Product quality management of industrial connectors

Sous la direction de :
Wenqiang SHAO, Responsable Qualité
Jean-Pierre CALISTE, Suiveur UTC

Mémoire d'Intelligence Méthodologique
ST02-P2014

Stäubli Hangzhou Mechatrnic

Xinyi ZHAO

STÄUBLI

Summary

List of figures

Glossary

STHZ	Stäubli Hangzhou
STF	Stäubli Faverges
PQM	Product Quality Management
FCS	Fluid Connect System
SRM	Supplier Relationship Management
CRM	Customer Relationship Management
NCR	Non Conform Report
SR	Service Request
PQE	Product Quality Engineer
SQE	Supplier Quality Engineer
MCS	Multi-coupling systems
QMC	Quick mould clamping

Abstract

This report aims to describe the adopted methodology during the period of my internship in quality service at Stäubli (Hangzhou) Mechatrnic Co., Ltd., Hangzhou, China.

This internship has allowed me performing the following tasks:

- Quality control of products as industrial connector
  - Trouble-shooting on the production line
  - Process control and final inspection for product
  - Management of the Chinese supplier
- Management of customer complaints.
  - Dealing with customer complaints
  - Adherence to and implementation of corrective and preventive actions

Résumé

Ce rapport a pour mission de décrire la méthodologie adoptée pendant la période du stage effectué au service qualité chez Stäubli (Hangzhou) Mechatrnic Co., Ltd., à Hangzhou, Chine.

Ce stage a permis d'effectuer les tâches suivantes :

- Contrôle de qualité des produits du connecteur industriel
  - Trouble-shooting sur la ligne de production
  - Contrôle de processus et contrôle final des produits
  - Management du fournisseur chinois
- Management des plaintes des clients.
  - Traiter les plaintes des clients
  - Poursuivre des actions correctives et préventives

摘要

本报告旨在描述我在史陶比尔杭州公司质量部门实习期间所采用的方法。实习中完成的任务包括:

- 对于工业接头产品质量的控制
  - 在产线上随时解决出现的问题
  - 产品终检以及过程的控制
  - 对中国供应商的质量控制
- 对于客户投诉的管理
  - 处理客户投诉
  - 跟进后期的纠正预防措施

Acknowledgements

I would like to show my heartfelt gratefulness to all the people of Stäubli group, University of Technology of Compiegne(UTC), and who have helped me to complete this 6-months' internship.

Firstly, I want to acknowledge Mr.SHAO Wenqiang, the chef of Quality Department, and Madame GUO Xiaofang, my tutor of the internship, for their patient to all my interrogations, for their valuable advice and guidance during all the process of my internship.

Secondly, I want to show my thanks to Mr.Jean-pierre Caliste, my strategy tutor in UTC, for the help they provided and gave me during the 6 months, and for his kind visit in Stäubli Hangzhou.

I also want to acknowledge all the members of Stäubli Quality Department, who had warmly welcomed me in their team and helped me a lot for my work and this final report.

Preamble

Because of my curiosity about France and my interests in science, I studied Materials Engineering at the Sino-European School of Technology of Shanghai University during my Bachelor's studies. During the internship phase of my engineering studies, I became less interested in becoming a materials engineer, or in acquiring expertise related to that field. Instead, I chose to focus more upon the quality of Chinese products. That is why I instead to pursue a Master's degree in Quality Management.

For my graduation internship, my goals were three-fold: 1) to acquire practical, real-world experience within the industry; 2) to prepare for my future employability; and 3) to apply the theoretical knowledge I acquired during the course of my quality master's education and the mechanical and materials knowledge I gained at UTT. In this, I have sought to exploit my own extensive research in a variety of industries, including those related to plastics, automotive, and even aviation.

My skills and expertise corresponded to the needs and expectations of quality service at Stäubli, which led to my decision to apply to offer my services.

The combination and diversity of proposed missions, the harmonious atmosphere during my interview and also a close alignment with my own expectations and goals were powerful motivating factors for me.

This experience has given me the opportunity to quickly discover and appreciate the intricacies of, and differences between, French and Chinese business cultures, to put into practice my own theoretical knowledge, and to learn how to work alongside people from different cultures. Most importantly, I have been afforded the opportunity to work within and assimilate the dynamics of a multi-cultural environment. I was also able to achieve proficiency in written, reading and oral English and French.

For this experiment, I was assigned several tasks. In this paper, I will concentrate on five main areas that I consider most pertinent and which allow me to explore a range of topics.

1 Introduction

1.1 General presentation of Stäubli

Stäubli is an innovative mechatronic solutions provider with three dedicated divisions: Textile, Connectors and Robotics. With a workforce of over 4000, the company generates a yearly turnover surpassing 1 billion Swiss francs. Stäubli is active on all 5 continents:

- overseas 12 industrial production sites, including its group companies Multi-Contact, Schönherr and Deimo
- maintains a presence in 25 countries through its sales and customer service subsidiaries
- has agents in 50 countries

■ History

Founded in 1892 in Horgen, Switzerland, Stäubli was originally known as a workshop specialized in producing textile machines.

In 1909, the company opened a new manufacturing site in Faverges, Haute-Savoie, France, in order to be closer to their clients.

In 1956, the company diversified its line of products into the field of hydraulics and pneumatics and commenced the production of rapid action couplings. The Connectors division was born.

In 1982 the company diversified again, this time into automation and robotics.

In 1997, Establishment of an assembly plant in Hangzhou, China.

Today Stäubli is an international group headquartered in Pfäffikon, Switzerland, delivering innovative solutions to all industrial sectors around the world.

■ Mission

Innovation is Stäubli's driving force. In its constant search for excellence, the Group expands on expertise and experience in mechatronics by designing, producing, selling and providing support for products and systems in markets where high productivity levels are essential.

■ Customer focus

The company asserts its position as a global innovator by:

- offering customers the best products and services in terms of both quality and performance.
- actively supporting any initiative aiming at further improving products and services.
- maintaining synergy between the needs of customers, suppliers, shareholders, staff and the environment.

Figure 1: The global presence of Stäubli Group [1]

1.2 Group divisions

Since its foundation in 1892, Stäubli has expanded into three different lines of products and services:

- **Stäubli Textile** is the division of the company's original field of products and has since expanded into multiple countries. It manufactures Dobbies and similar products related to textile weaving, including shedding systems, Jacquard machines, carpet weaving machines and weaving preparation systems.

- **Stäubli Connectors** manufactures quick, single and multi-connector systems used for all types of fluids, gases and electrical power, as well as robot tool changers and quick mold change systems. In this particular division, there are three different activities: Fluid Connect System (FCS), Electronic Connect System (ECS) and products of Prévost.

- **Stäubli Robotics** is Stäubli's automation and robotics related division founded in 1982. It produces SCARA (Selective Compliance Assembly Robot Arm) and 6-axis robots for industrial automation, including controllers and software.

1.3 Stäubli in Hangzhou

In 1997, Stäubli opened its first production site of Asia in Hangzhou, China. At the beginning, STHZ (short for Stäubli Hangzhou) was just an assembly plant of the company. They imported the parts and the equipment from Europe and did the assemblage in STHZ. There were not many local customers at that time so that the products were mainly exported.

Today, STHZ has been developing in China over 16 years. With the rapid growth of China's industry and its urgent need for high-tech equipment and products, all three Stäubli divisions are now represented in China. The importance and dynamic development of the Chinese market motivate the Group to expand its business all around China.

Workshops / Assembly lines in STHZ

There are three workshops for different products in STHZ. Workshop 1 is for the production of connectors and textile machines, and is the largest workshop.

The assembly lines in Workshop 1 have a unique feature which sets them apart from a traditional continuous production model, in which workers are in charge of only a part of the assembly of a whole machine. Instead, “A worker is in charge of the assembly of an entire machine”.

This feature has both its advantages and disadvantages. The advantage is that the product has better accountability, as the worker responsible for each machine is easily traceable. Furthermore, both production and quality management are more streamlined.

The disadvantage is that productivity is relatively low. The training period for workers is long, because they need to be expertly familiar with all aspects of assembly for a whole machine.

Figure 2: Workshop 1 of STHZ [2]

2 Quality approach

2.1 Quality approach of STHZ and the Quality Department of STHZ

In different circumstances, the definition of “Quality” can vary. The word “Quality” does not only denote the quality of a manufactured product. It can also refer to the quality of the process (men, material, machine, method, measurement, and environment), as well the management of said process. The quality of products or services may well also be measured in terms of the degree to which a customer's requirements are fulfilled. 'Quality', therefore, is in some respects a subjective concept, but one which can be judged or defined through comparison with existing standards.

As a century-old enterprise, Stäubli considers its own quality culture as an expression of its corporate ethos. Stäubli's quality culture can best be summarized thusly [1]:

- ✓ To ensure our worldwide leadership in different activities by applying the policy of sustainable development.
- ✓ To achieve the customers’ satisfaction with the most optimized costs.
- ✓ To improve our adaptive capacity in order to respond to the market’s needs.
- ✓ To win the customer through good product quality, leading technologies and good service.
- ✓ To maintain the balance between customers, suppliers, enterprises and stake holders.
- ✓ The consistent improvement of quality is the primary object of all personnel in Stäubli.

These quality objectives are approved by the top managers of the group.

Quality is usually determined by such characteristics as design, dimensions, material, chemical composition, and mechanical function, among other properties.

Generally, quality management encompasses the oversight of all activity related to product delivery: from suppliers, through the production line and, finally to the customers. Incoming materials/components from the suppliers are examined to make sure that they meet the demanded functional specifications. The assembly specification should be respected strictly during the assembly process by the workers. And this process is controlled by the process quality technicians and engineers. The final products and services are also inspected at the end of the production line before being delivered to the customer.

To ensure effective quality management, the quality department of STHZ has been divided into 4 teams (Figure 6), which are as follows:

- **Incoming quality team:** tasked with controlling the quality of parts and other activities from **local suppliers**;
- **Product quality team:** tasked with controlling the quality of production and products before sales and managing quality complaints;
- **Project quality team:** tasked with controlling projects' quality-related activities;
- **System assurance team:** tasked with controlling the perfection of the quality management system, especially with respect to the environment, security and standards of hygiene.

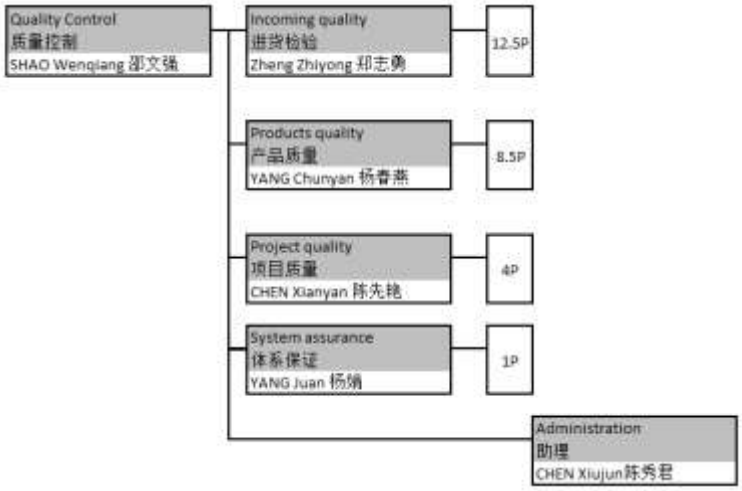

Figure 3: Organization of the quality department [3]

2.2 Quality management system of STHZ

STHZ passed its first certification ISO 9001 in 2012. And it is renewed because of the relocation of plant. The perimeter of this certification includes 2 parts:

Part 1: Manufacture of shedding systems for the textile and industrial connectors; this part concerns the design, production, sales, logistic, after-sales of all the localized products.

Part 2: Provider of quick connector systems and robots for all industries; this part only concerns the sales, logistic and after-sales activities of the imported products (Annexe 2)

This system is actually in perfection. We are attending to include the processes of treatments of complaint of customer. Referring to ISO 9001, STHZ has its own system for the management of documentation.

2.2.1 Documentary system

The management of documentation in Stäubli is highly digitalized. Virtually all documentation concerning daily activities can be found on either our intranet or in our ERP system.

This is a documentary system which consists of a set of procedures and instructions, which are well-structured according to the mapping process.

Figure 4: Pyramid of documentary system

2.2.1.1 Mystäubli system

The Mystäubli system is an internal multi-functional system of Stäubli group. It integrates the intranet, the mail box, the technical documents management system, the supplier relationship management system, etc. Information and documentations among people, sites, even countries are shared on this system. With the help of Mystäubli, we are able to find out the latest press of Stäubli group; presentation of all our products. We can also find the 2D drawing of parts, the instruction of our products which depends on your limits of authority. Mystäubli is

not only a management system, but also a facility for all personnel in group to work efficiently and to communicate easily.

Figure 5: Homepage of Mystäubli system

2.2.1.2 AS/400 system

The AS/400 was renamed as the "IBM iSeries" in early year, but it is normally known as AS/400 which is a midrange server built for businesses and departments in the large enterprises. It is popular in small and middle size corporations.

In Stäubli, the AS/400 system is mainly used as the ERP (Enterprise resource planning) business management software, which is a suite of several integrated applications that a company can use to collect, store, manage and interpret data from many business activities, including:

- Product planning, cost and development
- Manufacturing
- Marketing and sales
- Inventory management
- Shipping and payment

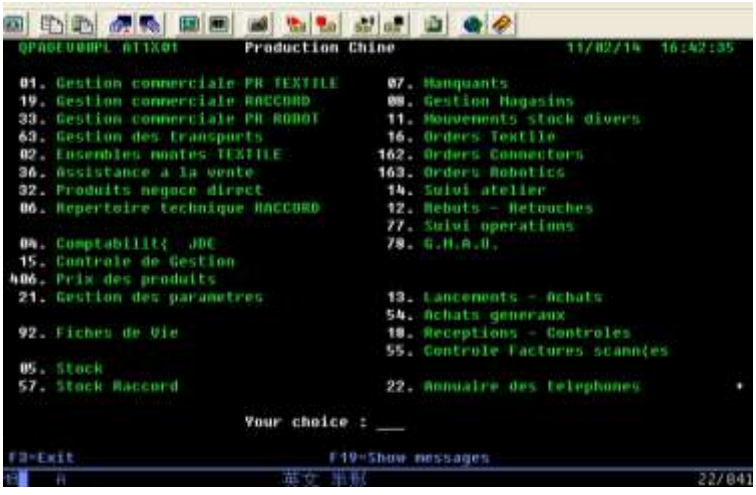

Figure 6: Main interface of AS/400 system

3 Mission of the internship

3.1 Introduction

Definition - What does *Product Quality Management (PQM)* mean?

Product quality management is a comprehensive set of tools that enables organizations to control and manage the activities related to product quality across enterprises. The activities include product and manufacturing defects, field failures, customer complaints, product improvements and corrective and preventive actions requests [3].

My internship in the quality department of STHZ has been divided into two areas. The first area, which is also the primary focus of this internship, is: **Quality controls of the production process of the Fluid Connect System (FCS)**. The second part is: **Quality management of customers' complaints**.This internship has allowed me to perform the following tasks:

- Part 1: Quality control of FCS products
  - Trouble-shooting on the production line
  - Process control and final inspection of product
  - Management of the local supplier of platen for QMC 122
- Part 2: Management of customer complaints
  - Dealing with customer complaints
  - Adherence to and implementation of corrective and preventive actions

For the first part of my internship, my responsibility is to organize and supervise the progression of product control during and at the end of assembly. Assisting me in this task is a technician who works with me to control the FCS products. When quality problems occur in components during production, either I or my technician are directly involved in contacting the relevant supplier.

It may come as somewhat of a surprise, that a product quality engineer would be in charge of a supplier, at a time when an incoming team is joining the quality department in HZ. The reasons will be explicated in the following text of *Chapiter 4.4 Management of the local supplier of platen for QMC 122.*

The second part of my internship has to do with handling customers' complaints. As product quality engineers, we are not in direct contact with our final customers, but rather with sellers and SAV engineers. We mainly concentrate on carrying out cause analysis and tracking improvement through surveillance of corrective actions. In this role, I have acquired a heightened awareness of the value of customer service, critically important to the success of a company.

3.2 Definition of the subject

In order to frame the problem properly, as well as to obtain essential information as in order to pinpoint possible causes and possible solutions, a 5W1H (QQOQCP) is achieved (Figure 12).

Input	• Target quality characteristics defined by customer and mother company • Design of parts	
Who?	Direct	Indirect
	Emitters: Quality manager Receivers: Student-engineer	Emitters: STF, Mother company of STHZ Receivers: Quality Department
What?	Be familiar with the existed process to ensure product quality.	
Where?	In Quality Department of Stäubli Hangzhou	
When?	From March 2014 to July 2014	
How?	Be familiar with the existed process to ensure product quality by - Be familiar with the internal quality document and products - Learn from my tutor and colleagues Measurement Indicators: - Error rate of my work - Appraisal from my tutor - Number of customer complaints caused by quality problem - Number of non-conformity product or Concession release product - ...	
Why?	To ensure product compliance and customer satisfaction To clarify the manufacturing process and to define the critical control points To explain to the operators how and what to check To have reliable methods of product control	
Output	**Understanding and possible improvement of process to ensure FCS product quality**	

Figure 7: 5W1H (QQOQCP) [2]

3.3 Development Strategy

For an overview, to explain the overall objectives of the internship (job) and to do better practices, a dynamic strategic planning (PDS) (cf. Figure 13, next page) is designed to target the continuous improvement process.

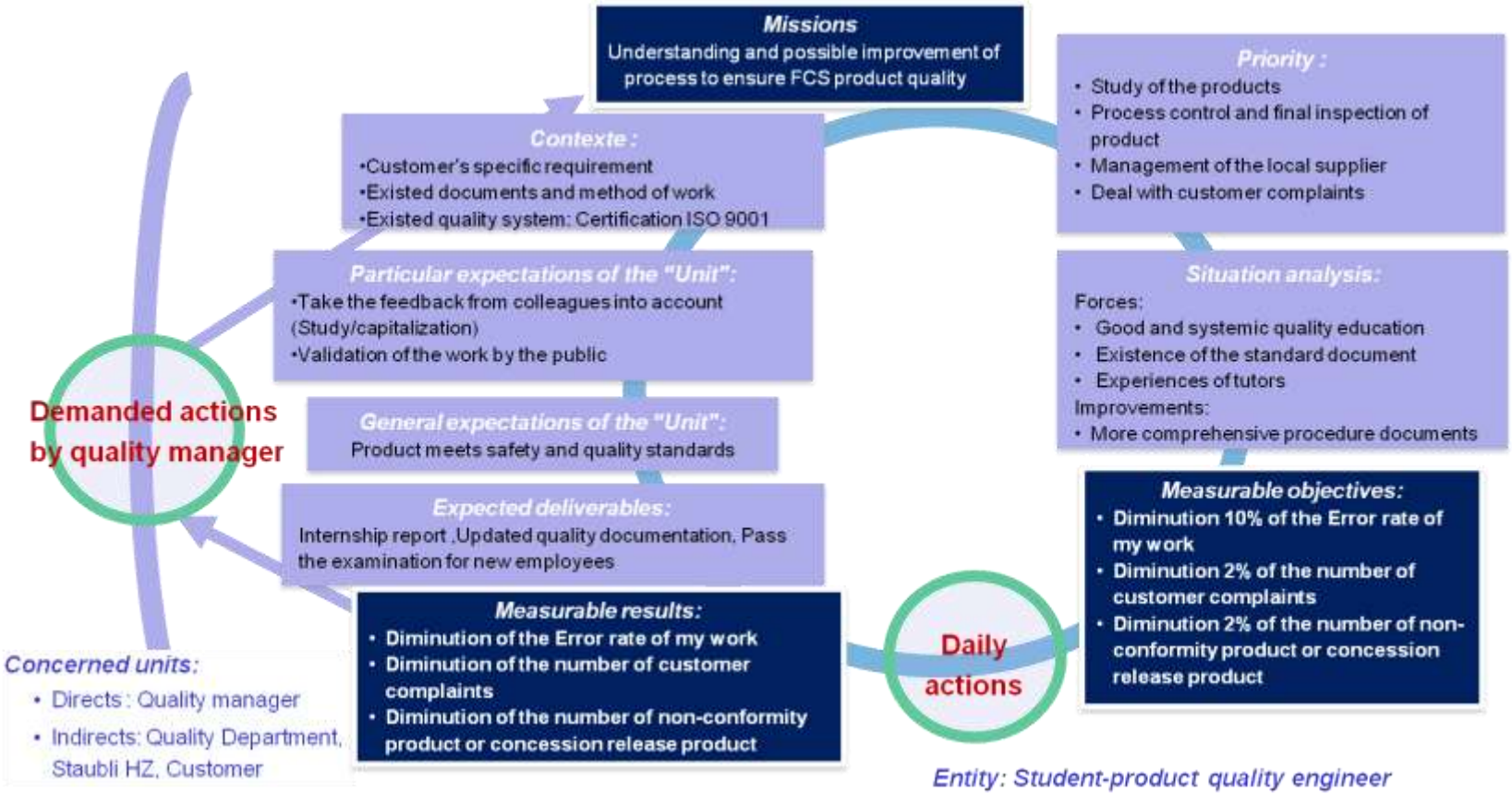

Figure 8: Dynamic strategic planning (PDS) [2]

4 Problems

In the following sections of this report, the scope of my internship goals, along with further technological and cultural information regarding quality engineering will be presented in detail.

4.1 Product quality control process

4.1.1 Origin of parts

A Stäubli FCS product is composed of at least dozens of parts, a few of which are produced at STHZ. In practice, this means that STHZ has an enormous need for incoming parts, from different suppliers.

All sections of STHZ can be divided into two families:

- Domestic parts (made by Chinese local suppliers)
- Imported parts (made by other sites of Stäubli)
    - For FCS products, the QMC122 and MCS originate in France: Stäubli Faverges
    - The MPS，QMC 106，QMC 122 Loading Table originate in Germany: Stäubli TEC SYSTEMS GMBH

For domestic parts, STHZ maintains close contact with all local suppliers for all the activities related to production. For imported parts, we contact the relevant Stäubli site.

With the burgeoning growth of Chinese industry, more and more parts are being produced by ST China. For FCS products, there are presently four projects underway. There are two types of localization; one solely to localize the assembly line, and the other to localize components suppliers.

Two important advantages to the localization of products are:

- Low cost
- Short delivery time

It is well-known that the cost of a part made by a local supplier is much lower than it would be to import the same part. In addition, the delivery time is much shorter.

However, a major obstacle to the localization of production lies in selecting a qualified supplier. The quality of suppliers varies significantly in China. But, thanks to the efforts of STHZ, stable relationships have been cultivated with numerous Chinese suppliers who can provide qualified parts. By having started out slowly, with non-critical parts requiring less precision, STHZ has carefully and steadily built upon its initial successes. Nowadays, more and more local parts appear in our machines.

In the future, both our customers and Stäubli itself will benefit from having more localized products. It will be a win-win situation for both parties.

4.1.2 Product presentation

To have a quality product, the first challenge is to truly know one's product. Stäubli's products are geared towards an upscale market. So, I devoted a lot of time and energy to studying, and thoroughly familiarizing myself with, the full range of FCS products.

Stäubli has more than 50 years' experience in manufacturing fluid and energy connectors. Its designs focus especially on ensuring rapid replacement and upgrading of tools, and on developing solutions to automate these processes.

As a product quality engineer in the Connector Division, I am in charge of five products:

- Quick mould clamping systems
  - QMC122
  - QMC106
  - Loading table for QMC 122
- Multi-coupling systems (MCS)
- MPS

Quick mould clamping systems

Quick mould clamping systems are designed to implement the rapid alteration and swapping out of moulds, particularly in the Plastics Industry. Tool change times are a significant cost factor in the Plastics industry. Stäubli's quick mould clamping systems enable our customers to improve productivity, increase flexibility and minimize response times.

QMC 122

QMC 106

Loading table

Product name	QMC 122	QMC 106	Loading table
Product description	Magnetic rapid clamping systems	Mechanical rapid clamping systems	Mould changing tables and mould changing trolleys
Functions	- Quick mould change with magnetic solution - Optimization of organization methods (SMED), - Satisfaction of safety requirements relating to injection presses.	- Quick mould change with mechanical solution - Security of operators - Simple to operate - Clamping force of up to 200 tones and tools weighing up to 2000 kg	The co-ordination of your machining facilities with the Stäubli mould changing table and trolley can realize: - Reduction of unproductive preparation times to a minimum - The "single minute exchange of die"(SMED) process - Customized dimensions, type and function of the trolley
Application field	Plastics industry		
Norm/standard	Safety standard: EN201: 2009, directive 2006/95/CE and 2004/108/CE.	EUROMAP/SPI/JIS drilling pattern	Euromap71 interface

Figure 9: Presentation of QMC products

Multi-coupling systems (MCS)

Functions: Perform simultaneous connections of all fluid and electrical lines. To meet customers' specific requirements, different modules are available: Modular couplings and electrical connectors, guiding and floatability components, connection and locking systems, etc.

Figure 10: MCS product

Application field: nearly all industrial sectors: Automotive, Engineering, Aeronautics, Plastics, Railways, Off-shore, Nuclear, Iron and Steel

Robot tool changer systems (MPS)

Functions: The MPS is solely used to connect / disconnection (change) tools (such as welding tongs, grapples, etc.) predominately on industrial robots and handling units in automated production lines, including the coupling and release of energy and medium lines.

Application field: predominately automotive industrial

Figure 11: MPS product

Synthesis:

All FCS products share one common characteristic: they are highly customizable. Even in the case of a product of the same type, dimensions, the type of the modular can vary according to the demands of a customer. This characteristic determines a model of discontinuity production; the so-called *Made-to-Order*.

4.1.3 Management of the local supplier of platen for QMC 122

As mentioned earlier, it is perhaps surprising to find that a product quality engineer is in charge of a supplier, especially when there exists an in-house team in the quality department in HZ.

There are two reasons for this.

a) Firstly, the management of the platen for QMC 122 has its own peculiarities. Because the product QMC 122 has to be compatible with the customer's injection machine, the design of the platen for each type of machine is different. It is a highly customized product. All fabricating methods, measuring methods, and the control plan of each platen are defined by Stäubli. As well, the particular measuring instruments are provided by Stäubli. The authority of process control is therefore passed on to the supplier due to an inability to be available at all times to the supplier.

Other suppliers are managed in a relatively systematic way. The quality of components is mainly controlled through incoming inspections. According to the results of incoming inspections, it is possible to decide whether to accept or refuse parts.

However, it is potentially too late to discover defects in the platen until incoming inspections are completed, due to the risk of an entire platen being rejected, a costly situation for both Stäubli and its suppliers.

Considering the risks undertaken, it is crucially important to control the process for a product. The PQE understands better the application of the products than does the SQE, which allows a quick response to reported problems. For example, when a defect is detected by a supplier, Stäubli can directly determine if it is a critical control point or not. But as I mentioned above, the control plan is made by Stäubli. And the control reports have to be disseminated to Stäubli Hangzhou without delay.

b) Secondly, the restitution of 3 teams in Quality Department started in 2012. Prior to that, there were no distinctions between the incoming team, product team and project team. At that time, if you were in charge of one product, you had to manage all the activities related to the product. That meant management of the project when it was imported, management of the suppliers, and the management of the process. As it invariably involved a high-demand and complex product, the management wasn't distributed to the incoming team in the first place. So it was kept under the management by PQE.

During the course of my internship, I visited a supplier once. The objective of the visit was to familiarize myself with the supplier's working environment and equipment. As well, to communicate any changes to the control plan, and possible regular audits in the future.

4.1.4 Metrology

As a product quality engineer, a part of my work is to organize the control of products, for which I must determine appropriate measuring instruments and equipment to be used, as well as the necessary operating mode.

How can it be determined whether or not a product is good? It can be evaluated by measuring compliance with the customer's specifications. A product is possesses several quality characteristics. Stäubli's products must meet all of these characteristics. More precisely, the measured dimensions of our products have to satisfy levels of tolerance.

Commonly-used types of equipment for FCS products are:

- **Micrometer** to measure thickness
- **Roughnessmeter** to measure roughness
- **Caliper** to measure dimensions
- **Threaded plug gauge** to measure the thread
- **Depth gauge** to measure depth

Stäubli also makes use of its own additional proprietary specialized tools and operating modes to further measure particular dimensions.

Other equipment and instruments in the quality department of STHZ:

- **Geometry and assistant:** Coordinate Measuring Machining (CMM), Projector, Faro arm, High scope, Caliper, Micrometer, Marble, Roughness tester and some special tools
- **Metallurgy and treatment:** Microscope and preparing equipment, HV hardness tester, HB hardness tester, HR hardness tester, etc.
- **Electronic:** High voltage and insulation tester, special test instruments for products etc.
- **Environmental:** Salty spray machine, high-low temperature cycle test
- **Painting and coating test:** Thickness, adhesion test

Figure 12: Micrometer

4.1.5 Method «PDCA »

Figure 13: PDCA for product quality control process [2]

Due to the particular role of Hangzhou as Stäubli Faverges company's subsidiaries, the control methods of localized FCS products are partly borrowed from our sister company.

4.1.5.1 Phase “Plan”

STHZ is rarely involved in the early-planning phase of localized products. For example, the company generally uses the Failure Model Effectiveness Analysis (FEMA) tool to define the potential risk of products, and to determine critical control points. Here, the "control plan" of our sister company is in principle borrowed, and modified so as to adhere to China's national conditions.

For some localized parts, Stäubli is authorized to define its own control plan. It is therefore vital to have the sensibility to identify key characteristics.

Identification of the key characteristics

Each piece has specific characteristics related to safety, assembly with other parts, or that are related to operation.

It is sound practice to list all the requirements related to process or product by grouping them in a diagram Ishikawa (Figure 14).

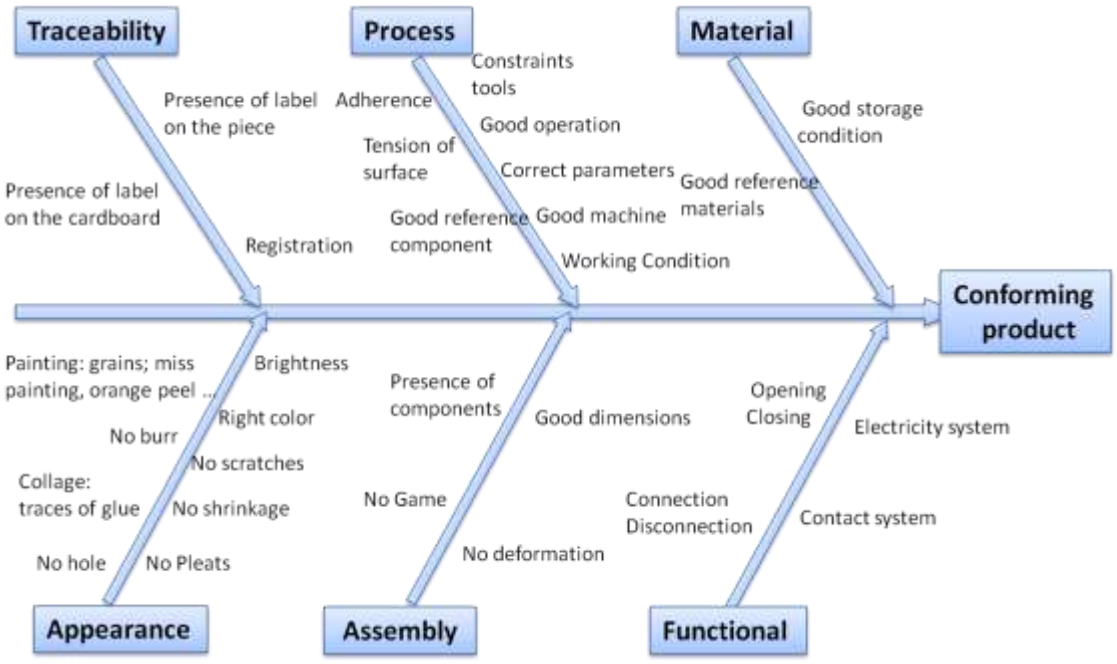

Figure 14: Grouping of requirements by ISHIKAWA diagram [2]

The advantage of this method is that the key characteristics can be listed quickly.With the identification of the key quality characteristics, the control methods can be planned and defined more targeted.

Our control methods also vary according to the product. For example, for an MPS product, final inspection is more of a priority than process control. Otherwise, for the platen of QMC 122, it is

more important to control the process. If a problem is detected late, there exists the risk the entire platen will be rejected, which is expensive for both the company and the supplier.

Establishment of the final inspection sheet

For the new products, the final inspection sheet is established by PQE. The following document is established by me for our new FCS product: BQR120.

The inspection sheet is generally constituted of 5 parts.

- Part 1: General information: order number, customer, part number
- Part 2: Items of the assembly inspection
- Part 3: Items of the functional inspection
- Part 4: Other remarks
- Part 5: Final analysis conclusion (Ok/NOK), the signature of inspector and approved engineer.

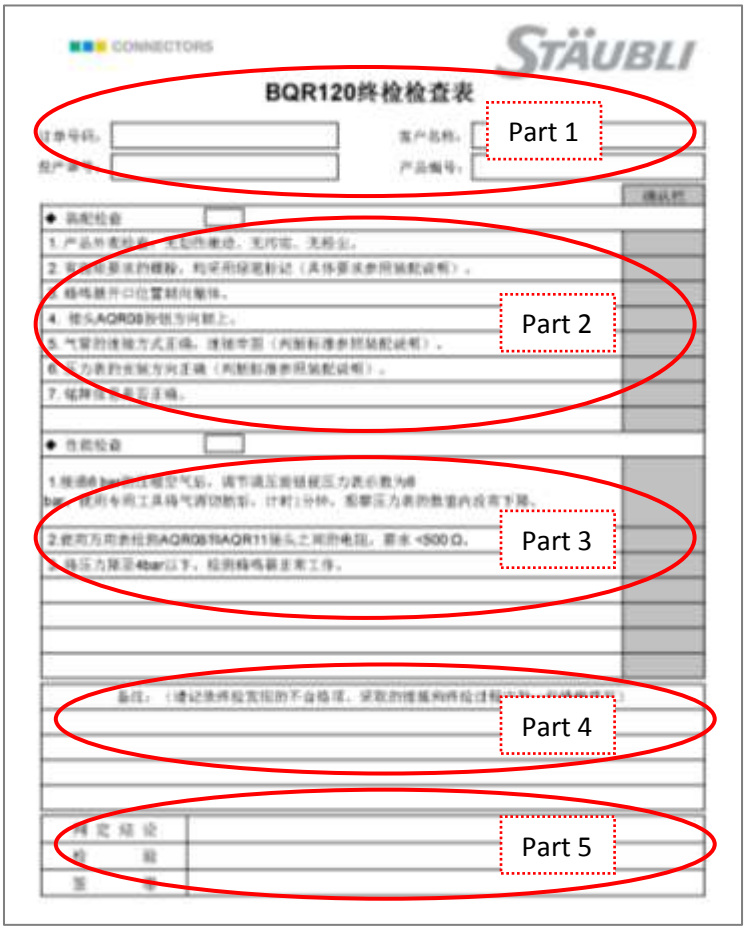

Figure 15: Structure of a final inspection sheet

4.1.5.2 Phase “Do”

In fact, a procedure of “product quality control” is integrated in our documentation system, as determined by ISO 9001. It can best be summarized by the following flowchart (Figure 16).

The workers check their work themselves during assembly. A "Checklist" is required.

For the process control, my mission was specifically to solve quality problems arising on the assembly lines. Once a problem occurs on an assembly line, I need to address it as soon as possible, and then analyze it according to a series of procedures, ultimately pinpointing the source of the problem and giving a result.

In order to assure the quality of every machine sorted from assembly, a final inspection is undertaken following the last performed operation on the control line immediately prior to delivery of the product to the customer.

It is performed on the basis of the verification of the characteristics of the finished product (visual, functional, and dimensional) according to the **inspection sheet**.

According to the control plan of products, Final Control can be achieved 100 % (ex. case of QMC 122) to assure maximum safety.

Non-conforming parts are stored in a red pot awaiting a decision by the quality team. After a check of all the criteria on the checklist, a “Cross checklist” is generated.

For non-conforming parts, a Non-Conformity Report (NCR) is generated in AS400, which serves as an assembly line complaint.

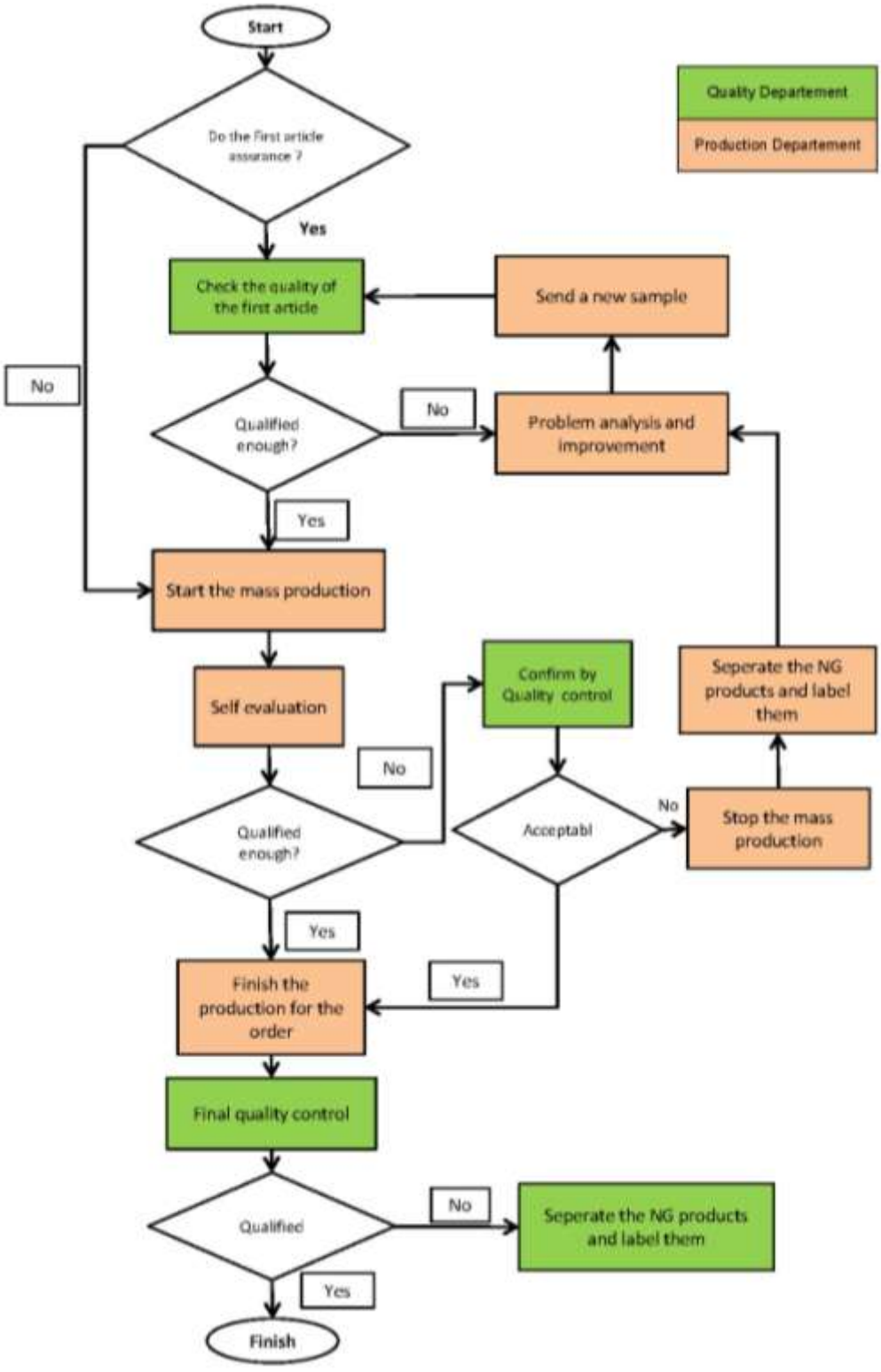

Figure 16: Flowchart of the product quality control process [3]

4.1.5.3 Phase "Check"

Quality Indicators:

- Number of customer complaints and the defect type
- Final inspection qualified rate. It equals the conformity product quantity / production quantity comes from the assembly line.

Every month, the NCR (Non Conform Report) data is exported from AS400. This data allows the determination of the final inspection qualified rate.

Otherwise, the number of customer complaints and their defect type are concluded in a form entitled "Data analysis FCS".

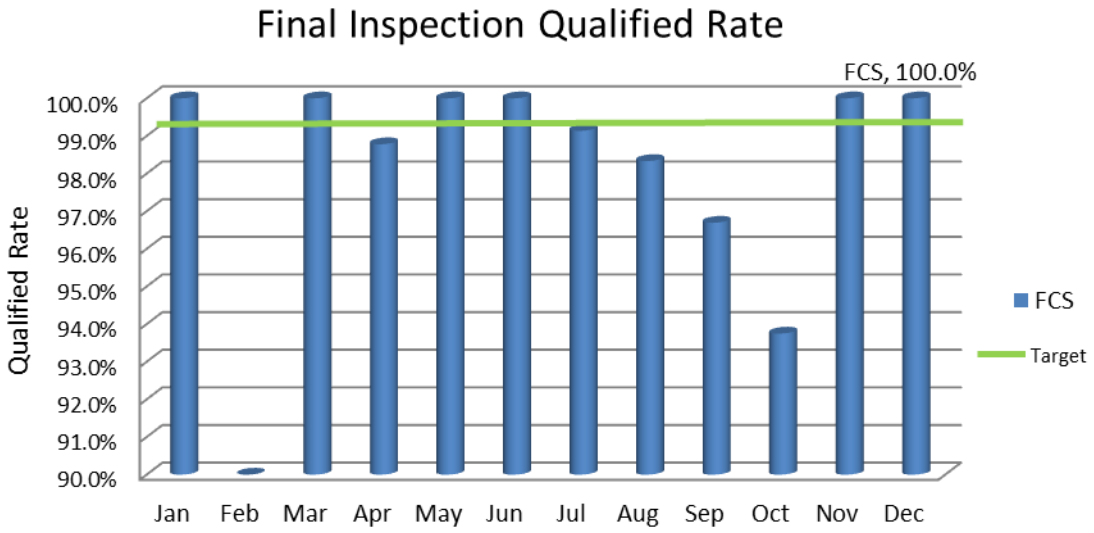

Figure 17: Final inspection qualified rate in 2013[4]

From this histogram, we can see the difference between the target rate and the actual rate of every month in 2013. There are several months that we didn't reach our goals. In order to augment the final inspection qualified rate in 2014, close coordination with the Production Department is necessary.

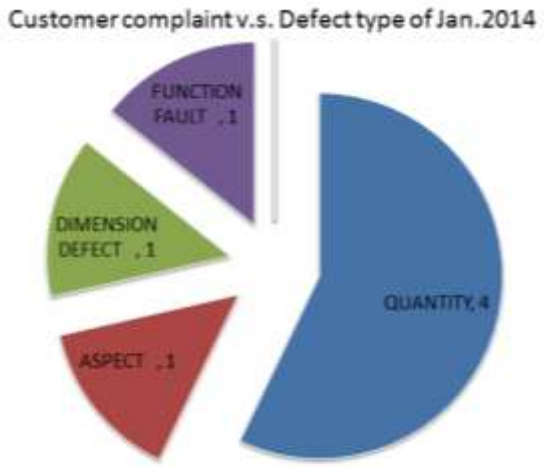

Figure 18: Customer complaint vs. defect type in January 2014

From this chart, we can see the quantity of different defects types. The predominant cause of customer complaint is the quantity problem.

These results are then analyzed, resulting in the determination of which corrective and preventive actions should be taken for the most significant factors.

4.1.5.4 Phase "Act"

The corrective and preventive actions are progressed in different ways. For example, current days the wires of the MPS products are frequently complained by the customer to be very disordered. This problem is seriously taken by us. Now for each order, the arrangement of the wires is defined by the engineer in the technical center. In the final inspection of this product, we consider this as a point to check. This is a example for a small change. For the big changes as the improvement of the control plan, there must be compelling reasons to propose that Faverges make changes.

Improvement: practice of PDSA method

In 1987 Moen and Nolan presented an overall strategy for process improvement with a modified version of Deming's cycle of 1986: PDSA cycle.

For the first part of my work: to be familiar with the existed process, it's good to follow the existed method, which is to progress a PDCA cycle for the quality management of products. As the control plan has already been defined. For the improvement of the existed processes in STHZ, this PDSA model can be applied for developing, testing, implementing, and spreading changes that result in improvement.

The use of the word "study" in the third phase of the cycle emphasizes that the purpose of this phase is to build new knowledge. It is not enough to determine that a change resulted in

improvement during a particular test. As you build your knowledge, you will need to be able to predict whether a change will result in improvement under the different conditions you will face in the future. In addition, they added three basic questions to supplement the PDSA cycle:

- What are we trying to accomplish?
- How will we know that a change is an improvement?
- What changes can we make that will result in improvement?[5]

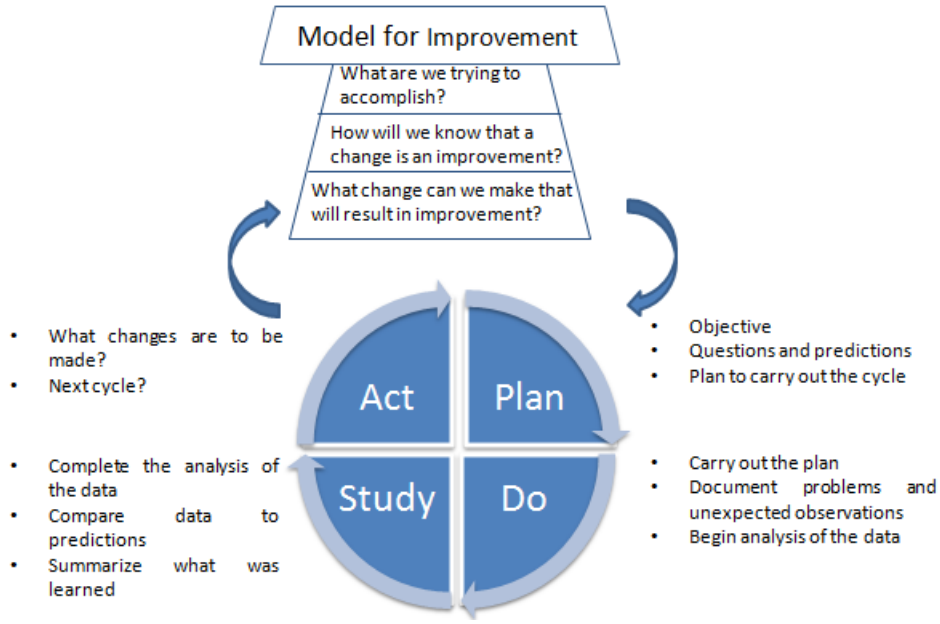

Figure 19: PDSA for the improvements for the existed process [5]

4.2 Handling customer complaints

For our customer, the quality of our brand is not only evaluated by the quality of our product, but also by the quality of our service.

- Can we respect the delivery time?
- Does our customer receive the right product that they ordered?
- Are their problems seriously considered and analyzed, and is the result that our customer is satisfied?

Being a product quality engineer, it is important to put oneself in the position of a customer. That is why handling customer complaints is an integral aspect of a quality engineer's work.

Unlike the management of product quality, in this respect, we have no internal standard procedure to follow. It's more like a process of learning by doing. I summarize a rule or a pattern of problems by myself.

4.2.1 Background

As a policy of the quality culture of Stäubli group, customers' satisfaction is the key to our products' success. But as no machine can keep running forever, there necessarily arises the need to repair products. So while we are trying to provide customers the best products, we should at the same time always ensure that our after-sale service meets customers' requirements.

STHZ has its own access point for customers, which is the after-sales department. Engineers and assistants in the after-sales department are in charge of affairs related to customers; such as maintenance of products, by respecting the after-sales policy of the Stäubli group. And if some quality problems are involved, the quality department will be right behind the after-sales department in providing support.

Stäubli uses the Customer Relationship Management system to manage all activities related to customers. Unlike the SRM system, the CRM has not been integrated into the Mystäubli system. The CRM is considered to be an external system, whereas the SRM is internal. And the quality department is in-between, because we believe most quality problem found on the customer side can be traced to a cause on the supplier side. That is why quality engineers always play an intermediary role in dealing with the customer complaints.

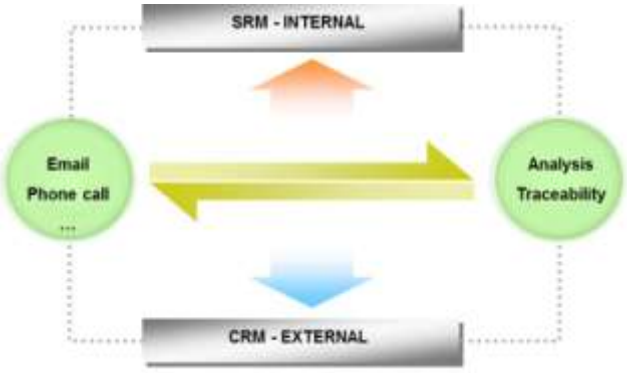

Figure 20: Relation of internal & external management system

An important policy that STHZ demands that its personnel respect when dealing with customers' affairs is the "Quick policy" (Figure 22). This policy demands that since we receive a customer's complaint, we should reply to the customer with a quick analysis within one working day, and reply with a fuller analysis within one week. By subsequently following up with supplementary information, we can thereby ensure customer satisfaction.

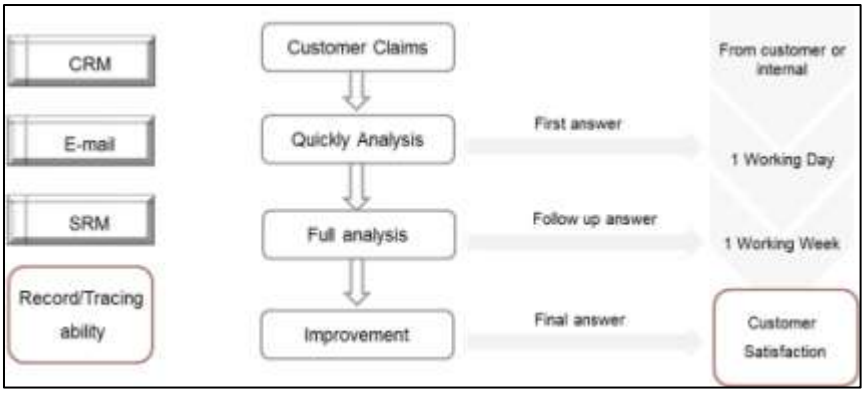

Figure 21: Flowchart simplified of customer complaint management

4.2.2 The process of treatment of customer's complaints

The first case I treated was performed following the instructions of my tutor. She taught me the general thoroughness of treatment, identification of persons concerned, and explained the functions of the software used in CRM. After observing several cases, I began working autonomously, putting into practice what I had learned from my tutor.

Generally, the complaints can be:

- Shortage of parts
- Wrong part
- inappropriate packaging
- Broken parts received
- Functional faults of components

Among all the cases I have been involved with thus far, I will present below one of the most frequent case-study.

a) Receipt of complains to service quality

Our sellers in FCS division reported the issue of a customer missing one type of part. After receiving this compliant, the first step I took was to make sure that there was enough information to perform an analysis. If that wasn't the case, more information woul be need to be collected by our sellers.

Generally, at the very least, information related to the following is needed to track an issue:

- The customer
- The date of receipt
- The part number
- The order number
- Quantity
- The photos (if necessary)
- The part returned by the customer (if necessary)

b) Analysis process

5M1E method

The 5M1E is a method used in the quality control for different industries. However, when we deal with a problem, we also use this method to list all the possible cause of the problem.

In real application, we often use the "Fishbone diagram" to help to list the secondary causes or more sub-causes for those six factors as follow:

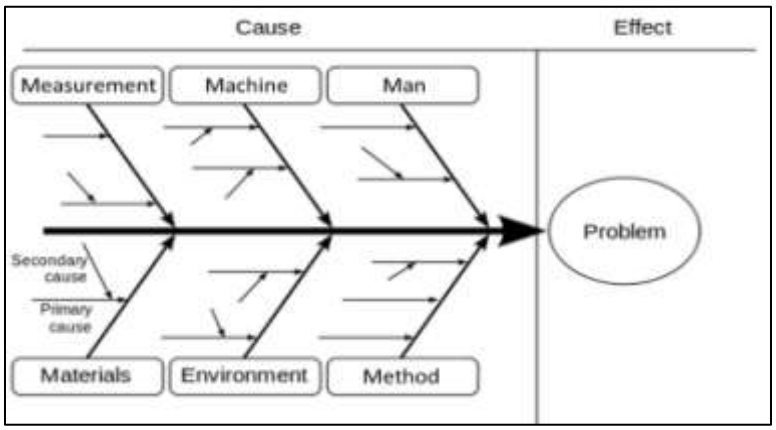

Figure 22: The cause-effect matrix [6]

Data analysis

The order number (or part number) is very important. With either of these numbers, I am able to find the order in AS400, which will reveal:

- The general information of the order: product type and quantity.
- Stocks
- Price of the product

Now knowing the quantity in stock, the first step is to check to see if there are extra parts currently available. I find that there are perhaps four extra parts remaining in stock. The quantity is the same as the demanded quantity. I strongly doubt that it is the warehouse staff's mistake to have forgotten to deliver the part. But, just to make sure, I check the delivery sheet which is generated automatically by the AS400 system. According to the product delivery process, the delivery staff has to consult the list when preparing goods for delivery. Accordingly, delivery staff must mark all checked items with a "√". For a double check, it should be rechecked by the packaging staff with another "√". I see there is a "√" mark from the delivery staff, but no mark from the packaging staff. This reveals that delivery staff made a mistake which was detected by the packaging staff, who neglected to remind the delivery staff to include the missing part.

This omission creates a serious problem, because the product delivery is meaningly processed. It therefore reflects a significant issue in the management of the delivery process.

In some other cases, it can be attributed to a combination of several factors.

c) Transition of problem and information (optional)

The root cause is found in this case. It is also possible that we don't have the ability to analyze their problems because it is an imported part. In this case, a report should be generated in English in which the problem is described in detail, to include all pertinent information. The problem then must be communicated to our supplier.

Figure 23: Example of Problem description report

d) Proposition of solutions

To close the case, after identifying the source of the complaint, the first thing we do is to notify the sales department, and request that the warehouse promptly send the missing part(s).

To make an improvement, we contact the manager of the warehouse. Corrective and preventive actions are demanded by us in this case. I devoted a lot of time to observe the delivery process in the warehouse. A report about the current situation will be edited, and then it will be diffused to supervisor of the warehouse to range the actions.

e) Implement of solutions

The corrective and preventive actions are practiced by the warehouse in this case.

f) Review of results

The PQE has to supervise the progress of the proposed improvement actions. The results can be evaluated by the future data like the figure 22.

To solve this problem,

g) Registration

Related information should be registered in the form of a service request in the CRM. And the number of the complaint(s) is included in a form entitled “Data analysis FCS”.

5 Conclusion

5.1 Overview of my work

Role of product quality engineer in the company

The process quality engineer serves as an intermediary between actors both inside and outside of the company. In the daily work of a PQE, he or she must interact seamlessly with different departments.

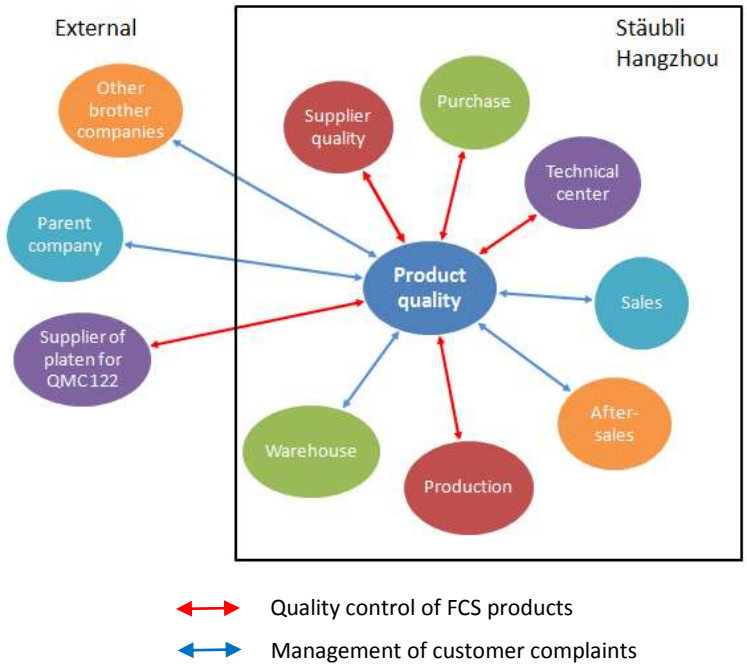

Figure 24: Interaction between product quality engineer and other actors [2]

I communicate frequently with the supplier quality, the technical center and the production department for the process control of products. For the management of the platen for QMC122, I contact with the purchase and the supplier of platen.

For the management of customer complaints, the interactions between me and the sales department, after-sales department and other companies in Stäubli group are very frequent.

Time management

The workflow of a process quality engineer is very complicated. Urgent situations may arise at the same time. Therefore, as a product quality engineer, it is crucially important to effectively prioritize missions. Accordingly, a degree of importance and urgency (from 1 to 5) is assigned to each mission.

Mission	Importance	Urgency
① Trouble-shooting on the production line	4	5
② Process control and final inspection for product	5	2
③ Management of the Chinese supplier	3	3
④ Dealing with customer complaints	2	4
⑤ Assist the stock to reduce their sending error rate	1	1

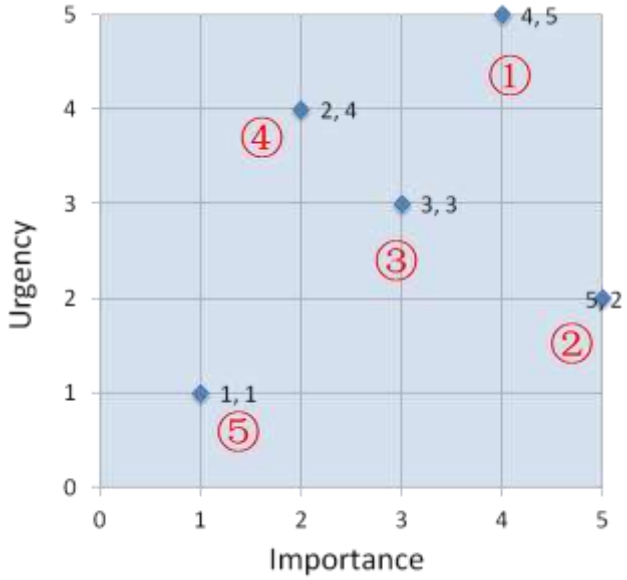

Figure 25: Importance-Urgency Matrix [2]

From the figure above, we observe that the points near the upper right corner get higher priority, which makes the mission ①＞②＞③＝④＞⑤. But this summing-up is just for advice. The priority is also influenced by many factors such as the importance of one particular customer for the mission ④. It's very important for the efficiency of my work.

Overview of quality control process

The quality control is like a shooting game for me. The PDS table is to define the strategy, which gives me the direction. My target (my objective) is cleared by the practice of 5W1H. The most important, I applied the method PDCA combined with other quality controls tools to realize a continuous improvement.

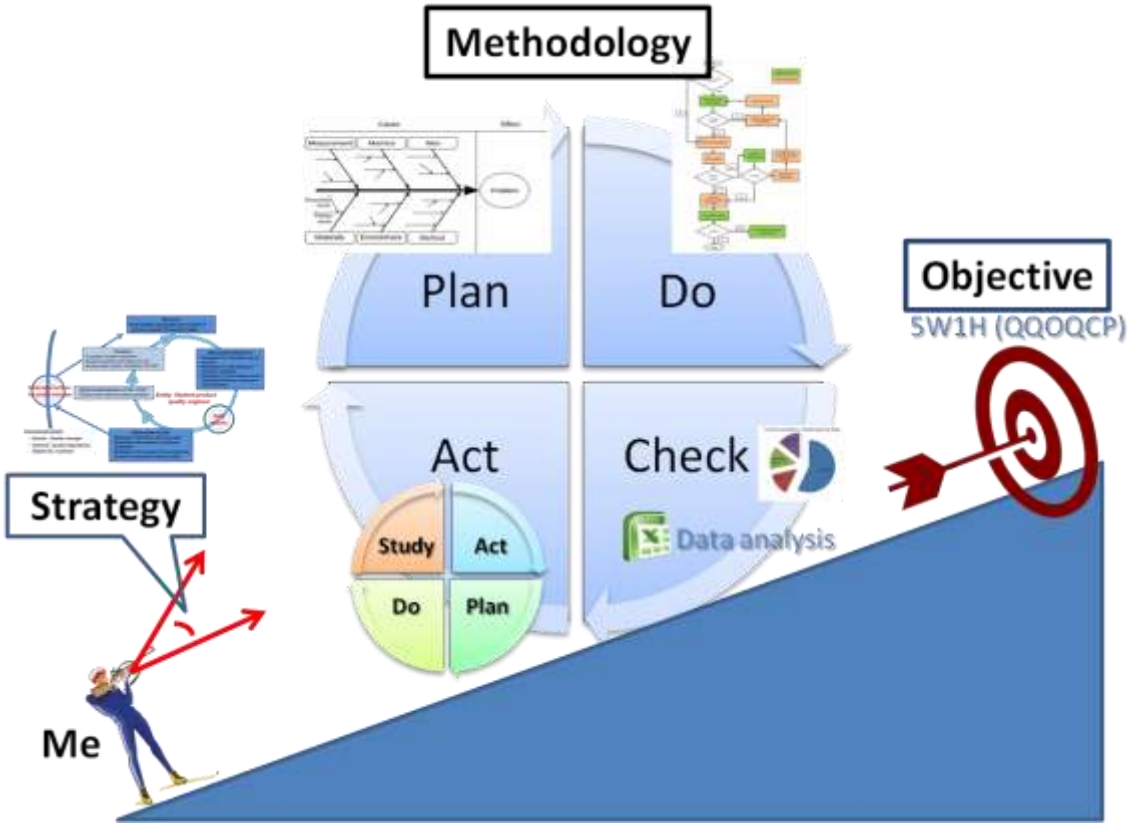

Figure 26: Overview table of quality control process [2]

Overview of the treatment of customer complaints

Generally, I progress the following procedure to handle the customer complaints:

a) Receipt of complains to service quality
b) Analysis process
c) Transition of problem and information (optional)
d) Proposition of solutions
e) Implement of solutions
f) Review of results
g) Registration

It is well corresponded to the 7 steps problem resolution (figure 27).

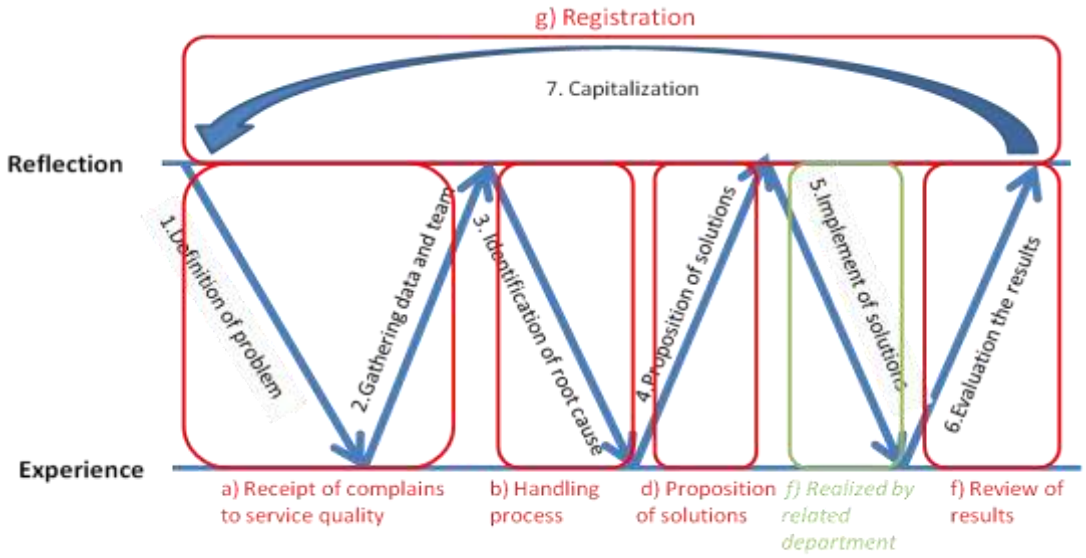

Figure 27: Cycle WV-7 steps problem resolution

5.2 Personal conclusion

Improvements	
Knowledge	• Quality tools • Metrology • The spirit of continuous improvement
Competence	• Analysis of Requirements • Good interpersonal skills • animation Ability • Transversal Communication • Management of the importance and urgency • Being confidence • Decision-making
Linguistic	• English in term of science • French in term of science
Difficulties	
☹	Study of the products at the beginning of the course
☹	Understanding of the technical and scientific terms
Perspectives	
☺	Self-control capacity
☺	Best autonomy
☺	Management of importance and urgency

The main difficulty I encountered during my internship was a lack of relevant knowledge, especially in the field of metrology. Quality problems arose from everywhere during the production cycle; whether physical, chemical, electrical or otherwise. It is hard to say exactly what body of knowledge a quality engineer should possess, but in a mechanical production group such as Stäubli, basic knowledge in mechanics and material is indispensable. However, since I majored in material and quality at University, I had relatively limited knowledge in mechanics. But, thanks to a very professional training offered by our department and with the ongoing support of my colleagues, this difficulty was not unsurpassable during my internship. On the contrary, it further motivated me to ask questions, to search for answers, and to put into practice what I learned.

6 Bibliographie

[1] Staubli site: http://www.staubli.com/

[2] ZHAO Xinyi, Université de Technologie de Compiègne, Master Qualité et Performance dans les Organisations (QPO), Mémoire d'Intelligence Méthodologique du stage professionnel de fin d'études, juin 2014, www.utc.fr/master-qualite , puis "Travaux" "Qualité-Management", réf n°299

[3] U176 40 003_C_产品过程质量控制程序

[4] Internal document: FCS data analysis in 2013

[5] Ronald Moen, Clifford Norman, Evolution of the PDCA Cycle, Available: http://pkpinc.com/files/NA01MoenNormanFullpaper.pdf [Accessed: 10-Jun-2014].

[6] G. Farges, Ishikawa. Available: http://www.utc.fr/~farges/gbm_et_qualite/outils/ishikawa.htm [Accessed: 10-Jun-2014].

Other documents:

[1] ISO 9001 : 2008 Système de management de la qualité, URL: http://www.afnor.org

[2] Garvin, David, and Artemis March. (1981). A Note on Quality: The Views of Deming, Juran, and Crosby

[3]U176 00 000_D_质量手册

[4] U176 40 005_C_标识和可追溯性管理程序

[5]U176 00 005_C_不合格品控制

[6]U176 40 603_A_螺纹检测通用规范

[7] U176 40 602_A_质量安全操作说明

[8]U176 30 402《不良零件回收表》

.

7 Annexe

Auto-diagnostic before and after the work

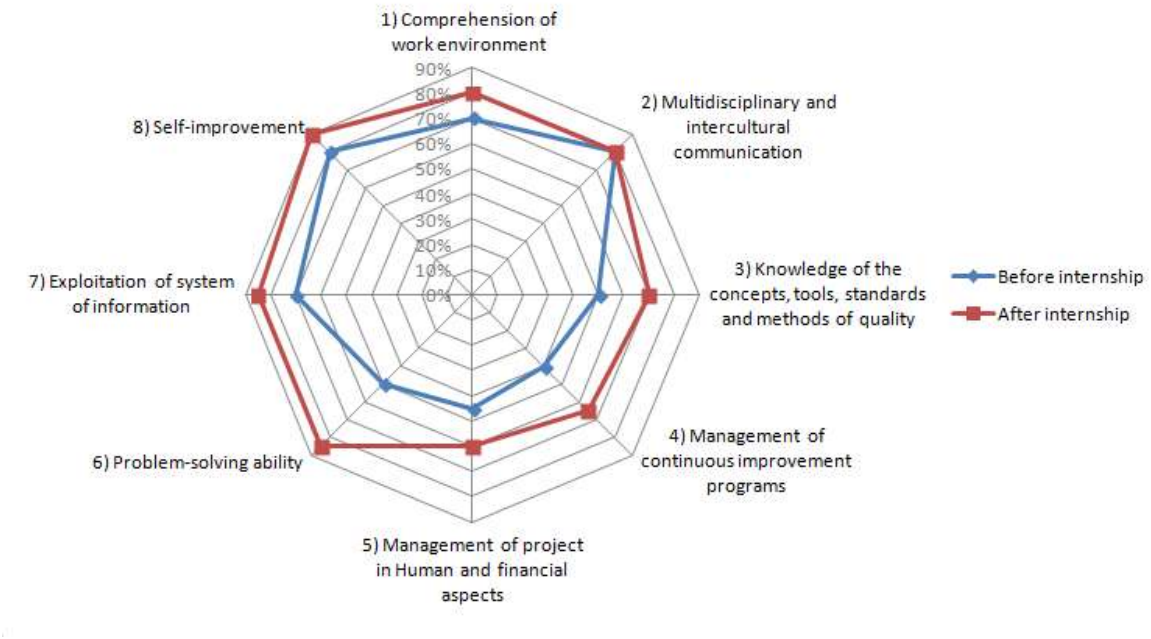

Figure 28: Auto-diagnostic before and after the work

1) Comprehension of work environment : Fundamentals knowledge of human, technology, the economy and the organization of company
2) Multidisciplinary and intercultural communication
3) Knowledge of the concepts, tools, standards and methods of quality
4) Management of continuous improvement programs : Competence in production, validation, evaluation and management of continuous improvement programs
5) Management of project in human and financial aspects: Fundamental knowledge of the management of human resources, innovative and creative projects and financial management
6) Problem-solving ability: Ability to classify the problems, to identify priorities, to respond to emergencies
7) Exploitation of system of information: Competence of using the system of information, using all the resources of the new technologies and social networks
8) Self-improvement: Ability to continuously improve their own skills (fluency in a foreign language, update their knowledge, assessment practices ...) and to innovate in a complex rapidly changing environment.

LRQA
Business Assurance

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

Stäubli (Hangzhou) Mechatronic Co., Ltd.
No. 123, Weiken Rd., Baiyang Street, Hangzhou
Economic & Technological Development Zone,
Hangzhou, Zhejiang Province,
People's Republic of China

has been approved by Lloyd's Register Quality Assurance
to the following Quality Management System Standard:

ISO 9001:2008

The Quality Management System is applicable to:

Manufacture of shedding systems for the textile and industrial connectors; Provider of quick connector systems and robots for all Industries.

Approval
Certificate No: QAC6007921

Original Approval: 26 January 2012
Current Certificate: 2 September 2013
Certificate Expiry: 25 January 2015

Issued by: Lloyd's Register Quality Assurance (Shanghai) Co., Ltd.
for and on behalf of Lloyd's Register Quality Assurance Limited

UKAS MANAGEMENT SYSTEMS
001

This document is subject to the provision on the reverse
Room 2018, Ocean Tower, 550 Yan An Dong Road, Shanghai, P. R. China
For and on behalf of 71 Fenchurch Street, London EC3M 4BS United Kingdom. Registration number 1879370
This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA.
The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001

Figure 29: Certificate of approval of ISO 9001