PREDICTION OF QUALITY OF SEWING DEPARTMENT UNDER UNSTEADY OPERATING MODE CHANGE

Olga Mokshina[1], Nikolay Riabchykov[2]

[1]Volodymyr Dahl East-Ukrainian National University, Lugansk, Ukraine,
[2]Ukrainian engineer-pedagogical academy, Kharkiv, Ukraine

Summary. The articles describes mathematical model of quality dynamics in garments industry and garments merchandising. As a result, the major identified ways and means of production to working with vibrating equipment with conditions to achieve the greatest level of quality. The algorithm of dynamic programming to achieve the minimum loss of quality in the case of work in several areas. The obtained optimal distribution of vibration during operation in the organization of work with different number of plots
Key words: quality, garments industry, dynamic programming, vibrating equipment.

INTRODUCTION

Quality of sewing goods varies according to the needs of society which is constantly changing and growing. The level duality clothing items valued complex indices. Hygienic quality index apparel products allows hygroscopic, heat insulation, air permeability, water resistance, etc. The quality of garments is dependent on the quality of fabric, quality of modeling, design, technology, tailoring. Quality control of garments performed by comparing the product with standard samples.

The standards and specifications with the technical requirements for products. For example, the requirements for the production of clothing are: treatment of the edges of parts, the use of gasket materials, paving edge processing pockets requirements lining to the bottom hem and sleeves products, the use of supers. Garments should have a beautiful appearance, good save fashioned, to be comfortable and practical to wear.

Quality control of finished products are completed by the department of technical control in accordance with the requirements[1,2] which contains the methods of quality control and identified the features that characterize the quality of the product. For quality inspection the inspector workstation is equipped with a set of dummies, bracket shelves, model-a model and an assembly diagram, specifications on the model, a set of technical standards, a set of measuring tools and accessories, stationery stamp to mark the defect in the product on the adaptation .

Noted on the form and location of the defect on the adaptation of the product is returned to the workplace where admitted fault. Grade products are installed in accordance with the requirements of [3,4], which set out the requirements for the quality of products.

Size, appearance of products and technology approved to meet the technical requirements for the model. Control of linear measurements performed roulette type RH with a limit value 0 - 2000 mm and scale factor - 1 mm. Control size of the product in accordance with the data of the design documentation for the model, for each site according to the dimension table products in finished form. Maximum deviations from the nominal size in the product and are located symmetrically in the finished product are as follows: for the main seams ± 1 - 2 mm, length 10 mm ± back to back width of ± 5 mm, the width of a shelf zone ± 5 mm, the width shelves at the armhole ± 10mm, the width sleeves ± 5mm for length sleeves ± 10 mm, the width of the collar to ± 5 mm, length 10 mm ± collar and so on.

Errors in control mainly observed due to errors of measurement errors on the dummy landing articles and errors of the manikins, pliable material, inaccuracies cut parts and assemblies, negligence or other controller.

Existing techniques estimate the errors can detect the degree of influence of each of the reasons for the emergence percentage of defective products, but these methods do not take into account the uncertainty of manufacturing and production control in the relationship.

OBJECTS AND PROBLEMS

Our main goal is achieve maximum quality during operation. Note for the production of a single product to perform many operations, each of which can be determined by their own speed, including the speed of the machine, which undoubtedly affects the vibration characteristics. Thus, the implementation of long straight seams provides typically the maximum speed of the machine under the maximum level of vibration. Performing warped seams, short transactions running on low speed, according common vibration will be reduced.

RESEARCH ANALYSIS

A single operator machine can perform operations that are defined by different vibration equipment. Pose the problem of determining the distribution patterns of vibration over time, which determines the maximum final product quality.

In a number of works [5-7] discussed the determination of quality garments, in particular the question of exposure sewing equipment quality. But still not solved the real development of recommendations for the production process to ensure maximum quality.

Purpose is to solve variational problems determining the program of work on sewing equipment with vibration for maximum quality.

Grade finished garments will be set in accordance with standards of quality. Grade determined in accordance with the requirements of the standard and consumer properties of products: appearance, landing on the shape, size, and in accordance with the requirements of the construction, the range and quality of materials, technical documentation on the product and approved samples.

Note that the manner specified in [8] defined quality obtained at the end of work. Define T - total time, t - current time, R - the maximum permissible level of vibrations, r - current vibration. We introduce the dimensionless time and dimensionless vibration.

$$\tau = \frac{t}{T}. \quad (1)$$

$$x = \frac{r}{R}. \quad (2)$$

We consider a change rate as from time to time and vibration

$$Y = B + A \cdot e^{-a \cdot x^b \tau^c} + D \cdot (1 - \tau). \quad (3)$$

Where D term associated with general fatigue employee regardless of level of vibration. We identify it with the condition $A + B + D = 1$, c - coefficient changes as the time under vibration. Although each level of vibration, this ratio can be separate, experience shows that the variation was not very large.

For its location experiment definition quality early work, inside and end were held.

Evaluation of the quality finished products produced by 40-point scale. The presence of defects reduces the appearance evaluation of quality clothing by subtracting points from the baseline value reduction estimates. If the sample has the ideal product quality landing, it has maximum score point scale - 40 points and belongs to the I grade. Based on the 30% aqueous (for products I grade) or 50% aqueous (for products II grade) level of positive answers experts that the defect is visually prominent, set points differentiated by grades according to the level of defect. Thus, for a variety of products I found 38-40 points for a variety of products II - 32-37 points.

Distribution of marks obtained at the beginning of the day when using equipment with vibration working surface given in [8]. We can prove that this distribution is close to normal.

Define quality for mid-day to mid-level vibrations when the fair is a normal distribution (table 1).

Table 1. Distribution points as the middle of the day

0	1	2	3	4	5	6	7	8	9
35.954	36.315	36.676	37.037	37.398	37.759	38.12	38.481	38.841	39.202
4	10	10	16	18	17	6	11	6	2

Constructing a histogram distribution of quality in the middle of the day (fig. 1) we can conclude its proximity to the normal distribution.

Value grade products is determined using the integral

$W = \int_{37}^{40} p(x)dx = 0,686.$ indicating that 68.6% of production goes to first grade.

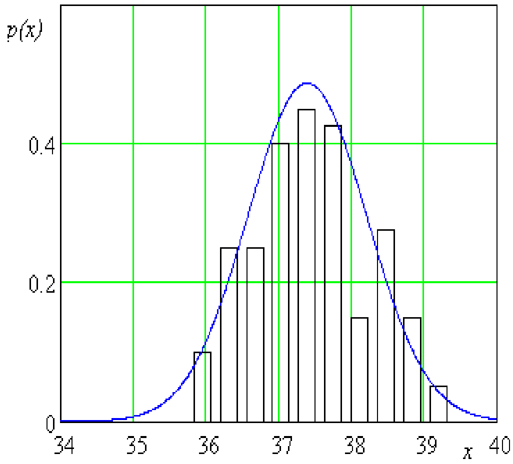

Fig. 1. Histogram distribution points as the middle of the day

To find the coefficient *c* go

$$Y_c = A + B_e^{-aX^b 0,5^c}. \quad (4)$$

Where have

$$c = \log_{0,5}\left[\frac{\ln\left(\frac{Y_c - A}{b}\right)}{-aX^b}\right] = \frac{\ln\left[\frac{\ln\left(\frac{Y_c - A}{b}\right)}{-aX^b}\right]}{\ln 0,5}. \quad (5)$$

For the parameters found c=1,28

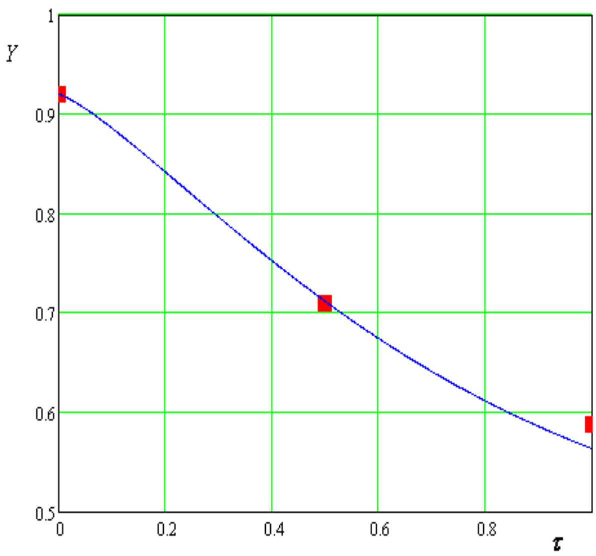

Fig.2. Reduction of time as the average level of vibration

Then compatible relationship quality on time and the vibrations will look (fig. 2)

$$Y = 0.45 + 0.57 \cdot e^{-2.291 \cdot x^{1,66} \cdot \tau^{1,28}}. \quad (6)$$

In the case of variable vibration is very difficult to construct an experiment which would consider all possible patterns of vibration. We introduce the hypothesis of legal compliance changes as mainly an expression of the increment. For this we find the differential input function.

$$dY = -a \cdot A \cdot e^{-a \cdot x^b \cdot \tau^c} \cdot \left[b \cdot x^{b-1} \cdot \tau \cdot \frac{dx}{d\tau} + c \cdot x^b \cdot \tau^{c-1}\right] d\tau. \quad (7)$$

Recall that we are dealing with a specific amount of time and vibration, which varies from 0 to 1. It may be noted that the differential at any values have negative nature, that is, it shows reduced quality in some time under the influence of vibration, given their change in time.

The general decrease in quality.

$$H = \int_0^1 a \cdot A \cdot e^{-a \cdot x^b \cdot \tau^c} \cdot \left[b \cdot x^{b-1} \cdot \tau \cdot \frac{dx}{d\tau} + c \cdot x^b \cdot \tau^{c-1}\right] d\tau. \quad (8)$$

It rejected the sign "minus" because we are not dealing with quality, and reduced quality. Then the overall quality can be defined as

$$Y = B + A - H. \quad (9)$$

Posing the problem of finding the vibration function changes over time, which provided the lowest level of quality products during working hours. We introduce restrictions during work should be used every possible level of vibration. We will offer some features change vibrations that match the condition.

The real work in garment production presents a number of time periods during which implemented a separate operation. As already mentioned, a separate operation provides fairly certain level of vibration. Try to improve the quality of change operations in a systematic way, which determines the average level of vibration during operation.

Reduced quality in this interval can be defined as

$$\Delta H = \left\{e^{-a(i \cdot \Delta x)^b [(j+1) \cdot \Delta\tau]^c} - e^{-a(i \cdot \Delta x)^b [j \cdot \Delta\tau]^c}\right\}. \quad (10)$$

The overall decrease in quality over time can be determined amount

$$H = \sum_{j=1}^{n-1} \left\{ e^{-a(i\cdot\Delta x)^b\left[(j+1)\cdot\Delta\tau\right]^c} - e^{-a(i\cdot\Delta x)^b\left[j\cdot\Delta\tau\right]^c} \right\}. \quad (11)$$

The problem in this case can be formulated as follows.

There is a table that defines the decline in the quality of products at different ratios of time and vibration. We must find a way to change vibrations in time to the total drop in quality would be minimal (table 2).

Table 2. Changing the level of vibration equipment

	1	2	...	j	...	n-1	n
1	$\Delta H_{1,1}$	$\Delta H_{1,2}$	...	$\Delta H_{1,j}$	...	$\Delta H_{1,n-1}$	$\Delta H_{1,n}$
2	$\Delta H_{2,1}$	$\Delta H_{2,2}$	...	$\Delta H_{2,j}$	...	$\Delta H_{2,n-1}$	$\Delta H_{2,n}$
...	...	...	...	...	...	...	...
i	$\Delta H_{i,1}$	$\Delta H_{i,2}$	...	$\Delta H_{i,j}$	...	$\Delta H_{i,n-1}$	$\Delta H_{i,n}$
...	...	...	...	...	...	...	...
n-1	$\Delta H_{n-1,1}$	$\Delta H_{n-1,2}$	...	$\Delta H_{n-1,j}$	...	$\Delta H_{n-1,n-1}$	$\Delta H_{n-1,n}$
n	$\Delta H_{n,1}$	$\Delta H_{n,2}$	...	$\Delta H_{n,j}$	...	$\Delta H_{n1,n-1}$	$\Delta H_{n,n}$

Adds a condition to each section met once. Then the formal task is to find the number of vibrations depends and depending on the number of vibrations j in condition that the sum of (11) become minimum.

To determine this dependence algorithm multi movement, the essence of which can be defined as follows. First movement begins with the first column of the table, which is determined by the minimum value. For the second column is the minimum value of the sum of the first of the second, for the third - the second to the third, and so on. After the first movement to place first column put the second and the process repeats for him. Process of movement tripled, exposing each column forward.

The results, among other things, to determine the best mode in terms of the number of operations performed.

CONCLUSIONS

As a result, the major identified ways and means of production to working with vibrating equipment with conditions to achieve the greatest level of quality.

These results include the following:

- The stated variation problem of determining the shortest vibration function changes during the work to achieve the greatest level of quality;
- The algorithm of dynamic programming to achieve the minimum loss of quality in the case of work in several areas. The obtained optimal distribution of vibration during operation in the organization of work with different number of plots;
- Defined the most efficient in terms of quality of sites throughout the day;

The novelty of the results is as follows

- The first posed and solved the optimal combination of quality and vibration at work;
- Installed new facts necessary for workflow based on increasing quality;
- Engineering and intuitive representation of the dependence of reduction in quality of the production process received theoretical confirmation.

The practical significance of the results is made in this

- Opportunities to organize the production process with minimal quality;
- Ability to select the mode of equipment with different levels of vibration while maintaining quality;
- Obtaining control methods defect production and the costs of examinations and stage production.

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ПРОГНОЗИРОВАНИЕ КАЧЕСТВА ПРОДУКЦИИ НА ШВЕЙНОМ ПРЕДПРИЯТИИ В НЕСТАЦИОНАРНЫХ РЕЖИМАХ РАБОТЫ

Ольга Мокшина, Николай Рябчиков

Аннотация. В статье описывается математическая модель динамики качества в швейной промышленности и квалиметрии одежды. В результате показаны основные пути и средства производства одежды при работе с вибрирующим оборудованием при условиями для достижения наивысшего уровня качества. Разработан алгоритм динамического программирования для достижения минимальной потери качества в случае работы в нескольких областях. Получено оптимальное распределение вибрации во время работы и организации работы с различным количеством участков.

Ключевые слова: качество, легкая промышленность, динамическое программирование, вибрационное оборудование.