the synergetic effect was found among the labor efficiency factors affecting the product quality improvement in the organization. The study establishes the key factors of labor efficiency that improve the quality of the products in the company: personal motives of the employees, material remuneration and working conditions. It has been mathematically justified that such factor as “personal motives” is the factor of the synergetic effect produced by the labor efficiency on the product quality improvement in the organization. The priorities of the labor efficiency factors affecting the product quality improvement have been quantitatively determined. The complex conceptual model for improving the efficiency of the quality management system in the company has been developed taking into account the priorities of the labor efficiency factors and their synergetic effect. The action plan for ensuring the labor efficiency growth has been suggested based on the key labor efficiency factors that secure the product quality improvement. **Applications/Improvements:** The results of the investigation have been developed into the concept that enables their practical application in the organizations in any industry and at any stage of the production cycle.

Keywords: Human Resources, Human Resources Efficiency, Labor Efficiency, Management, Product Quality, Quality Management System

1. Introduction

Under the conditions of the globalization processes the problem of the product quality improvement becomes the prerequisite factor of the competitive power of the company that establishes foundations for its sustainable operations. Modern market economy sets fundamentally new requirements to the quality of the manufactured products and to continuous quality assurance. The major part of the modern world production is represented by the production of goods; therefore, the process of manufacturing that or another item is an embodiment of both consumer value and value of goods¹. Consequently,

quality is a complex idea that reflects the efficiency of all aspects of business operations, particularly, the efficiency of using labor resources that is expressed by the labor efficiency level. Human factor directly affects the quality of the products and ensures the efficiency of the quality management system in the company². Improving labor efficiency helps reduce the production costs which, in turn, makes it possible to generate the potential for improving the quality of the products. Modern system of quality management is aimed at total quality control and at reducing the prime cost of the product taking into account the increase in the level of the labor efficiency as a strategic managerial task³. Under the conditions when

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the product quality is supposed to be socially oriented, the management system should be closely associated with human factors. Product quality management system should be implemented as an aggregate of mutually complementing subsystems and should be considered from the perspectives of the interrelated components of the continuous process of quality improvement⁴ engaging all the employees of the company that would secure better operations of every structural unit of the organization due to the constant growth of the labor efficiency. Conventional methods for quality improvement are founded solely on identifying the factors of the labor efficiency and on their statistical evaluation^{5,6} that does not make for optimizing the quality management system in the company in sufficiently objective manner. Within the framework of the empirical investigations the conceptual interpretation of the scientific and research practices proved that there is a direct effect produced by the growth of the labor efficiency on the product quality improvement. In this regard, this study is focused on eliminating the abovementioned disadvantages striving to establish a qualitatively new dimension in the methodology of the product quality management in organizations.

2. Literature Review

Quality management system has been developed within the framework of the systemic approach to management founded by Taylor⁷. The basis of Taylor's system paradigm was represented by the necessity to create an efficient mechanism for managing the quality of each separate manufactured item. However, given the fact that the production process is, in the first place, a process, the concept of quality management changed its focus and commenced investigating and ensuring the quality of the production process. Such theories as "Strategic quality management" generated the approaches to statistical quality management aimed at ensuring the efficiency in solving production issues⁸⁻¹⁰. While Deming¹⁰ focused in his works on improving the quality of the processes, systems and statistics in his works, Juran¹¹ justified the concept of the necessity to engage all the employees of the organization into the system of quality improvement. The basis of his concept was represented by further development of the personnel motivation system as a factor of the quality management system efficiency. The foundation of the quality management paradigm became the basis for developing the concept of Total Quality Control

(TQC) that expressed the need to identify and to take into account all the factors that affect the quality of the production process and the quality of the products within the framework of cause and effect relations based on the complexity principle^{12,13}. Over the 80s, following the progress and the improvements in the production processes and aiming to ensure the complexity of quality management, there was a transition from total quality control to Total Quality Management (TQM)¹⁴. This approach reflected the change of focus of the quality management system that moved from the process approach into the area of management systems. Quality assurance would be secured through the managerial function of the management system. This trend ensured the transition from the quantitative criteria of the production process and product quality directly to the necessity of establishing their qualitative characteristics^{15,16}. While TQC represents the quality management system targeted at achieving the existing requirements, TQM methodology makes for the continuous, constantly developing and dynamic control over the targets and over the quality requirements from the perspectives of the complex approach¹⁷.

Given the growing significance of the communal need for social and economic development, the concept of complex quality management should have taken into account the interests of the society. This, in turn, stipulated the development of the ISO 14000 Series of Quality Standards predetermining the regulations on the environmental conditions and product safety in the quality management system¹⁸⁻²⁰.

Modern stage of developing the concept of quality management is progressing under the conditions when management itself comes to be recognized as science and it is characterized now by shifts in emphasis among the issues of direct quality improvement acquiring the features of institutionalization^{21,22}. Quality improvement strategy transits from the state of a managerial idea to the state of one of the components of business operations as a system, becoming the fundamental basis of its activity^{23,24}. New directions in the quality management system are based on quality standardization and are reflected in such most widely known theories as "management based on objectives" (MBO) and management based on quality²⁵⁻²⁷. The research areas should also be noted that are focused on analyzing the practical issues faced in the process of implementing the quality management system in the organization²⁸⁻³⁰. Nevertheless, under the conditions of globalization and intensive development of the imports

of goods, it is necessary to develop innovative approaches to quality management that would ensure competitive advantages of the national companies. In particular, the issue of improving quality based on labor resources motivation in the company is of current importance. This approach, as has already been mentioned elsewhere, has been studied in works belonging to Juran,¹¹ though only from the perspectives of the strategic significance of quality, while there is also a need for developing and substantiating the approaches that would integrate two components of the quality management system: scientific management and human relations management. These subsystems should be considered from the perspectives of the mutually complementing components of the continuous process of quality improvement that should engage all the employees of the company and that should lead to the improved life activity at each level of the company. In this regard, the objective of the study is to develop a conceptual model aimed at improving the efficiency of the quality management system in the organizations based on motivating the company's labor efficiency that represents the key factor of the labor resources efficiency through the example of Deloitte.

3. Analytical Review

It has to be noted that under the conditions of the severe market competition, continuous improvement of the quality of goods, works and services is prerequisite for the efficient operations of the company. Statistical data show that the process of quality certification develops intensively in modern environment. Thus, since 1993 till 2014 the total growth of ISO certification amounted to 3214%. Broken down by the types of certification, the most intensive growth is observed in ISO 9001 certification that amounted to 2444% over the period under consideration. Since 2004 till 2014 the growth of ISO 13485 certification category made 1157%; that of ISO 14001 amounted to 358%. The most recent type of quality certification is represented by ISO 50001 which number increased by 1477% since 2011 till 2014 (see Figure 1)³¹.

The data make it possible to maintain that the world trend in quality is progressive and positive predominantly covering European countries that account for 42.5% and East Asia and Pacific accounting for 41.8%. It should be noted that the concentration of the improved quality of goods in the companies over the last 21 years shifted from Europe to the countries of East Asia and Pacific.

Nevertheless, today European countries are characterized by the highest quality of their products, while in some regions of the world there was a decrease in the level of the quality certification over the period under consideration which testifies of poorer quality of their products: Africa (-1.3%), North America (- 4.1) (see Figure 2)³¹.

Attention should be paid to the fact that the development trend in improving quality across the world economy is associated with sustainable growth of labor efficiency as one of the key factors of the quality management system. The analysis of the labor efficiency per one employee carried out for the period since 1993 till 2014 shows that the labor efficiency increased by 55.4% in the companies all over the world in all types of businesses. Split by the industries, there was growth up to 16.9% in retail, wholesale, transport, accommodation and food; up to 30.9% in industry; in information and communication services (3.0%) and in business-services (8.4%). Thereat, the growth of labor efficiency is accompanied by a continuously decreasing trend in the specific weight of labor spent in product cost (OECD). It should be noted that the intensity of labor efficiency growth observed since 2009 tends to decline by 4% as of 2015. This, in turn, was the reason for the decrease in the efficiency of labor resources also testified by the increased growth of the share of labor in the product cost by 5%. In all, it is possible to observe

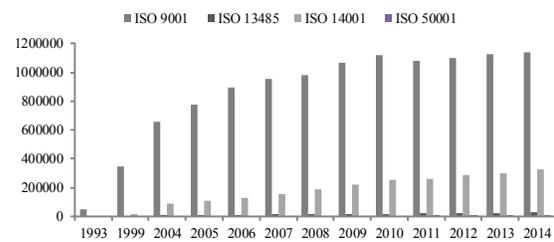


Figure 1. Dynamics of issued ISO quality certificates in world quality management system, pcs.

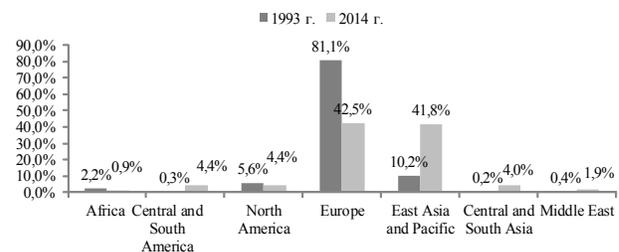


Figure 2. World structure of ISO quality certification.

the upward trend in labor efficiency (over the period under investigation the average increase amounted to 2%) outrunning the specific weight of labor resources in the cost of products (average increase amounted to 0%) (see Figure 3)³².

Within the framework of the investigation a determination quotient was found for labor efficiency and ISO certification across the world since 1993 till 2014 that made a figure of 98.3%. This high level of determination explains the parallel upward trends in labor efficiency and quality certification all over the world that are stipulated by the specific features of modern quality management systems: there is a determining dependency of the product quality upon the labor efficiency. However, it has to be noted that, notwithstanding the positive trends in the labor efficiency and product quality growth, there is a decrease in the intensity of their development. Thus, since 1994 the growth rate has become lower by 2%, and the quality certification rate decreased by 48% (see Figure 4)³²; and these figures were observed at the background of the growth of the product quality improvement outrunning the labor efficiency growth by 18%.

Therefore, under the conditions of this close interrelation observed between the product quality and the labor efficiency, it seems practicable to search for the ways to improve the efficiency of the quality management system taking into account the improved efficiency of

labor resources. This study makes an effort to develop a conceptual model for optimizing the quality management system in the companies based on the labor efficiency improvement factors.

4. Results

The basis for developing the model is represented by determining the effects produced by the labor efficiency factors on the product quality through a dependency model. The resulting factor of the model should be the change of the product quality in the company and the labor efficiency factors should be perceived as independent variables.

The object of the investigation is represented by the network of companies Deloitte Touche Tohmatsu Ltd, which render professional services in the sphere of consulting and audit³³. Deloitte is included in “Big Four” auditing companies and is the largest professional network in terms of the employee headcount (225,000 people)³⁴. In 2015 Fortune included Deloitte in the rating of 100 most outstanding companies of the world³⁵—which proves the high quality of the rendered services and the high level of management in the company.

The study identifies the factors that determine the efficiency of the company’s resources by verbal generalization:

- labor relations denoting relations between the company’s employees (microclimate in the company, corporate culture, philosophy of the company);
- working conditions, meaning the arrangement of the working places and the opportunities for the employees;
- material remuneration (wages, bonuses, premiums, material aid, social package);
- system of sanctions, meaning punishment for improper performance (depriving of bonuses, fines);
- professional development of the employees in the company;
- personal motives of the employees of the company (self-fulfillment, experience).

Basic method of the investigation selected to determine the degree of change in the quality of the products affected by the labor efficiency factors was represented by the expert evaluation method³⁶. Using collective expert evaluation is most practicable, as this method, by contrast to individual evaluations, makes it possible to obtain more objective information.

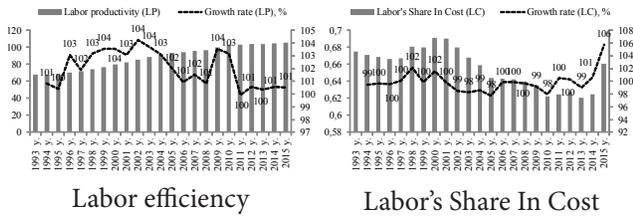


Figure 3. World trend of labor efficiency development.

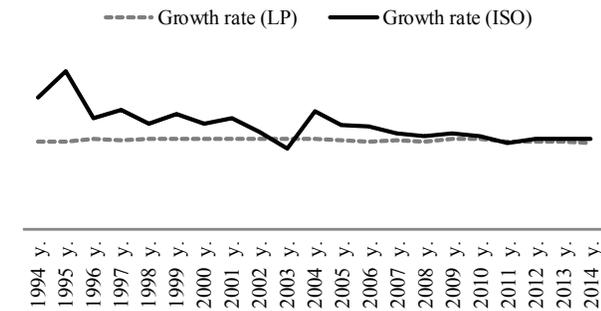


Figure 4. Intensity of changing world labor efficiency and quality certification.

Insofar as the quality of the expert evaluation depends on the professional attainments of the experts, on their knowledge and skills, the initial stage of the expert evaluation envisages the evaluation of competences of the experts in the sphere of managing labor resources. The quantitative indicator reflecting the advisability of engaging an expert into the working team is represented by the coefficient of competence:

$$K_l = \frac{\sum_{z=1}^m e_{lz}}{m}, \quad (1)$$

$$e_{lz} = \begin{cases} 1, & \text{if } l - \text{expert included } z - \text{expert in the team,} \\ 0, & \text{if } l - \text{expert did not include } z - \text{expert in the team} \end{cases}$$

where, K_l – coefficient of competence of an expert;

e_{lz} – mutual evaluations of the experts;

m – number of experts³⁷.

$K_l \in [0; 1]$. The higher the value of the coefficient, the better the competence of the expert in this area and the greater the advisability of including him in the expert team are. The threshold value of the coefficient of competence is 0.5.

The experts were represented by the managing personnel of Deloitte head office located in Great Britain. To minimize the possibility of the erroneous judgments of the experts, the team was formed of 20 managers whose coefficient of competence was 1.

The experts were suggested to evaluate the significance of the factors for product quality improvement using 5 point scale and taking into account the improved labor efficiency. Thereat, the gradation of scores was as follows:

- 1 – the lowest labor efficiency factor significance;
- 5 – the highest labor efficiency factor significance.

Based on the generalized expert evaluation, the factor priority vector (w_i) has been found together with the normalized priority vector (w_i^*) that indicates the significance of the factors.

$$w_i^* = \frac{w_i}{\sum_{i=1}^n w_i} \quad (2)$$

$$w_i = \frac{\sum_{j=1}^m e_{ij}}{m}, \quad (3)$$

where, e_{ij} – evaluation of the significance of w_i factor by m expert (points 1 to 5);

m – number of experts;

n – number of factors.³⁷

The results of the expert evaluation are represented in Table 1.

The values of the labor efficiency factor significance make it possible to build a model of the product quality

Table 1. Significance of the effects produced by labor efficiency in the organization on the product quality

Factor	w_i	w_i^*
Labor relations (F_1)	1.6	0.08
Working conditions (F_2)	4.35	0.21
Material remuneration (F_3)	4.85	0.24
System of sanctions (F_4)	3.7	0.18
Professional development (F_5)	2.25	0.11
Personal motives (F_6)	2.7	0.13
Other factors (F_7)	1.1	0.05
Σ	20.55	1

alteration depending on the labor efficiency improvement factors:

$$\Delta Q = \sum w_i^* \cdot F_i$$

$$\Delta Q = 0.08 \cdot F_1 + 0.21 \cdot F_2 + 0.24 \cdot F_3 + 0.18 \cdot F_4 + 0.11 \cdot F_5 + 0.13 \cdot F_6 + \varepsilon_F, \quad (4)$$

where, ε_F – effects of the factors that were not included in the model (F_7)

In as much as within the framework of the investigation it seems impossible to include all available factors of labor efficiency that affect the quality of the product, they have been designated in the model as a constant term represented by factor (F_7). This approach ensures objectivity in creating the dependency model.

Apart from the unaccounted factors, the model should also be adjusted for the probability of the erroneous judgments of the experts and for the potential achievement of the maximum effect of the factors affecting the product quality. Erroneous judgments of the experts (fallacies) may occur when the competence of the experts is low or when their opinions are different.

In as much as this particular expert team was formed of the experts whose coefficient of competence equaled to 1, the effect of the low competence factor was minimized ($\varepsilon_{comp} \rightarrow 0$). The degree of convergence of the expert opinions was evaluated applying Kendal's coefficient of concordance:

$$K_{conc} = \frac{12S}{m^2(n^3-n)} \tag{5}$$

$$S = \sum_{i=1}^n (\sum_{j=1}^m R_{ij})^2 - \frac{(\sum_{i=1}^n \sum_{j=1}^m R_{ij})^2}{n} \tag{6}$$

where, S is the sum of squares of rank differences (deviation from mean);

$$R_{ij} - \text{rank evaluations}^{38}.$$

The value of coefficient of concordance calculated as 0.92 proves that the results of the expert evaluation are valid and it also shows that the uncertainty ratio (erroneous judgments of the experts and contradictory opinions) makes $\varepsilon_{conc} = (1 - K_{conc}) = 8\%$

The developed model indicates that the most significant factors of labor efficiency for quality improvement are represented by material remuneration, working conditions and by the system of sanctions. Their effects on the personnel performance improvement accounts for 63% thus also helping improve the product quality.

Any organization, as an operating unit, represents a system that is subject to synergetic effects. In this regard, achieving maximum effect produced by the labor efficiency factor on the product quality is only possible when there is synergy in their effects. To determine the potential quantitative evaluation of this synergetic effect, calculate synergetic capabilities of the factors (synergism coefficient K_s):

$$K_s = \frac{\sum_{i=1}^m e_i^+}{\sum_{i=1}^m e} \tag{7}$$

where, $\sum e_i^+$ is a number of positive expert opinions about the presence of the synergetic effect of a factor;

$\sum e$ - total number of expert opinions on a factor.³⁸

Applying the sociological review methods to question the expert team a matrix was developed to present the opinions on presence (+) or absence (-) of the synergetic effect produced by i -factor on j -factor. The results are shown in Table 2.

The results of the investigation prove that the highest synergetic capability belongs to the factor of personal motives (F_6), whose effect strengthens the effects produced by two other factors on the labor efficiency and on the product quality accordingly, accounting for 89%.

Taking into account the synergetic capabilities of the factors and given the potential erroneous judgments of the experts that may result from their contradictory opinions, the model of changing product quality affected by the labor efficiency improvement factors will be presented as follows:

Table 2. Results of evaluating the effects produced by factors of labor efficiency in the organization on the product quality in the process of synergy

		j -factor						$\sum e^+$	$\sum e$	K_s
		F_1	F_2	F_3	F_4	F_5	F_6			
i -factor	F_1		7	6	0	6	6	25	100	0.25
	F_2	8		7	0	7	8	30		0.3
	F_3	11	10		2	12	17	52		0.52
	F_4	2	2	1		2	1	8		0.08
	F_5	8	8	11	2		10	39		0.39
	F_6	20	20	20	9	20		89		0.89

$$\Delta Q = \left[\sum [w_i^* \cdot (1 + K_{Si})] \cdot F_i \right] - \left[\sum [w_i^* \cdot (1 + K_{Si})] \cdot F_i \right] \cdot (1 - K_{conc}) + \varepsilon_F$$

$$\Delta Q = 0.09 \cdot F_1 + 0.25 \cdot F_2 + 0.34 \cdot F_3 + 0.18 \cdot F_4 + 0.14 \cdot F_5 + 0.23 \cdot F_6 + \varepsilon_F \tag{8}$$

Upon analyzing the results of the model describing the product quality improvement and taking into account the increase in the labor efficiency in the company, it is possible to maintain the following: the most efficient factor in ensuring the product quality is represented by material remuneration, its effect accounting for 34%; then follow working conditions that account for 25% and personal motives accounting for 23%. However, these effects are only possible if the factor of personal motives of the employees of the company is accounted for, as it is responsible for creating synergy.

5. Discussion

Based on the models of dependency of the product quality on the labor efficiency factors and on synergetic effect of the labor resources efficiency factors, it becomes possible within the framework of this study to develop a conceptual model for improving the quality management efficiency in the companies based on the labor efficiency motivation (Figure 5).

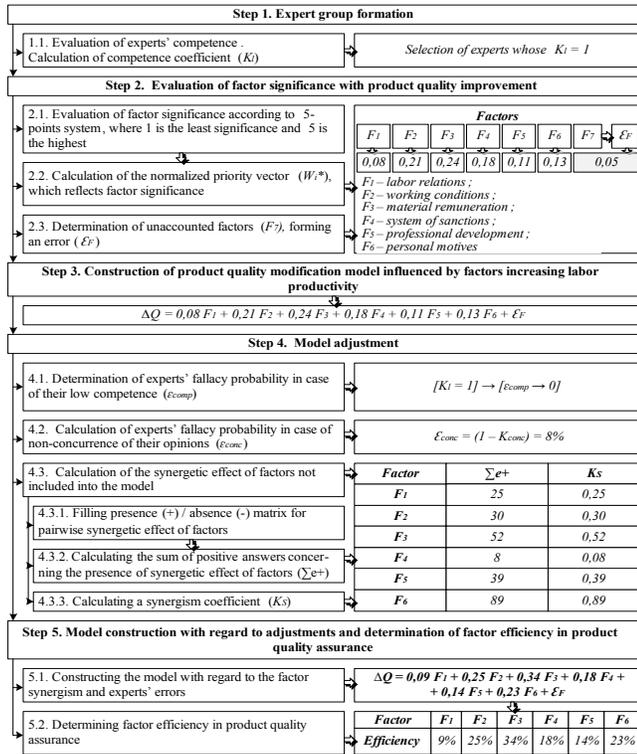


Figure 5. Conceptual model for improving quality management system efficiency in organizations based on increasing labor efficiency.

This model reflects the soft methods of affecting the factors of the labor resources efficiency that facilitate positive changes in the product quality. The conceptual model is of practical importance as it affords creating the system of the factors that affect the product quality at any stage of the production cycle.

Based on results obtained with the developed model and exemplified by the case of Deloitte, it is possible to state that under modern conditions the quality management system should be founded on better material remuneration of employees, on improved working conditions and on increasing their loyalty levels.

Thereat, it has to be considered that increasing the efficiency of labor in the company by way of manipulations with the “employees’ personal motives” factor should necessarily be incorporated with other labor efficiency factors to create positive synergetic effect that would improve the quality of the products. The synergetic effect, as the study illustrated, accounts for 89% of the strengthened positive effect on the product quality. Basically, just these three factors affect the improvement in the company’s product quality by 84%.

The key factor for motivating the labor resources efficiency in the company is represented by material remuneration of the employees.

Deloitte already makes good use of such personnel motivation approaches as commission payments in form of the fixed percentage of the contracted deal with the client and monetary payments for fulfilling the tasks that are not envisaged by an employee’s terms of reference. Therefore, for the purposes of improving the quality, it seems advisable to adopt special individual payments to the employees that are awarded to acknowledge their value for the business of the company. Such incentives can be granted, for example, to distinguish personal experience and also for the good command of some certain skills. It is practicable to use different types of the employees’ participation in the company’s equity. This approach to motivating the labor efficiency implies granting small packages of the company’s shares and/or giving the right to purchase them. Implementing the program of profit sharing provides the employees with an opportunity to receive certain percentage of the company’s profit as an individual bonus for good performance which, in turn, helps uniting the employees of the company and improves labor efficiency.

The new method of human resources management can be represented by unconventional compensations that would include payments for the results and for knowledge (Scanlon system), giving bonuses to employees for increasing the output of conditionally clean products calculated per one unit of wages (Rucker system), awarding premiums to the employees for saving the working time in man-hours (Iproshear system), incentives for continuing educational studies, bonuses for the ideas on the process improvements.

It also seems advisable to adopt the practices of awarding payments to the employees for changing their working places as a motivation factor of labor resources efficiency as well as providing them with special office equipment, separate room in the office, a corporate car, etc. together with ensuring deeper involvement of the employees that could be expressed orally as gratitude or as a release in the mass media.

Another important factor for improving labor efficiency in the quality management system is represented by the working conditions. From this perspective it seems practicable to introduce the practices of paying the employees’ cars insurance premiums at the company’s expense and providing the car parking areas free of charge;

giving opportunities for entertainment and sports; annual payments to the employees who live healthy and who visit the doctors on regular basis, who go in for sports or go to work by bicycle; granting interest-free loans for purchasing car, house, new clothes according to the dress-code adopted by the company, etc., practicing flexible working hours up to freelance. An important thing is to introduce medical and social insurance at the company's expense and to practice assistance in paying the loans, developing the so-called family programs.

It will help improving the labor efficiency if the working tasks are distributed as a factor of optimizing the working conditions. The work that takes more than 40 hours per week should be divided between two or several employees. Due to this approach, there emerges an opportunity to make use of the experience of not one but several employees in the organization. Besides, this approach makes it possible for the company to hire highly qualified employees that cannot work on a fulltime basis due to some certain reasons.

A considerable factor that facilitates the product quality improvement in the company and that has to be taken into account within the quality management system as the factor that produces the synergetic effect on the labor efficiency is represented by personal interests of the employees of the company. Personal interests of the employees of the organization, from the perspectives of the human resources policy, should be ensured by means of increasing the levels of loyalty of the company's employees.

The basis of the human resources policy in the short-term should imply the improvement of the quality of the relations that exist between the management of the company and the personnel, introducing the principle of just and unambiguous rules within the company, respecting the opinions of the employees in the process of managerial decision-making, aligning the interests of the management and the interests of the personnel of the company, etc. Only upon ensuring psychological loyalty the management of the company can establish the prerequisites for achieving the high level of the staff loyalty across the company. Also, to achieve the objectives of improving the efficiency of labor, the human resources policy should be focused on securing opportunities for the employees' career development. The programs aimed at improving the employees' qualifications and at providing opportunities for developing different competencies should be implemented. This approach will make it pos-

sible to achieve the high level of personnel loyalty that, in turn, will establish the basis for improving the labor efficiency and, consequently, for improving the quality of the products.

6. Conclusion

Thus, the developed conceptual model focused on optimizing the quality management system makes it possible to determine principal factors for improving labor efficiency at any stage of the production cycle. A distinguishing feature of this model, by contrast to the developed scientific studies in modern literature, is represented by the fact that it identifies the key factor for improving labor resources efficiency that possesses positive synergetic effect interacting with other labor efficiency factors in the course of improving the quality of the products in the company. The developed model depends upon the labor efficiency factors and upon the product quality; it enables quantitative evaluation of the intensity of the produced effects that, in turn, makes it possible to identify and to take into account their priorities in the process of improving the efficiency of the quality management system. This approach creates the basis for setting tactical and strategic objectives to optimize the quality management system based on the labor efficiency improvement factors. It also lays the foundations for improving theoretical and methodological principles of quality management. It is notable for its simplicity and universal applicability, as it is not limited by the schedule of the implemented strategic and tactical tasks of the management of the company or by types and specifics of businesses.

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