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QUALITY CONTROL OF APPAREL PRODUCTS USING QFD

Scientific Paper
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Abstract: *Design and construction the new fashion product is base on the modeling of produce with costumer needs for the new or better product. Process of produce arrival and development are needs company strategy, with so many methods and models, like as tools for withes performance of produce. High frequency market changes caused by global competition in clothing industry have conditioned production-business systems (PBS) to set permanent production goal: short delivery terms, high quality of clothing products and price which is acceptable on market. Achieving quality goals and increase in PBS potentials is possible by application of continuous Quality Management System (QMS) improvement. If the ''voice of the user" is taken into consideration as one of most important factors in quality management, application of the method of Quality Function Deployment – QFD initiates and enables the right kind of information for adequate decision making, correctly positions PBS on market and creates necessary conditions for establishment of feet back and estimate of realized improvement. Qualitative product could be profitability with good marketing price of its development which necessary correlation design and construction with other business-manufacturing and marketing.*

Key words: *fashion product, clothing industry, QFD, quality*

KONTROLA KVALITETA ODEVNOG PROIZVODA QFD METODOM

1. INTRODUCTION

In clothing industry which must realize high quality flexible product, place and role of QFD method in the framework of the QMS quality loop has for a goal achievement of precisely defined level of quality which suites users' demands. For the first time in our clothing industry suggested method is applied in the example of female denim trousers.

Contemporary industrial production of clothing demands permanent innovation and improvement of product and production processes. Aggressive competition on global level, and demanding buyers cause fast pace of changes in technological processes. Therefore today's technological systems are characterized by orientation to productivity, while future ones will be characterized by orientation to quality [1]. Higher application of informatics technology and knowledge management brought to new ways of planning and clothing production techniques in order to create high quality clothing product.

Unpredictable market trends, expansion of nanotechnology and construction of new textile materials with use in all aspects of life (medical textile, ambient textile…) brought to:

- Increase in frequency of introduction of new products;
- Changing of parts of existing products;
- Great and frequent changes of fashion trends of clothing products and their combinations;
- Changes in application of rules (standards, safety at work, environment preservation, use of Oeko-Tex standards…);
- Changes in technological process.

Producers of clothing products should, therefore, choose business strategy for adaptation to changes in the surrounding, to study without fail and implement TQM approach for strategic management, as well as QFD method for efficient reaching of goals of clothing products improvement.

In clothing industry which must realize high quality flexible product, place and role of QFD method in the

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framework of the QMS quality loop has for a goal achievement of precisely defined level of quality which suites users' demands. For the first time in our clothing industry suggested method is applied in the example of female denim trousers.

2. QFD IN CLOTHING INDUSTRY

QFD method enables bringing of demands of users which reflect their needs and expectations, in adequate correlation with the characteristics of services performing, in it's business system. Purpose of application of the method in clothing industry is to spot critical characteristics of performing services from such correlation, i.e., critical processes and their activities, in order to later apply procedure for introduction of corrective measures in such critical places, for the purpose of their improvement. Final effect of bettering of critical elements is raising the quality level of clothing product (kind of material, choice of prototype, way of fabrication, and choice of thread), i.e. satisfying the needs of users and through that increase in gain from the market. Demands of users are gathered on the market, and characteristics of service performance are established and estimated by the provider of services, while corrective measure represent important element in the system of quality which enables efficient acting of feed back in such a system. Although, in the beginning, this method served for designing a new product, today it is applied in all other functions inside the PBS (Figure 1), and is often present as integral part of national standardized methods (Gustafson in 1993. classified it among seven tools of management). In clothing industry it can be simultaneously applied on development of new product and improvement of existing one.

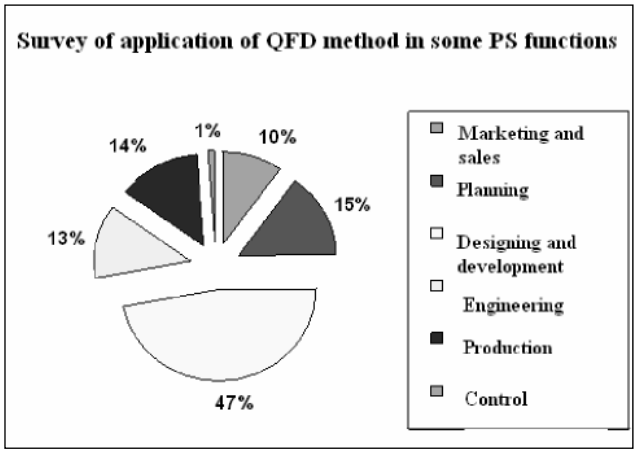

Figure 1 - *Survey of application of QFD method in some PS (production system) functions*

QFD method is mostly used in quality management processes in Japanese companies and so their experience is being followed in application and the way of fixing. Japanese society for QC recommends QFD for defining ''the voice of the buyer'', as a scientific process. The voice of the buyer is also starter of QFD method and as such determines success or failure of product and service on the market. Barnard and Wallace (1994) integrated QFD as compulsory method of development strategy defining [2].

Needs of consumer are one of starting foundations for clothes designing, therefore information received by designer must be realistic, clear, and precise with recommendation for the quality level of clothing articles and timely so that the new collection appears on market at the right time. If the buyers demands, important for their satisfaction are not harmonized, critical components of product and services not established, and then removed in the phase of critical parameters of the production process and not transferred to procedures and instructions for realization and control of clothing articles, the battle for prestigious place on the market and for the buyer of clothing article will be lost.

3. PHASES OF THE QFD METHOD APPLICATION IN CLOTHING INDUSTRY

Implementation of the QFD method in clothing industry is represented through 4 principles of work in 4 phases:

- phase1 – translates buyer's demands into product characteristics,
- phase 2 – translates product's characteristics into characteristics of parts
- phase 3 – translates characteristics of parts into manufacturing technology and
- phase 4 – translates manufacturing technology into technical, instructions.

Forwarding information from one organizational unit to another (marketing, development, technology, production) through four "houses of quality", in which demands ("What") turn into characteristics of product/service, part of product/service or process ("How"), with following technical target values and their correlations in experimental part on example of female denim trousers led to:

- Reduction of product designing time.
- Improvement of clothing product quality (the exact quality as customer demands is offered).
- Reduction of total cost of designing and production.

- Plans and programs of workers' training especially on critical places.
- Definition of work procedures.
- Documentation and quality management system.

When questions of clothing product buyers' are analyzed through poll and claims on female denim trousers, list of buyer's wishes are formed (WHATs). It can be divided into:

1. Basic (primary, expected, unspoken-understood, **"must be"**).
2. Derived (secondary, spoken,**"might be").**
3. Exhilarating (tertiary, unspoken-pleasantly surprising, **"it would be nice, if it existed"**).

Basic WHATs are integral part or function of clothing product, and rarely increase buyers' satisfaction – he seldom even thinks of them. But, in the case of unfulfillment (shortage or malfunctioning) quickly follows the buyers' disappointment with the product. For example: zipper is not working, size is not adequate…

Derived WHATs are usually determined through market research. Buyers' satisfaction grows with the level of fulfilment.

Exhilarating WHATs increase buyers' satisfaction, although he wouldn't be unsatisfied even without them. It is not expected from PBS to make breakthroughs on the market with such innovations. With maturing of the product, exhilarating WHATs can pass into basic. For example denim trousers that women are wearing: they were very excited with them in the 70's, (during hippie revolution), while today they are obligatory clothing article for women.

HOWs

Producer defines group of quality elements which realize WHATs (buyer's demands), while each of HOWs "attacks" one or more of WHATs, and for every WHAT there is at least one HOW.

HOWs are methods or techniques of "translation" of the buyer's voice into criteria for estimate of shaping, for example, WHAT are a "comfortable clothing product (denim trousers)", and appropriate four HOWs demands are on: pattern making, prototype, colour, size.

Typical HOWs may be: length, width, height, thickness of cloth, volume, features of material etc.

HOWMUCHs represent feasibility limits of HOWs and targeted values of HOWs (qualitative elements) for every HOW one HOWMUCH.

To create criterion for the testing of successfulness, this is usually obtained through market research, typical HOWMUCH measures importance of HOWs, product designing, or group of targeted values.

HOWs contain extremes –permissible target values, positive or negative.

WHYs

Similar to WHATs and HOWs, group of WHYs is also a vector that describes relative importance of clothing product, in relation to world class products or the best in their class.

If the quantitative WHYs are multiplied with WHATs and summarized measure of total satisfaction of buyer is received. Example: WHY is vector of relative importance in relation to buyer's demand for a world class product of the main competitor (for example Levi's denim pants, or some relevant denim pants producer).

If the product is intended for a larger number of groups of buyers, like USA, Asia, Europe, Japan etc, the list of WHYs must include these groups and their relative demands, because WHYs are names of competitors, competitors' products, segments of market which describe instantaneous market conditions.

WHYs can be also used for evaluation of decisions for the future product.

4. EXPERIMENTAL

4.1. Analysis of the QFD method on example of clothing article

Analysis has been carried out with the QFD method in the framework of PBS-1 and partially in the framework of PBS-2 through 4 phases based on the part of planning and construction preparation. Each of these phases is represented through matrixes presented as houses of quality. For the first time, this method was applied on the example of PBS in domestic clothing industry.

In order to obtain relevant data marketing research has been performed through poll and claim of buyer of denim trousers. Results were systematized, photographed and analyzed and as such prepared for the first phase of transformation of the buyer's voice into characteristics of the product.

Meanwhile, in order to reduce number of claims and maintain the market position, all the possible causes of error occurrence were examined – for each possible error it is necessary to analyze the cause with

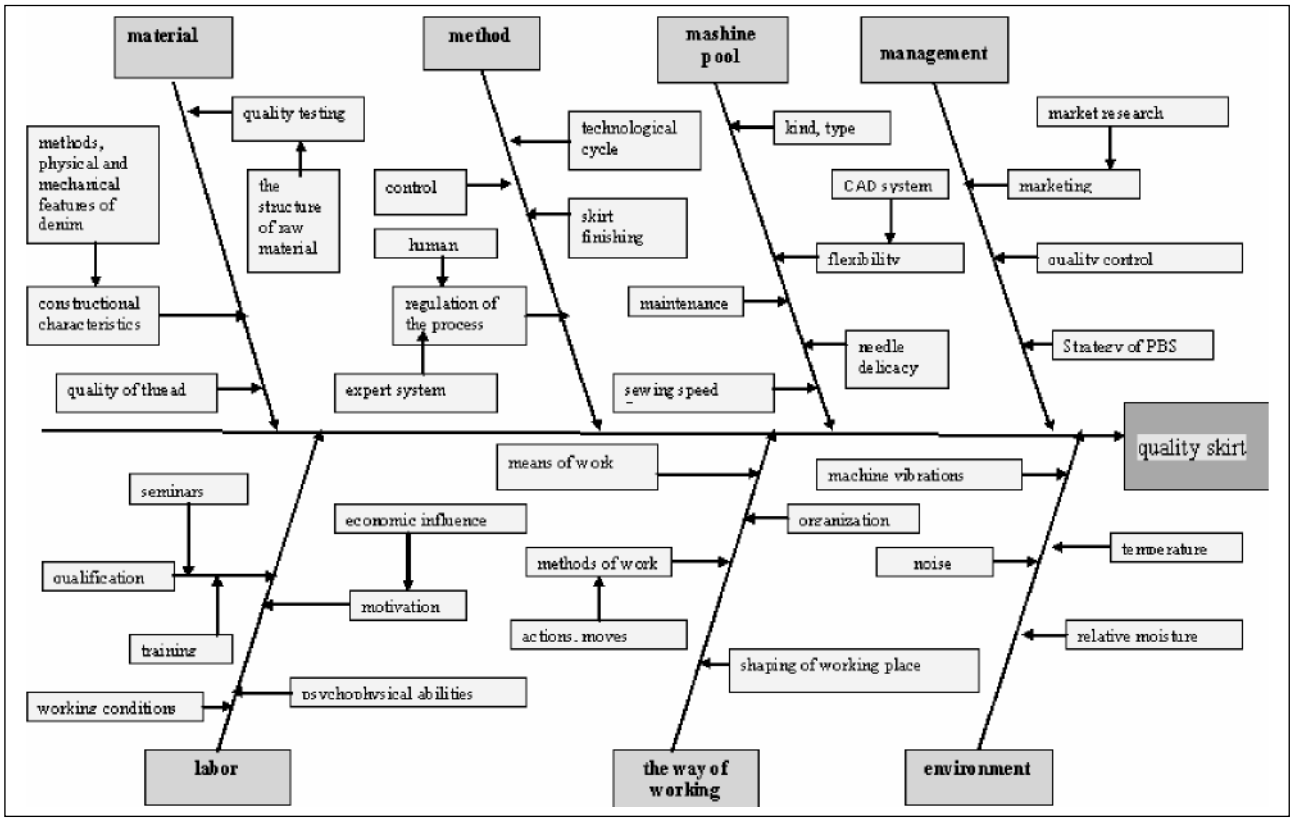

Figure 2 - *Cause and effect diagrams [3]*

Cause and effect diagrams (Figure 2), which takes into consideration consequence-causal influences of man-machine-materiel-method-surrounding-management and measurement.

4.2. Houses of quality

On Figures 3, 4, 5 and 6 were shown four houses of quality made on the basis of comparison of PBS 1 and PBS 2, as well as on the basis of the buyer's evaluation of given product in order to answer the questions HOW to satisfy the buyer's needs and improve the quality and features of clothing product.

Phase 1

- Trough analysis of houses of quality on the basis of marketing research it has been established by priorities what buyers really want.
- On the basis of performed SWOT analysis data of comparison of similar PBS on the basis of production of female denim trousers [4] were included.
- On the basis of reported buyers' claims (from sales facilities of analyzed PBS) were established most frequent claims with statistic method and possibility of their elimination.
- On the basis of buyer's demands in the field of WHAT were given buyer's demands received through market research. Buyer's demands are systematized and given in Fig.3. In the field of HOW are given product characteristics. Their numeric significance is established and for each is a separately given amount in percentage. In the first place is the fashion trend, while behind the fashion trend there are factors of organoleptic characteristics of denim trousers.
- Correlation has been established between the degrees in which dimensions of HOW support dimensions of WHAT. Grades were given from 1-9, i.e. were presented in known symbols.
- Numeric significance of some quality characteristics has been established, but it was not possible to establish whether dimensions of HOW with highest absolute value would really add to market success of the product.
- Between characteristics of HOW and WHAT conflicting goals can exist, therefore it has been established in the matrix of the roof that such kind of problems may occur during realization of technical rules.
- It is very difficult to compare two or more PBS because of the protection of privacy, but the comparison has been carried out and graded with grades from 1-5 where characteristics were

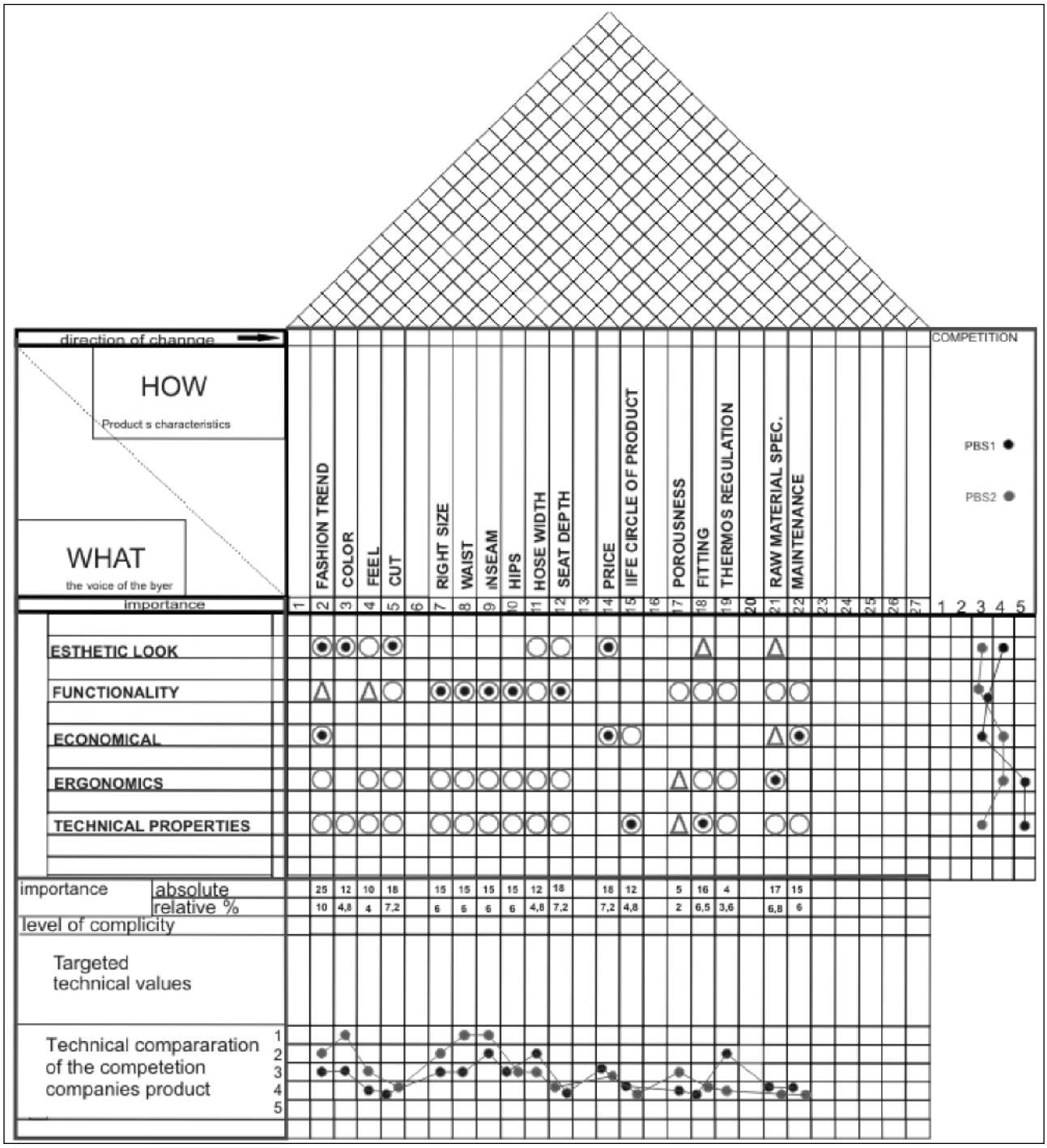

Figure 3 - *House of quality-phase and establishment of significant characteristics of the product*

spotted, given in diagrams in houses. (There are two moments in which QFD is used: when a new clothing product is being developed and when the existing one is being improved. When we are developing new clothing product we establish what it that is good at the competition or wrong is. While we are improving already existing product of our own service we ask users how they would grade certain characteristic of our product compared to competition. This gives us the possibility to improve characteristics of clothing product which are essential for the user, and where we are worse than the competition. Strategy of PBS-1 is to design clothing product better or at least on the same level as competition with which it compares itself (Benchmarking).

- Possibility of realization of improvement or new construction of product grades were given from

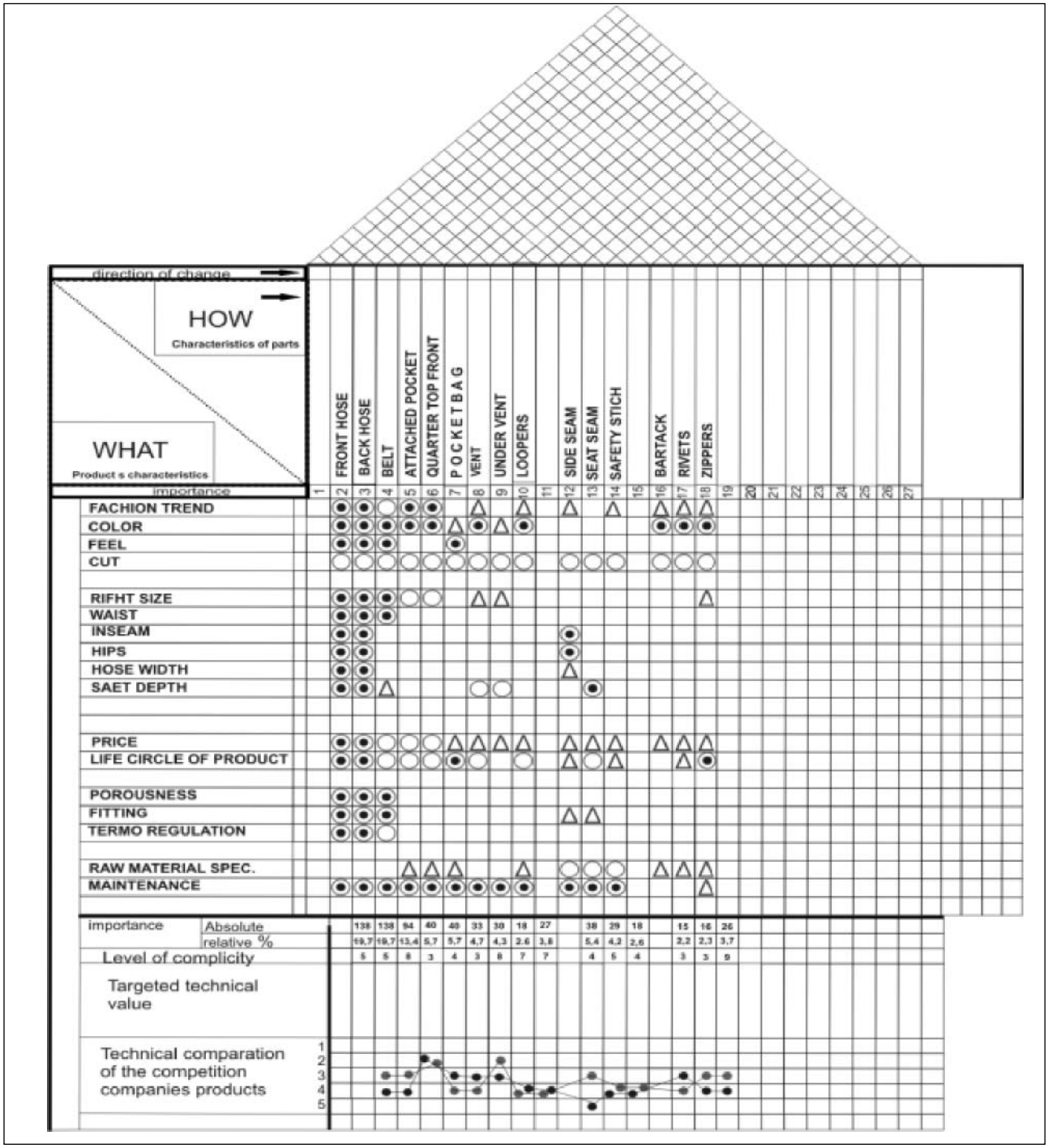

Figure 4 - *House of quality-phase II of the critical characteristic of the product*

1-10 which represent the system of complexity where they are ranked as low-high. Fabrication of some characteristic parts (house 2), technology of sewing and finishing (house 3), as well as application of certain technical rules (house 4) have the highest level of complexity.

Phase 2

- In the second phase are established characteristics of the parts of clothing product (house in *Fig.4*).
- Critical characteristics of parts are included in the field as dimensions of HOW with analysis from the FMEA method [5]. Degree of correlation has been performed and on the basis of it two targeted critical areas on female denim trousers were defined, such as: waist, side seams and slit.
- On these parts of clothing product exists the highest degree of errors which exerts influence on reduction of quality.

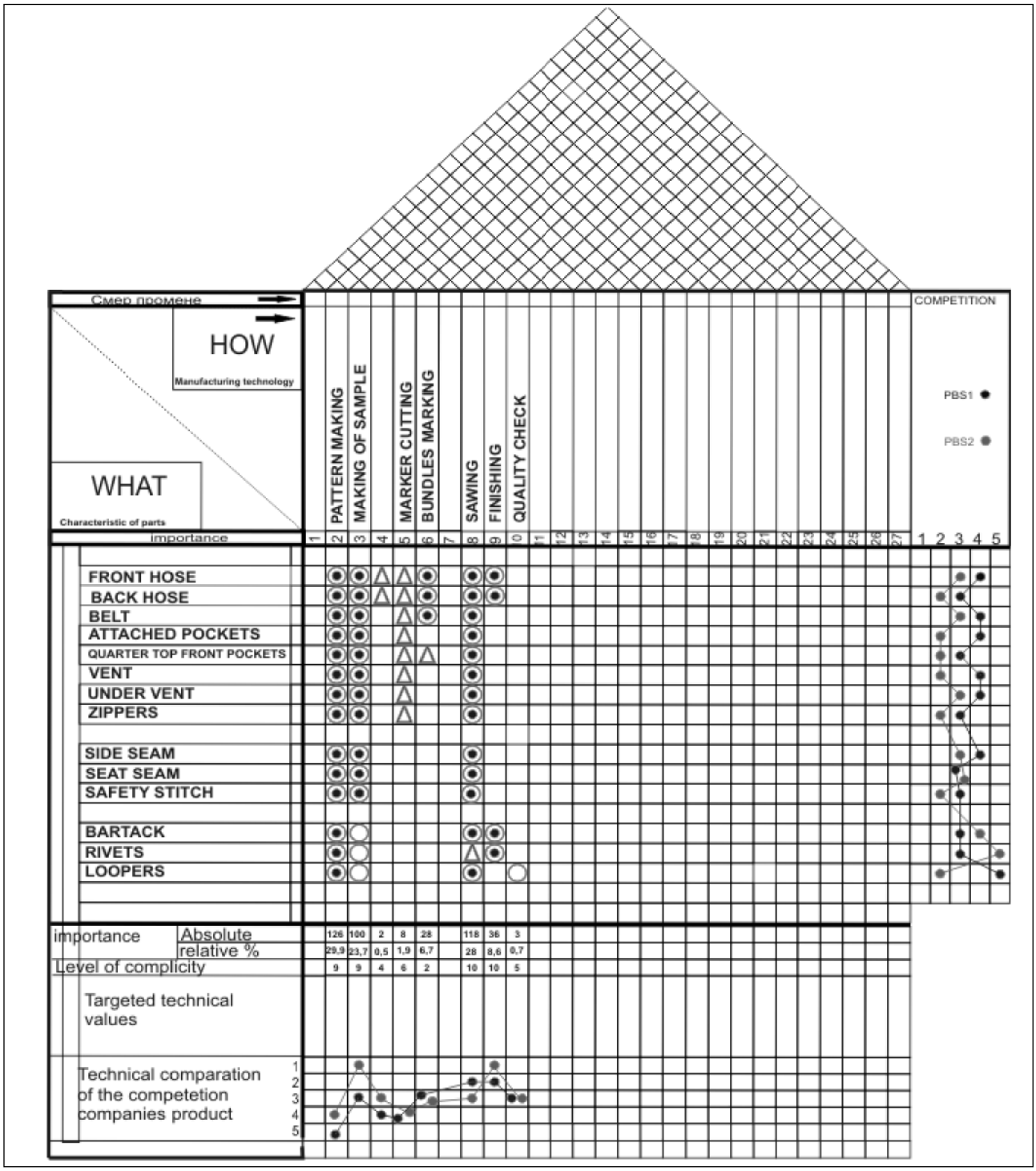

Figure 5 - *House of quality-phase III critical parameters of the process*

Phase 3

For each individual critical part all operations of fabrication were analyzed and established influential critical parameters. Characteristics of parts have moved out of house 2 into field of WHAT, and in the field of HOW technology of fabrication is shown.

Highest level of complexity by the sequence of critical parameters of the process have, arranged by sequence: sewing and finishing technologies (stone washing, finishing, designing by laser…), fabrication of pattern making and prototypes, (making of sample), marker cutting, fabric layer, bundles marking.

As a result of QFD analysis significance of some HOWs is received. Today we still compare ourselves with chosen raw model and competition, in order to see if we are better or worse in that category. If we are

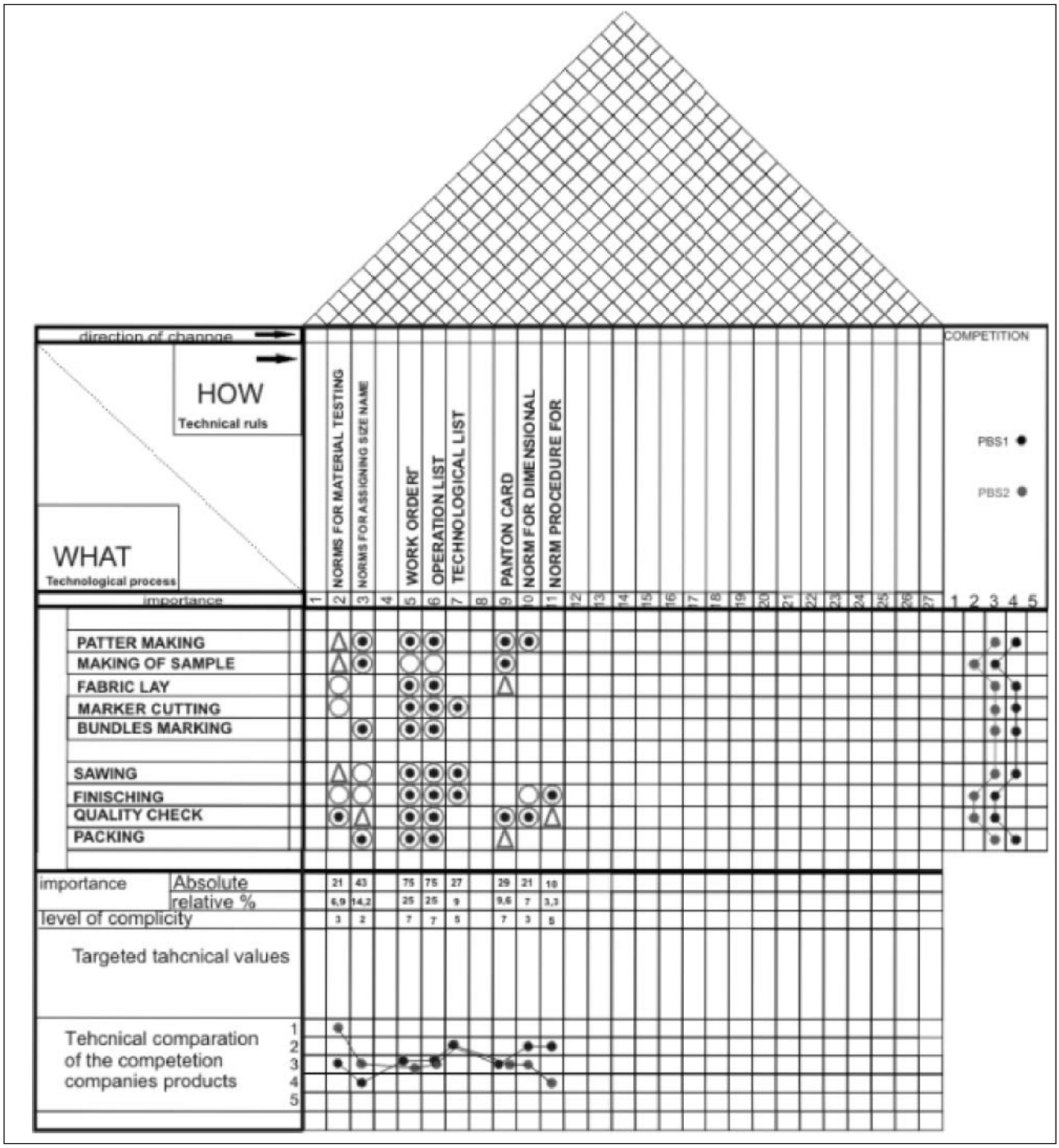

Figure 6 - *House of quality-phase IV critical parameters of production*

worse, it is necessary to establish if that is important and must improve ourselves. If we are similar to the competitors, and category is not too important, we will keep the existing state.

Phase 4

Matrix of establishment of procedures is provided for the next process of research which after application of all mentioned methods uses data from the third house. Goal is to get:

1. Preventive measures for production process.
2. Such plans for providing quality, that "the voice of the buyer" is really implemented in the product and his characteristics.
3. Optimal number of working instructions and instructions for work.
4. Application of appropriate standards (SRPS ISO).

4. CONCLUSION

Previous practice in our clothing industry, based on principle of designing of clothing product through creative effort and personal creativity of designer or the PBS owner, did not start from the real buyer and his needs, but from outdated fashion trend, or imagined user who would buy that clothing product.

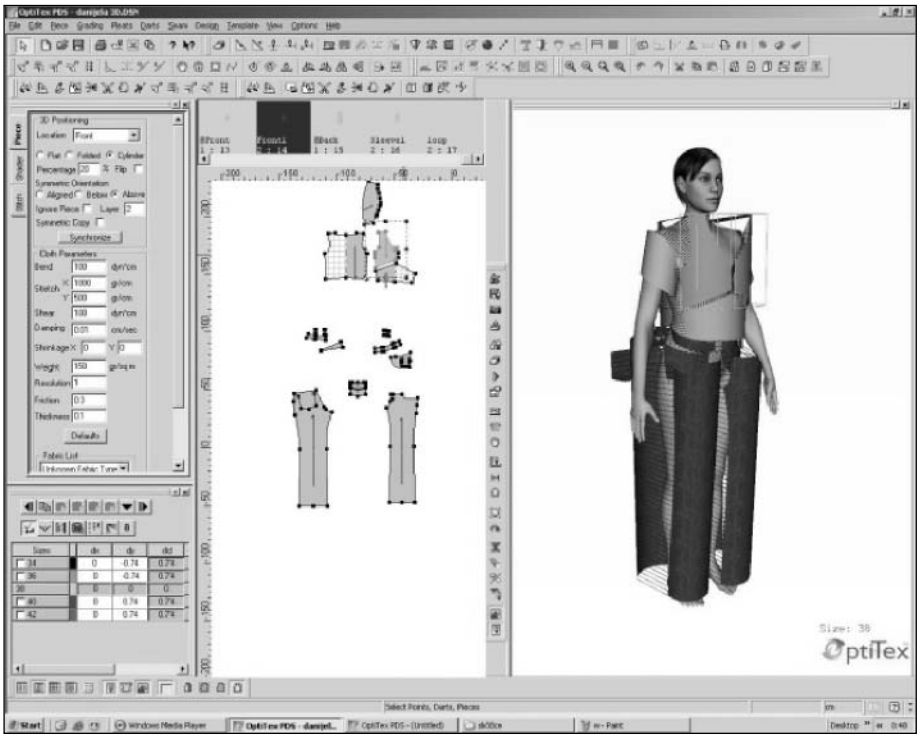

Figure 7 - *Virtual sewing, virtual control*

Complex analysis and acceptance of the team which analyzes the real consumer of the clothing product, brings PBS in clothing industry to think of and use methods (QFD, FMEA,SWOT, PNQ, Ishikawa, Design of Experiment, Taguchi and other tools of quality) with which quality clothing product that will have real place on the market among users, can be identified. In that way will provide:

- Reduction of time, costs and development necessary for the clothing product,
- Reduction of possibility of errors in the phase of designed quality,
- Reduction of subsequent corrections cost,
- Reduction of prototypes of clothing article fabrication,
- Benefit in demands of users who are the targeted group,
- Increase of users' satisfaction,
- Better identification of contradicting demands,
- Planning of desired draft solutions (pattern) according to demands of user in relation to the competition,
- Better communication inside the organization itself and in producer – user relations.

Besides advantage that is bought by this method there are also disadvantages that manifest themselves as one-sidedness when insisting on quality only, and in the course of work itself, because of the great number of clothing articles, there are problems such as matrix sizes and slow assembly-line processing. By introduction of software solutions for fabrication of houses of quality and by data keeping these disadvantages are easily removed.

As the end result analyzed PBS undertook following steps:

- Quality control between phases is introduced in every segment of construction preparation in a classic way and in computing system (*Figure 7*),

- Technological operations performed by workers on previous machines are controlled,

- Fabrication of female trousers is followed through all the phases of manufacturing and through every technological operation till finishing processing and packing, in order to increase percentage of error discovering,

- Potential errors according to priority are ranked,

- Priorities risks factors are established,

- It was provided for introduction of quality system, application of new SRPS ISO standard of sizes, ISO for stitches and kind of seams, training of workers and team responsibility.

In order to alleviate the process of designing and manufacturing of clothing products as one of the solutions it is necessary to use, besides QFD method, CFD methodology enables communication for engineers and comparative work during stages of PD³ (Product Design, Development & Delivery) process in order to secure quality and integrity of clothing product [7].

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