QUALITY MANAGEMENT SYSTEM IN GARMENT INDUSTRY – CASE OF THUAN PHUONG GROUP

Pham Cao Van[1], Bui Dinh Tan[2] and Vo Trong Cang[3]

[1] Binh Duong University, Binh Duong, Viet Nam, pcvan@bdu.edu.vn

[2] QA Manager, Thuan Phuong Group, tan.bd@tpgroup.com

[3] Binh Duong University, Binh Duong, Viet Nam, vtcang@bdu.edu.vn

Abstract. Product quality is an especially important factor for garment manufacturing enterprises. Companies always want to create products of the highest quality, with the lowest defect rate and rework costs to be able to compete better and increase customer satisfaction. However, quality management is a difficult problem that not all companies can solve well. Nowadays, industry 4.0 has gradually developed and applied to many fields in life, production and services. Quality management system (QMS) based on industry 4.0 platform is an effective solution for quality management in garment enterprises. QMS helps managers to have an accurate, immediate view of the quality situation, easily recognize problems and provide correct solutions. The article will describe the process of designing and implementing a quality management system (QMS) at Thuan Phuong Group. After implementing the software, the defect rate decreasing from 2.5% to 1.8% and saving 20% working time of QC department. Hopefully this article will help businesses have an overview of a quality management software system in the garment industry.

Keywords: Quality Management System (QMS); Industry 4.0; Garment.

1. Introduction

Textile and garment has always been a pioneer industry in the economic development strategy, bringing great profit for our country. However, with the economic opening-up and globalization trend, the competition in the market has intensified not only domestic enterprises but also foreign enterprises. Under the circumstances, improving product quality to satisfy customer and market demand is a big factor determining the maintenance and development of the business. Therefore, product quality is always a top priority at all times.

Nowadays, with the continuous development of technology, quality management based on industry 4.0 is a breakthrough solution that helps enterprises manage product quality better than traditional methods. Through a convenient and instant system from production, quality managers can be able to aware of the quality situation of the factory at any time. In addition to a quick and accurate reporting system, it helps to solve quality problems quickly, without the occurrence of mass errors that are not detected in time. Because of these great benefits, the research and application of industry 4.0 in quality management has been gradually studied and put into practice by enterprises.

2. Theory

Quality has many different definitions: Based on the customer's point of view, Edwards (1968) defines that quality is the ability to satisfy customer needs; From the point of view of manufacturing, quality is the degree to which a particular product conforms to a design or specification (Gilmore, 1974); According to Broh (1982), quality is the best level with reasonable price and variable control at reasonable cost.

Research conducted at Thuan Phương Group[1] . The company manufactures clothes, assigns export

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[1] Thuận Phương Group - Established in 1983 by Mr. Mai Duc Thuan, Thuan Phuong Embroideries Garments Co., Ltd has become one of top private embroidered and manufactured garment export companies in Viet Nam. Success in embroidered and manufactured garment field, Thuan Phuong Embroideries Garments Co., has

developed into Thuan Phuong Group with multi activities, and invested in many different fields such as clothing, embroideries, hospitals, schools, restaurants, and real estate.… # (267 - 275 Nguyen Van Luong Street, Ward 12, District 6, HCMC www.tpgroup.com.vn)

services to Haddad, Target...Therefore, the theoretical basis of research will be based on a number of standards on the garment industry and quality requirements of customers.

Quality management in the garment industry will include both material management and production management. Therefore, the study follows the direction based on the theoretical basis of the quality of these two groups. Raw Material Quality Management and Product Quality Management will be described in the following two sections.

2.1. Raw Material Quality Management

Checking the quality of fabrics before putting them into production is very important, to prevent defective products due to raw materials. The fabric quality control standard commonly applied by garment companies is the 4-point system of fabric inspection, a standard established according to the ASTM D5430-07 standard (2011) [2]. This is an important standard in the assessment, resolution and complaints in material quality management.

The 4-point system is based on the following control principles:

- All errors are assigned points.
- All extruded yarns (thin or thick) are wrong (unless the fabric is like that).
- Multiple continuation errors per Yard (=0.9144 m) are counted as 4 points.
- Each flaw, tear or broken yarn no matter how big or small is considered a serious error and is counted as 4 points.

How to calculate points in the 4-Point System:

- The length of defect from 0 inch to 3 inch (7,6 cm): 1 point;
- The length of defect from 3 inch to inch (15,2 cm): 2 point;
- The length of defect from 6 inch to 9 inch (22.8 cm): 3 point;
- Defect length greater than 9 inches (22,8 cm): 4 point.

Each yard of length must not count more than 4 points. Both horizontal and vertical errors have the same point.

[2] ASTM D5430-07 (2011): Standard Test Methods For Visually Inspecting And Grading Fabrics.

Acceptance criteria of the 4-point system:

Each fabric roll must not exceed 20 points / 100 square yards, if the fabric roll's score is more than 20 points / 100 square yards, the roll is not qualified.

The formula for calculating the 4 Points System for 1 Fabric Roll is as follows:

$$\frac{Point\ in\ 1\ fabric\ roll}{Fabric\ roll\ length\ (Actual)(yard)} x \frac{36}{Width\ (Actual)(inch)} x100$$

$$= point - 100\ yard^2, \quad (1)$$

The calculation formula of the 4-point system for a lot of fabric is as follows:

$$\frac{Total\ points}{Fabric\ roll\ length\ (Actual)(yard)} x \frac{36}{Width\ (Actual)(inch)} x100$$

$$= point - 100\ yard^2, \quad (2)$$

Common fabric defects include:

- About yarn: yarn extruding on the surface of the fabric, yarn error, uneven yarn, other yarn mixed in;
- Structural errors: yarns, holes, fabric with ripples, wrinkles, folds;
- Dyeing error: staining spots or streaks, staining;
- Other faults: smelly fabric, rotten, moldy fabric, termite, glued or other insect damaged fabric;
- Unacceptable slanting fabric with tolerances for each type of fabric as follows: woven fabric: maximum allowable 2% of fabric size; Knitted fabric: maximum allowed 4% of fabric.

2.2. Product Quality Management

This is the main stage of the machining process, where defective products form. Therefore, if this stage does not establish a strict inspection process, it will increase production costs and recycling costs, leading to an increase in product costs.

Purpose: Early detection of errors in production caused by consciousness, human level, equipment and other technological factors to take timely remedial measures.

- Sewing workers: when receiving products from the previous stage, they must check 100% and After sewing, they must check 100% products of their own stages

- QC staff (Quality Control): check 100% products of the sewing line.

Inspection tools include: Inspection forms, operational documents, sampling plans, standard samples (for visual QC staff), tape measure (must be standard) which can be manufactured from glass wire , metal, descriptions of measurements, measurement locations for complex operations, quality assessment reports, perform the test in a well-lit place.

3. Methodology

Methodology of the research follows steps (table 1) :

Table 1. Article research process

Num.no	Process	Implementation
1	Research Theoretical Basis	Learn and select: + Published documents or Published researchs + Several articles in other scientific journals + Several best-documented on website are related the research content.
2	Research actual situation of management at the Company	Go through: + View company documents + Ask and review information from Quality department. + Observed the practice in company.
3	Design software system.	Base on the requirement of the factory, write the requirement and create a demo in excel software
4	Write the software	Vocational IT Develop
5	Test the software	Base on funtions have been required to implement testing software
6	Training and implement	Training to operate and implementing the software system into production

4. Write Business Requirement Document (BRD)

4.1. Raw Material Quality Management System

Method to receive input data:

Currently, the factory is using an RFID system (Radio Frequency Identification) to manage the fabric roll inventory, each fabric has been fitted with a chip that carries the information of that fabric (code, color, size, supplier, lot, etc.). Therefore, when designing Raw Material Quality Management System, the research used this chip through a chip reader to transmit data to Raw Material Quality Management System (Figure 1).

Figure 1. Input device of Raw Material Quality Management System.

Import data:

Through understanding the actual needs of users to enter what data and what reports this data will be used for, the research has omitted the data that can be obtained directly from the SAP production management system (System Application Programming) and retain the data to be entered. Then, arrange these data into 2 parts as follows.

- Fabric quality, including defect and defect points, including:
  • Defect: include common defects when inspect fabrics: yarn errors, color splashes, spots, print loss, tears, oil stains and other defects;
  • Defect points: including 4 points according to the 4-point system;
- Fabric parameters: including entering the length of the fabric roll, the width of the fabric roll (first, middle, and end of the fabric roll).

Export report:

Based on input data, available data in production management software SAP (System Application Programming) and requirements of the factory quality management department, the research has built the following reports:

- Fabric quality report, view from date to date: help managers know the fabric quality status of the factory on a day-to-day basis;
- Detailed quality inspection report: is a type of report requested from customers in the 4-point inspection system, giving detailed information of the tested fabric roll and the score of the fabric roll;
- Total quality inspection report: is a type of report requested from the customer in the 4-point inspection system, giving the aggregate information and the score of the lot fabric roll;
- Detailed supplier quality report: helps managers know the fabric quality situation of each supplier, each of lot fabric;
- Supplier quality report overview: helps managers compare fabric quality between suppliers, thereby comparing, evaluating and choosing the best supplier;
- Report on working efficiency from day to day: evaluate the work results of QC staff based on the quantity and quality of fabric rolls inspect during the day;
- Online QCM user report: helps managers know how many employees are currently inspected fabric, how many fabric inspection machines are in operation;
- Report of unfinished fabric roll check from date to date: in the process of inspect fabric, there are unfinished fabric roll, if there is a problem, it must be stopped. This report helps to display detailed information about these fabric roll.

Hardware device:

After considering the features of the software, the research has selected a hardware device that interacts between the user and the software, which is a touch screen. Thereby, the user's operation is faster, the user is more used to using it and avoids errors during use.

4.2. Product Quality Management System

Method to receive input data:

The planning department has allocated the production plan on the production management software (SAP). Therefore, the research has linked SAP and Product Quality Management System software so that the software will automatically receive input data.

Import data:

Through understanding the actual needs of data needed for reporting, the research has designed the data entry part for the Product Quality Management System including 2 parts:

- List of sewing process: taken in SAP software data system;
- The list of defect that occur frequently at the sewing line includes: broken thread, loose thread, not hugging elastic, missing thread, pleated pleats, button bugs, oil/rust, different color, sewing technique, skipping, stitching only mismatched, drooping eyelids, drooping eyelids, uneven, asymmetrical, dirty, defective materials, pending.

Export report:

Based on the input data, the data available in the production management software (SAP) and the requirements of the factory quality management department, the research has built the following reports:

- Report to user QCM online: display quantity and information of QC staff working at the sewing line;
- Pre-wash parameter inspection report by date, style: helps managers monitor and ensure pre-wash parameters meet customer standards;
- The first product inspection report is viewed by date, style: when a new product style is uploaded, through this report, we know the quality problems that need to be resolved;
- The quality inspection report of QA (Quality Assurance) is viewed by date, style: the report monitors the overall quality of the factory, each sewing line, each process and each type of defect.

Hardware device:

After considering the features of the software, the research has selected a hardware device that interacts between the user and the software, which is a touch screen. Thereby, the user's operation is faster, the user is more used to using it and avoids errors during use.

5. Write Software, Implementation and Results

As analyzed, the program is built on the C# language and is divided into two software modules: Raw Material Quality Management System and Product Quality Management System (described in the following two sections).

5.1. Raw Material Quality Management System

After receiving business requirement document, the IT department wrote the software. The data entry interface (Figure 2) and the reporting system (Figure 3) are generally described as follows:
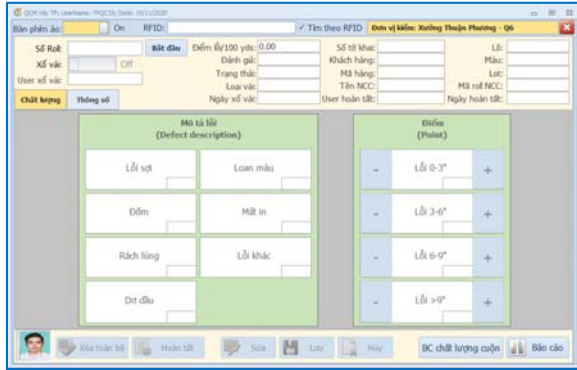

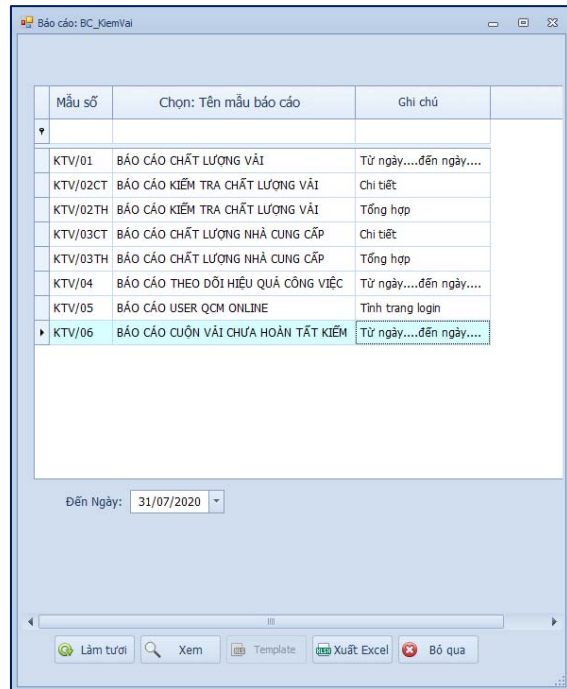Figure 2. Data input interface of Raw Material Quality Management System

Figure 3. Report interface of Raw Material Quality Management System

Software operation process:

Step 1: QC staff remove the chip on the cloth and scan it into the card reader.

Step 2: After the fabric roll information is displayed on the screen, the QC staff presses the "Start" button to start the fabric inspection process (Figure 4).
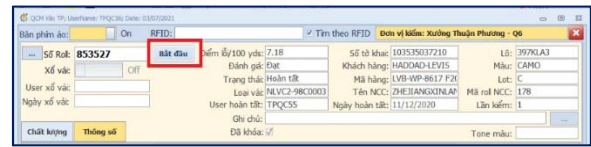

Figure 4: Step 2 in the operating procedure of Raw Material Quality Management System

Step 3: During fabric inspection, must strictly follow the 4-point fabric inspection regulations. If fabric roll has defect, import the defect and the number of defect points on touch screen.

Step 4: During the inspection of fabric roll at the top, middle and bottom, QC staff measure the width fabric and fill it in the "Parameters" Tab. At the end of the fabric inspect process, measure the length of the fabric roll displayed on the fabric inspect machine and fill in the length information in the "Parameters" Tab (Figure 5).

Figure 5: Step 4 in the operating procedure of Raw Material Quality Management System

Step 5: When the fabric inspection is finished, the staff presses the "Finish" button on the screen (Figure 6) and continues from step 1 to step 5 for other fabric rolls.

Figure 6: Step 5 in the operating procedure of Raw Material Quality Management System

After the software is written, tested and completed, Raw Material Quality Management System has been put into operation. The software has helped QC department to no longer take notes and calculate manually, but instead has been automated 100%. Thereby, a 20% reduction in the total daily working time of employees (Figure 7). Besides, fabric inspection reports are always updated continuously and accurately to help managers react promptly when fabric quality problems occur.

Figure 7. Fabric inspect time before and after software implementation

5.2. Product Quality Management System

Similar to Raw Material Quality Management System, after receiving business requirement document from research, the IT department had written Product Quality Management System software. The interface for data entry (Figure 8) and reporting (Figure 9) is as follows:
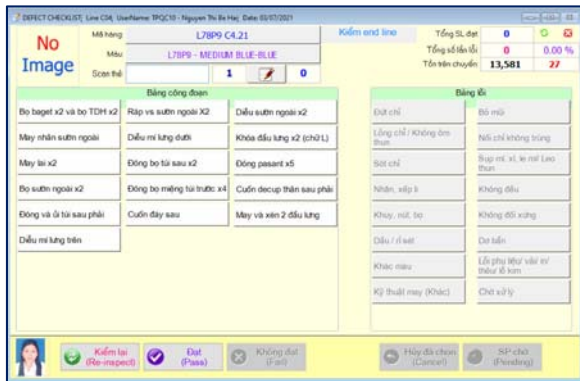

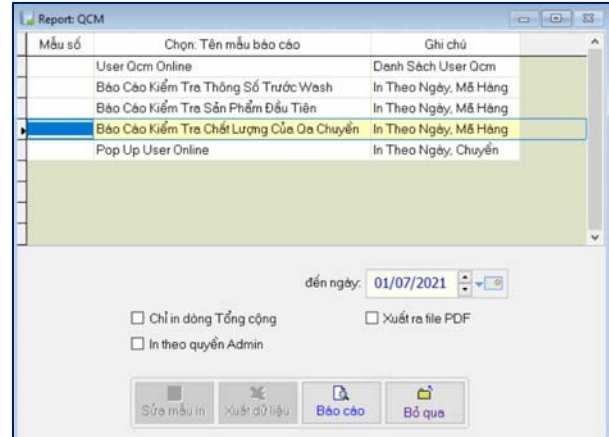Figure 8. Data input interface of Product Quality Management System

Figure 9. Report interface of Product Quality Management System

Software operation process:

Step 1: The QC staff of the sewing line selects the product style and color of the product being checked (Figure 10).

Figure 10. Step 1 in the operating procedure of Product Quality Management System

Step 2: During the inspection, if the product is defective, click on the process name and defect on the touch screen (Figure 11).

Step 3: When the QA department checks the product parameters according to AQL 2.5 standard, select the function "check parameters before wash" and fill in the parameter information (Figure 12).

Product Quality Management System software has been applied at the sewing lines of Thuan Phuong Group. After implementing the software for 6 months (from April 2020 to October 2020). The software has brought many great benefit, therefore the defect rate of Thuan Phuong Group has decreased from 2.5% to 1.8. % (Figure 13).
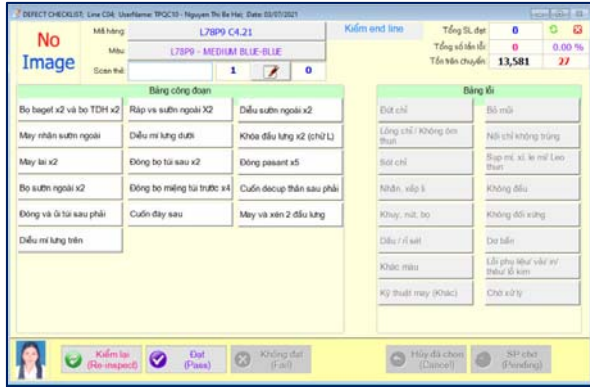

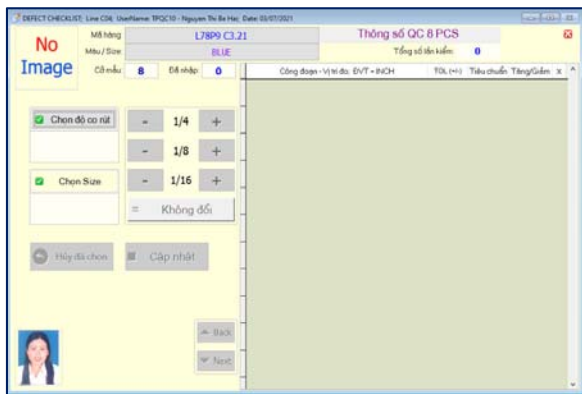Figure 11: Step 2 in the operating procedure of Product Quality Management System

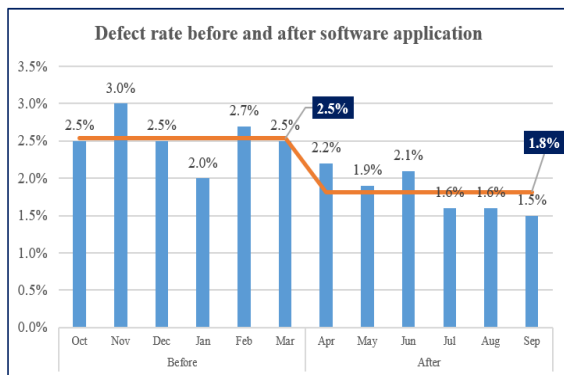Figure 12: Step 3 in the operating procedure of Product Quality Management System

Figure 13. Defect rate before and after software application

6. Conclusions and Recommendations

6.1. Conclusions

In the current situation, improving product quality is one of the strategies to survive and develop enterprises in a sustainable way, as well as an important key for promoting economic integration and engagement, expanding international diplomatic of enterprises.

Product quality is decisive to improve compete ability, asserting the position of products, goods and brands of enterprises in the market. Thuan Phuong Group has comprehended it and go ahead to apply industry 4.0 to aim to automate its quality management process. Through this, building Raw Material Quality Management System software for fabric control to manage the input materials quality and Product Quality Management System software to manage the out put of product quality. After implementing the software in daily work, the defect rate decreasing from 2.5% to 1.8%. In addition to saving 20% QC department working time.

6.2. Recommendations

Thuan Phuong Group: Raw Material Quality Management System and Product Quality Management System have been implemented and brought many positive benefits to businesses. Therefore, company should consider investing in this system for some other process in the factory such as the process of checking materials, cutting fabric ... Vietnamese Company: Technology is advancing day by day, the application of automation based on 4.0 technology to production management in general and quality management in particular is a Turning Point that brings great success to Vietnamese enterprises. Therefore, Vietnamese enterprises should focus on investing in this field.

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HỆ THỐNG QUẢN LÝ CHẤT LƯỢNG TRONG NGÀNH MAY MẶC

- TRƯỜNG HỢP THUẬN PHƯƠNG GROUP

Pham Cao Van[1], Bui Dinh Tan[2] and Vo Trong Cang[3]

[1] *Binh Duong University, Binh Duong, Viet Nam, pcvan@bdu.edu.vn*

[2] *QA Manager, Thuan Phuong Group, tan.bd@tpgroup.com*

[3] *Binh Duong University, Binh Duong, Viet Nam, vtcang@bdu.edu.vn*

Tóm tắt. Chất lượng sản phẩm là một yếu tố đặc biệt quan trọng đối với doanh nghiệp sản xuất hàng may mặc. Các công ty luôn luôn mong muốn tạo ra những sản phẩm có chất lượng cao nhất, tỷ lệ lỗi và chi phí làm lại thấp nhất để có thể cạnh tranh tốt hơn cũng như tăng sự hài lòng khách hàng. Tuy nhiên, việc quản lý chất lượng lại là bài toán khó mà không phải công ty nào cũng có thể giải quyết tốt. Ngày nay, công nghệ 4.0 đã từng bước phát triển và áp dụng vào rất nhiều lĩnh vực trong đời sống, sản xuất, dịch vụ. Hệ thống quản lý chất lượng QMS (Quality Management System) dựa trên nền tảng công nghệ 4.0 là một giải pháp hiệu quả đối với việc quản lý chất lượng trong doanh nghiệp may mặc. QMS giúp các nhà quản lý có cái nhìn chính xác, tức thời về tình hình chất lượng, dễ dàng nhìn ra các vấn đề và đưa ra cách xử lý chính xác. Bài viết sẽ mô tả lại quá trình thiết kế, triển khai và thực hiện hệ thống quản lý chất lượng (QMS) tại doanh nghiệp Thuận Phương Group. Sau khi đưa phần mềm vào triển khai thực tế, tỷ lệ sản phẩm lỗi đã giảm từ 2.5% xuống 1.8%. Bên cạnh đó, tiết kiệm 20% thời gian làm việc của bộ phận QC kiểm vải. Qua đây, hy vọng sẽ giúp các doanh nghiệp có cái nhìn tổng quan về một hệ thống phần mềm quản lý chất lượng ngành may mặc.

Từ khóa: Hệ thống quản lý chất lượng (QMS); Công nghiệp 4.0; Quần áo.