China Jiliang University Undergraduate Graduation Project(Thesis)

PDCA 在大连申华 40215-PLP020 机加工件关键工序中的应用

Application of PDCA in the key process of 40215-PLP020 machining part in Dalian Shenhua

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本科毕业设计（论文）

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Application of PDCA in the key process of 40215-PLP020 machining part in Dalian Shenhua

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2018 年 5 月

致 谢

本论文能够顺利完成要大力感谢曾其勇老师在百忙中抽出时间给予指导和帮助。同时也要感谢给予转载权和引用权的资料、图片、文献、研究思想的所有者。另外感谢大连申华电子有限公司提供的实习机会和测量数据。在此，向这些给予我帮助的老师、同学和组织致以衷心的谢意。

徐田园
2018.5.22

PDCA 在大连申华 40215-PLP020 机加工件关键工序中的应用

摘要：本次毕业设计是结合本人所在实习单位大连申华电子有限公司及其所生产的产品——40215-PLP020 机加工件与本人在质量管理工程专业所学质量管理方法的一次探索尝试。此次设计力图改进公司机加工件工序能力，提高公司产品质量，降低不良品率，以提高产品在市场上的竞争力。

主要着眼于对于 40215-PLP020 机加工件的工序能力，研究影响其质量问题的关键质量特性同时提出解决质量问题的方案措施，对措施加以实施并监测改进成果，将提高工序能力作为改进的主要目的，将过程能力指数 Cpk 由初始的 1.26 提升至 1.54，某种程度上完成了提高产品质量的目标。使企业在改进的过程中降低不良品所产生的成本，为企业创造更高的价值和利润。

关键词：PDCA 循环；机加工件；质量检验；质量分析与改进
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Application of PDCA in the key process of 40215-PLP020 machining part in Dalian Shenhua

Abstract: This graduation design is a combination of my internship at Dalian ShenHua electronics co., LTD. with its products: 40215- PLP020 machining part and my professional knowledge about my major: quality management engineering. It provides a great opportunity to practice what I learned during college time.The project itself aims to improve the process capability of certain type machining part, eventually comes to the consequence of improving the quality of the company's products, reducing the production of defective products and improving the competitiveness of the products in the market.

The project mainly focused on 40215 - PLP020 machining part’s process ability, studying the key characteristics that cause the quality problems and providing solutions to those problems at the same time. To implement and monitor the improvement efforts, regard improving the process capability as the main purpose of the improvement. Finally achieve the final result to improve the quality of products and reduce the cost of defective products in the process of improvement in order to create higher value and profit for the enterprise.

Keywords: PDCA cycle, machining part, quality inspection, quality analysis and improvement

Classification：F273.4

Contents

1 Introduction

1.1 The purpose and significance of the topic

Dalian Shenhua electronics co., LTD. is a manufacturing enterprise mainly engaged in the processing of precision machinery parts. The equipment mainly includes CNC lathes, center-less grinders, machining centers and other machine tools totaling more than 200 sets. In the mean time, there are contour-graph, projector, cylindricity instrument, automatic detection equipment and cleanliness detection system. The company has passed ISO 9001:2015 quality system certification and IATF 16949:2016 system certification. In recent years, Dalian Shenhua focuses on the processing of main components of automobile engine fuel injection system and medical equipment components, and designs and processes products to serve customers in the United States, Japan and Europe. In the process of production and processing, the control of the processing process often directly affects the quality of products.Under normal circumstances, the final inspection is used to determine whether the product is qualified or not. However, by the time of final inspection, the yield has been affected by many aspects.Therefore, the control of process capability under fixed working procedure becomes the key to solve the problem of defective product rate.The quality defects of machined parts are mostly caused by the stability problems in the process of machining. Therefore, it is very important to improve the level of process capability in production.A large number of scrap and rework caused by the quality problem of the work-piece, as well as the warranty cost of the products with quality problems after the sales process is also very surprising, the direct economic loss of the enterprise in this respect is very high every year, so for the improvement of the quality of the work-piece is very necessary and very urgent.Various reasons in the production process, such as unreasonable incoming material inspection method and personnel's unfamiliarity with the processing process, will directly affect the product quality, but at the same time, the specific cause of the quality problem is not clear.In this case, PDCA cycle method is used to analyze and improve the quality of the work-piece production process, and six sigma, QC team and other methods are adopted to comprehensively improve the process capacity of the work-piece production process, so as to improve the quality of the product [1].Nowadays, quality management and quality control are becoming the most important part of enterprises.Through the implementation of six sigma management, the establishment of QC team and other methods, the enterprise can bring unattainable competitiveness and vigorous development vitality.In the process of the development of quality management theory, the final inspection is usually taken as the main way to determine whether a product is qualified. However, the impact of problems in the production process on quality is often not negligible [2].Nowadays, quality management should focus more on how to identify and improve the problems in the production process, instead of looking for the causes from the results.Therefore, through the analysis and improvement of the quality of 40215-plp020 machined parts, the company can have a deeper understanding of the quality control of the production process, which will have an important and positive impact on the quality improvement work in the future.

1.2 PDCA Cycle summary

1.2.1 Principle and significance of PDCA cycle

PDCA cycle is a scientific working procedure that should be followed in quality analysis and improvement activities. It is closely related to "improvement" and "just-in-time production" in production management, also known as "quality ring". In 1930, the idea was proposed by American engineer Dr. Hugh hart, then known as the "Shewhart Cycle". In 1950, it was discovered by Dr. Deming, an American quality management expert. The Japanese renamed it "Deming ring", and it was widely used in the process of continuously improving product quality in the industry [4,5]. The so-called PDCA is composed of the initial letters of Plan, Do, Check and Action, which can be mainly summarized as four stages. Stage D is the process of implementing quality control and quality improvement;In phase C, based on policy, objectives and construction requirements, monitor and measure the process and products to form the final report results; In phase A, it is necessary to take corresponding measures to continuously improve the process. PDCA cycle quality management principles to plan, implementation, inspection and treatment of the four links as the main component, all the process should be determined in accordance with the quality objectives and quality requirements.The cycle takes the form of a large loop with a small loop, and the quality management activities are pushed to new heights in the cycle again and again. It is a cyclic process: deal with the hidden quality problems after the first cycle, then start another cycle, and constantly take measures against the newly discovered hidden quality problems.After continuous circulation, the established quality target is finally achieved [6].

1.2.2 characteristics of PDCA cycle

PDCA cycle in the process of continuous operation, the original quality problems will be solved at the same time will also create new problems, so the need to continue the cycle, such a cycle, is the process of quality improvement. Specifically, several characteristics of PDCA cycle are as follows:

(1) PDCA cycle is a process in which large rings are surrounded by small rings and promote each other. figure 1.1.

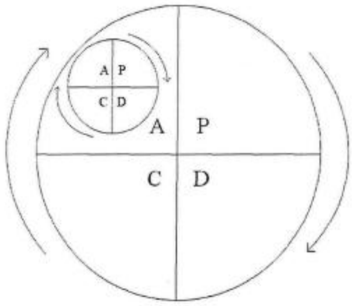

Figure1.1

The next cycle is not only the implementation and visualization of the previous cycle, but also based on the PDCA cycle of the previous level.The work of various organizations is linked organically through circulation, coordinating with each other and promoting each other.

(2) PDCA cycle is a rising cycle. figure 1.2.

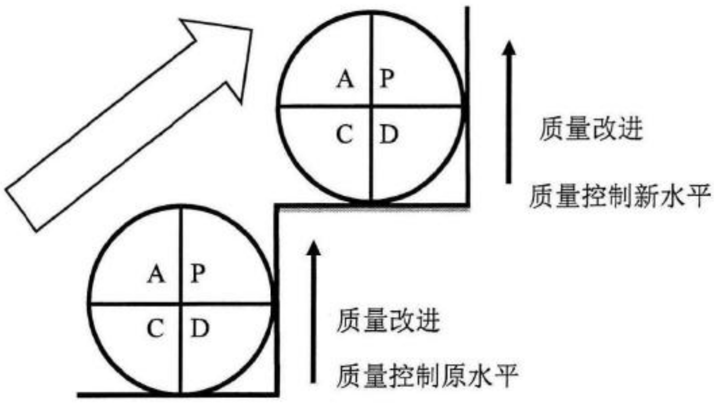

Figure 1.2

The PDCA cycle is not a simple cycle over and over again, but a ladder up cycle.Through each cycle, some quality problems can be solved, which can improve product quality and management level at the same time.

(3) in phase A, the summary is the main work and the up and down cycle is combined, which is the most critical part of PDCA.Summary is the process of learning from experience, correcting mistakes, asking new questions, and moving on to the next cycle.If there is no phase A, there is no link to draw lessons and consolidate achievements, and similar problems are likely to occur in the future.

1.3 The main contents of this paper

40215-plp020 machined parts were selected as the research object to be familiar with the production process flow, quality characteristic index (especially the key process and key quality characteristic index), current processing state and process capability index of this type of machined parts.Carry out effective measurement of the indicator status and analyze the quality data, evaluate the machining process of the machine by using the process capability index Cpk, and provide a level comparison benchmark for the subsequent research stage.If the process capability index Cpk is less than 1, it indicates that the process capability of the work-piece is seriously insufficient.If Cpk is greater than or equal to 1.67, it indicates that the process capability of the work-piece is too strict and can be relaxed appropriately.When Cpk is between 1 and 1.33, the manufacturing capacity is acceptable.When Cpk is between 1.33 and 1.67, the process capacity is sufficient [9].By using the quality tools such as causal diagram, this paper makes a preliminary judgment and screening on the factors that affect the processing stability, processing qualification rate and product quality of a certain type of machining parts, so as to prepare for the next research work.According to the reasons affecting the processing process, effective measurement was made. According to the measured data, quality tools such as normality test, hypothesis test, variance analysis and FMEA were used to analyze the key factors affecting the quality, so as to determine the quality factors that need to be improved in the follow-up research process and distinguish the non-essential factors.After determining the quality factor, the quality tools such as DOE are used to optimize the factors to find the best combination.Then, based on the above research process, corresponding improvement measures were formulated and evaluated, and the process capability level of machined parts was re-analyzed to determine the improvement results, and finally the best improvement measures were determined.In addition, SPC and other process control methods should be applied to track and monitor the improvement results, and implement the improvement measures into documents for curing.

This study aims to solve two main problems:

(1) determine the quality factors that affect the processing capability of a certain type of machining parts;

(2) develop and implement improvement measures, check results and continue the cycle.

2 40215-PLP020 Machining part overview

2.1 Grief introduction

Measured work-piece receiving force from the crankshaft, and through the petrol pump in the tank atomizer, gasoline pumps after atomization combustion produces power to promote the movement of the work-piece, after being measured work-piece will force them back to the crankshaft, crankshaft will force transmitted to the gearbox is produces the power, the car cycling cars will produce continuous power.

2.2 Technological process

As what's shown in figure 2.1, the 40215-plp020 machined parts are turned by raw materials through a numerical control lathe followed by gas nitriding and cleaning and finally through automatic inspection to complete the final inspection of machined parts and prepare packaging for delivery.

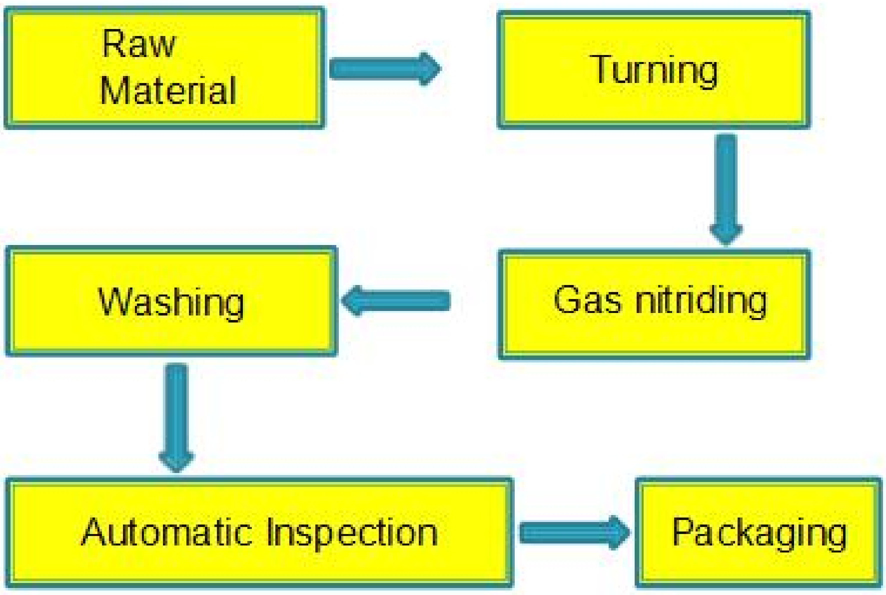

Figure2.1

2.3 Quality characteristic index

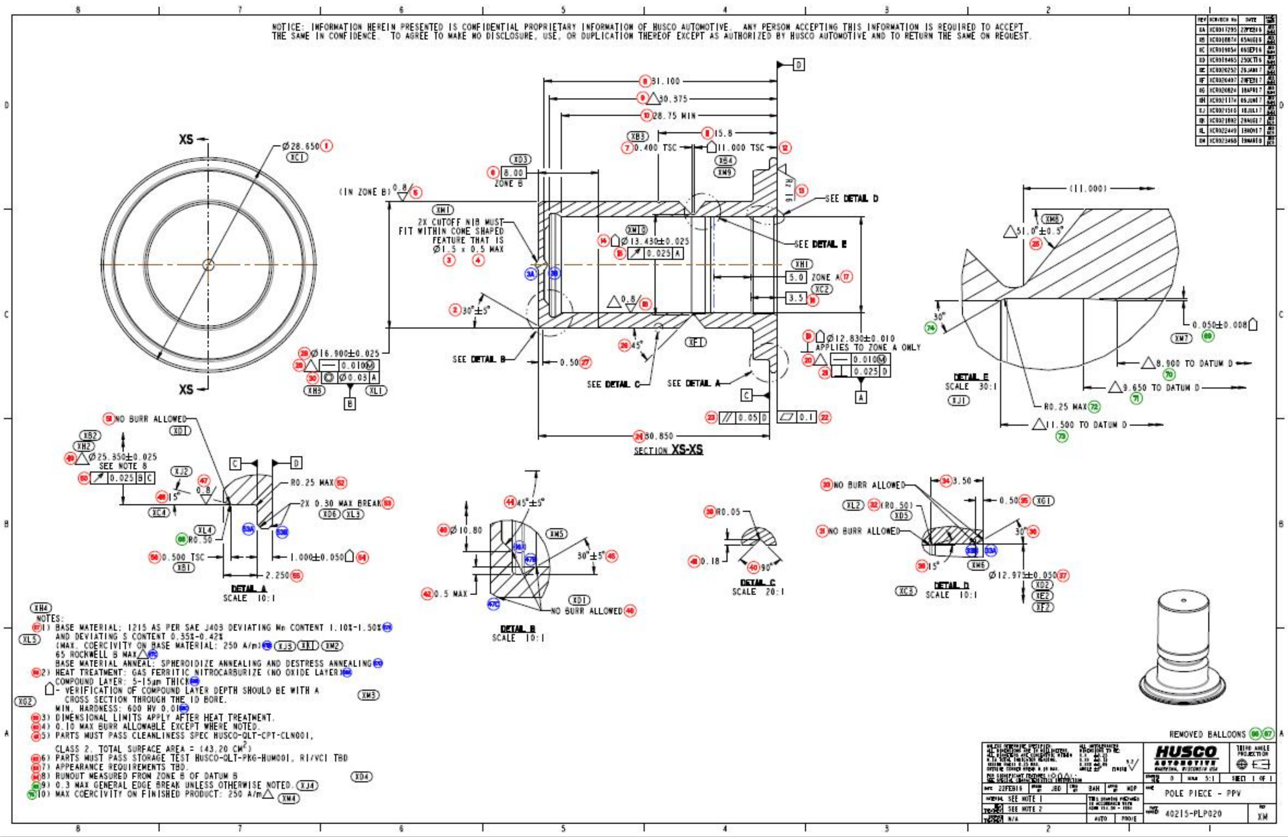

Figure2.1

Table t2.1

	Print Dimension			24	30.850	0.060	0.060	⌂54	1.000	0.050	0.050
Ref	Nominal	Upper	Lower	△25	51.000	0.500	0.500	55	2.250	0.060	0.060
1	28.650	0.060	0.060	26	45.000	2.000	2.000	56	0.500	0.060	0.060
2	30.000	5.000	5.000	27	0.500	0.130	0.130	68	0.500	0.130	0.130
3A		1.500		28	16.900	0.025	0.025	69	0.040	0.008	0.008
4A		0.500		△29		0.010		70	8.900	0.060	0.060
3B		1.500		30		0.030		71	9.650	0.060	0.060
4B		0.500		34	3.500	0.130	0.130	72		0.450	
5		0.800		35	0.500	0.130	0.130	73	11.500	0.060	0.060
7	0.400	0.060	0.060	36	30.000	2.000	2.000	74	25.000	5.000	5.000
8	31.100	0.060	0.060	37	12.975	0.050	0.050	31	NO BURR		
9	30.375	0.060	0.060	38	15.000	2.000	2.000	33A	NO BURR		
11	15.800	0.250	0.250	39	0.050	0.130	0.130	33B	NO BURR		
⌂12	11.000	0.060	0.060	40	90.000	2.000	2.000	46A	NO BURR		
13		16.000		41	0.180	0.130	0.130	46B	NO BURR		
14	13.410	0.025	0.025	43	10.800	0.130	0.130	46C	NO BURR		
15		0.025		47		8.000		51	NO BURR		
16		0.800		48	15.000	2.000	2.000				

⌂19	12.830	0.010	0.010	△49	25.350	0.025	0.025	10	28.750	1.600	
20		0.010		50		0.025		42		0.500	
21		0.025		52		0.250		44	45.000	5.000	5.000
22		0.100		53A		0.300		45	30.000	5.000	5.000
23		0.050		53B		0.300					

2.4 Main inspection methods and tools

Due to the limitation of time and conditions, 16-roughness was used as the main quality characteristic index.

Table 2.1

	Print Dimension			
Ref	Nominal	Upper	Lower	Measurement Device
1	28.650	0.060	0.060	micrometer
2	30.000	5.000	5.000	Tool maker microscope
3A		1.500		Tool maker microscope
4A		0.500		Drop indicator
3B		1.500		Tool maker microscope
4B		0.500		Drop indicator
5		0.800		Perthometer
7	0.400	0.060	0.060	profilmeter
8	31.100	0.060	0.060	Drop indicator
9	30.375	0.060	0.060	Drop indicator
11	15.800	0.250	0.250	Tool maker microscope
⌂12	11.000	0.060	0.060	Tool maker microscope
13		16.000		Perthometer
14	13.410	0.025	0.025	LVS2.5D
15		0.025		FRM
16		0.800		Perthometer

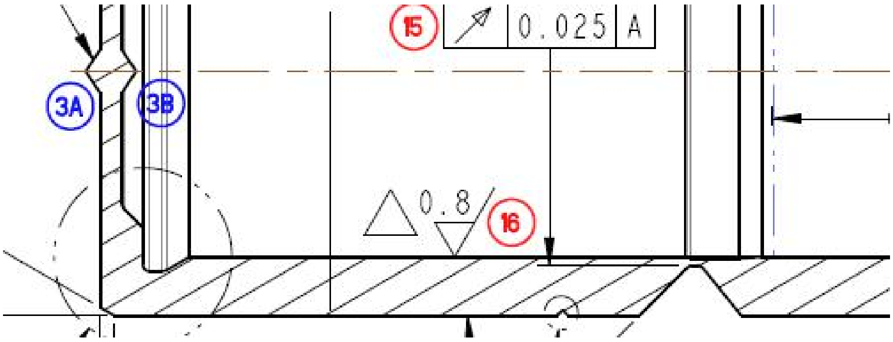

Figure 2.2 ⑯ Roughness

As what is shown in table 2.1 and figure 2.2, the roughness requirement is Ra 0.8, which will be tested by the roughness meter.

Roughness meter (as shown in figure 2.3), also known as surface roughness meter, surface finish meter, etc., has the characteristics of high measurement accuracy, wide measurement range, etc., so that it can be widely used in various metal and non-metal processing surface detection, mainly using needle tracing for measurement.

LSV needle stitch, also known as touch surface profile peak valley is ups and downs, through the stylus directly on the work-piece surface to be tested on the lines, will be produced in the measured contour surface is perpendicular to the move up and down, the mobile electronic device after the signal amplification and processing, the surface profile evaluation parameter values can be displayed on the screen, or by recording instruments contour graphics output table.

Figure 2.3

The basic information of the roughness meter used is shown in figure 2.4.

Figure 2.4

3 Measuring phase

3.1 Measuring methods

The random sampling method is generated by Minitab, and the surveyors make the measurement according to the order of the scheme and the operation specification of the measurement.

3.2 MSA

The result is shown in table 3.1.

Standard sequence	Operation sequence	Component	Operator	Result	SS	OS	C	O	R	SS	OS	C	O	R
7	1	3	001	0.4	34	31	2	001	0.43	64	61	2	001	0.43
16	2	6	001	0.48	58	32	10	001	0.48	61	62	1	001	0.59
10	3	4	001	0.42	43	33	5	001	0.53	70	63	4	001	0.43
28	4	10	001	0.46	31	34	1	001	0.56	79	64	7	001	0.48
25	5	9	001	0.52	55	35	9	001	0.53	88	65	10	001	0.48
13	6	5	001	0.51	37	36	3	001	0.39	76	66	6	001	0.49
22	7	8	001	0.44	40	37	4	001	0.43	85	67	9	001	0.52
19	8	7	001	0.47	49	38	7	001	0.5	67	68	3	001	0.39
4	9	2	001	0.42	46	39	6	001	0.47	73	69	5	001	0.51
1	10	1	001	0.54	52	40	8	001	0.43	82	70	8	001	0.43
17	11	6	002	0.49	35	41	2	002	0.4	68	71	3	002	0.41
26	12	9	002	0.5	59	42	10	002	0.47	86	72	9	002	0.52
23	13	8	002	0.42	32	43	1	002	0.55	65	73	2	002	0.4
14	14	5	002	0.52	56	44	9	002	0.51	62	74	1	002	0.56
8	15	3	002	0.39	50	45	7	002	0.47	74	75	5	002	0.53
2	16	1	002	0.56	38	46	3	002	0.4	80	76	7	002	0.46

29	17	10	002	0.48	47	47	6	002	0.48	77	77	6	002	0.47
20	18	7	002	0.47	53	48	8	002	0.44	83	78	8	002	0.4
5	19	2	002	0.4	41	49	4	002	0.4	71	79	4	002	0.41
11	20	4	002	0.43	44	50	5	002	0.5	89	80	10	002	0.49
18	21	6	003	0.46	57	51	9	003	0.52	87	81	9	003	0.55
24	22	8	003	0.43	45	52	5	003	0.51	81	82	7	003	0.49
27	23	9	003	0.53	51	53	7	003	0.47	63	83	1	003	0.55
12	24	4	003	0.41	33	54	1	003	0.58	66	84	2	003	0.42
6	25	2	003	0.43	42	55	4	003	0.42	78	85	6	003	0.48
3	26	1	003	0.57	60	56	10	003	0.49	84	86	8	003	0.42
30	27	10	003	0.47	54	57	8	003	0.41	90	87	10	003	0.48
21	28	7	003	0.49	36	58	2	003	0.42	72	88	4	003	0.42
15	29	5	003	0.5	39	59	3	003	0.41	69	89	3	003	0.39
9	30	3	003	0.38	48	60	6	003	0.49	75	90	5	003	0.5

Table 3.1

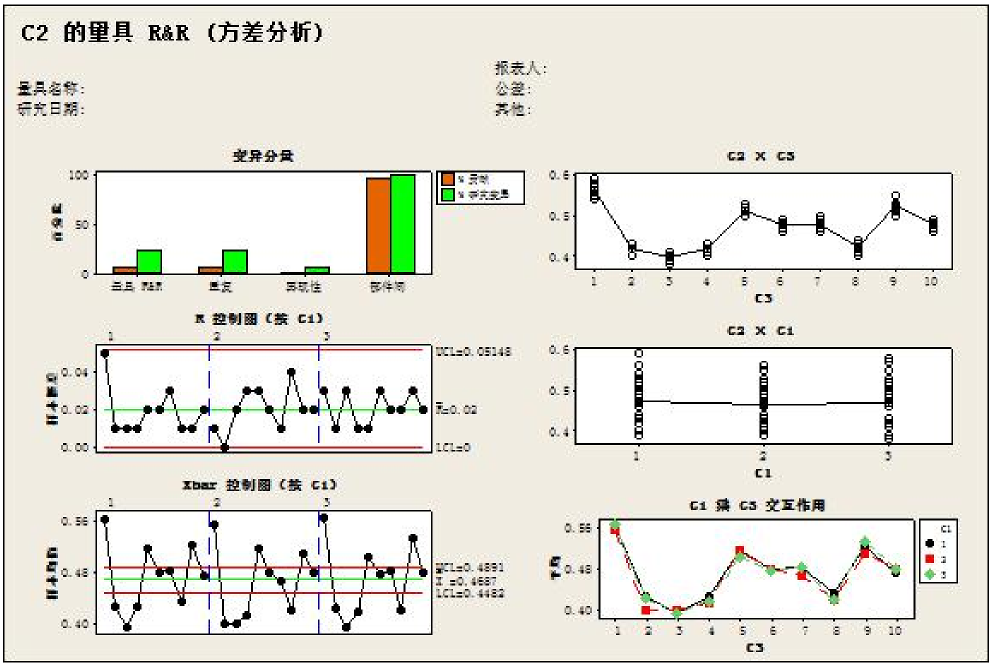

Figure 3.1

量具 R&R

来源	方差分量	方差分量贡献率
合计量具 R&R	0.0001552	5.07
重复性	0.0001445	4.73
再现性	0.0000106	0.35
C1	0.0000106	0.35
部件间	0.0029030	94.93
合计变异	0.0030581	100.00

来源	标准差(SD)	研究变异 (6 * SD)	%研究变异 (%SV)
合计量具 R&R	0.0124562	0.074737	22.52
重复性	0.0120221	0.072132	21.74
再现性	0.0032599	0.019559	5.89
C1	0.0032599	0.019559	5.89
部件间	0.0538791	0.323274	97.43
合计变异	0.0553002	0.331801	100.00

可区分的类别数 = 6

Figure 3.2

As can be seen from the chart, the total Gage R&R is 22.52%, between 10% and 30%, and the number of distinct categories is 6. In conclusion, it is considered that the measurement system is acceptable.

4 Data record and analyze

4.1 Surface roughness data record

Table 4.1

Part No.零件号：40215-PLP020						Date 日期：2018-4-9			
Part Name 零件名称：POLE-PIECE						Measuring instruments 测量仪器：Perthometer			
Dimension Study 尺寸研究：ID roughness 0.8						Equipment number ：			
No.	Data	No.	Data	No.	Data	No.	Data	No.	Data
1	0.57	26	0.62	51	0.56	76	0.54		
2	0.54	27	0.55	52	0.48	77	0.57		
3	0.49	28	0.64	53	0.58	78	0.62		
4	0.64	29	0.67	54	0.62	79	0.68		
5	0.59	30	0.64	55	0.66	80	0.54		
6	0.59	31	0.51	56	0.50	81	0.59		
7	0.59	32	0.55	57	0.63	82	0.61		
8	0.56	33	0.57	58	0.55	83	0.58		
9	0.59	34	0.58	59	0.61	84	0.62		
10	0.57	35	0.64	60	0.48	85	0.52		
11	0.55	36	0.57	61	0.66	86	0.57		
12	0.56	37	0.44	62	0.53	87	0.58		
13	0.64	38	0.67	63	0.54	88	0.61		
14	0.54	39	0.64	64	0.62	89	0.59		
15	0.60	40	0.54	65	0.66	90	0.66		
16	0.66	41	0.55	66	0.54	91	0.59		
17	0.52	42	0.57	67	0.57	92	0.58		
18	0.62	43	0.52	68	0.70	93	0.66		
19	0.57	44	0.60	69	0.59	94	0.64		
20	0.54	45	0.56	70	0.65	95	0.71		
21	0.62	46	0.62	71	0.57	96	0.59		
22	0.57	47	0.59	72	0.55	97	0.61		
23	0.66	48	0.61	73	0.54	98	0.63		
24	0.52	49	0.71	74	0.57	99	0.74		
25	0.44	50	0.57	75	0.53	100	0.61		

4.2 Data analyze

Minitab was used to stack all the data into a single column for the normality test. The results are shown in figure 4.1.

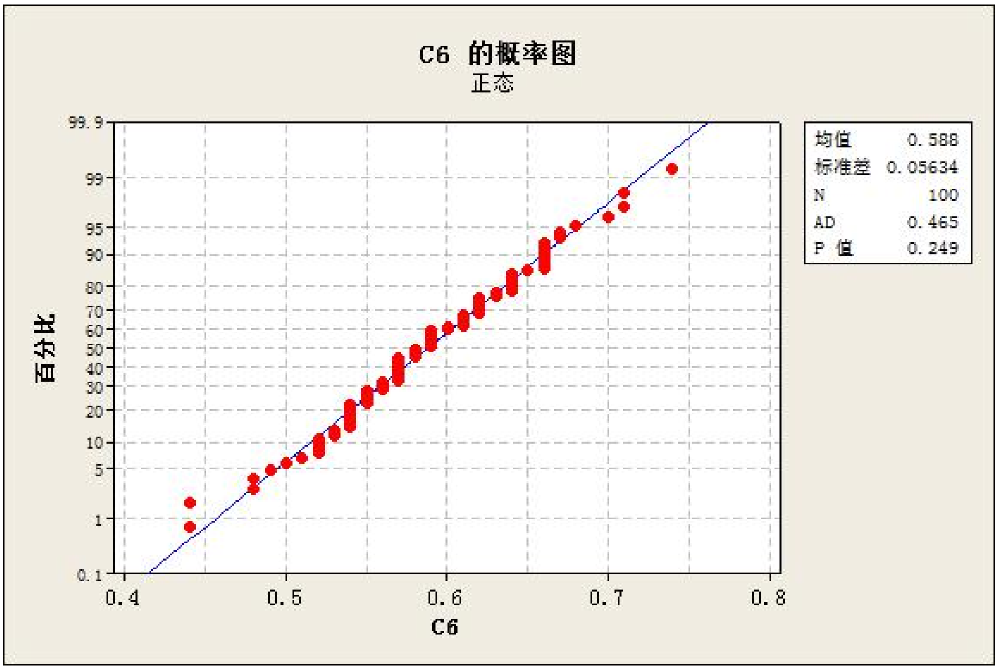

Figure 4.1

As what can be seen from figure 4.1, P=0.249>0.05, so the data is considered to be in normal distribution.

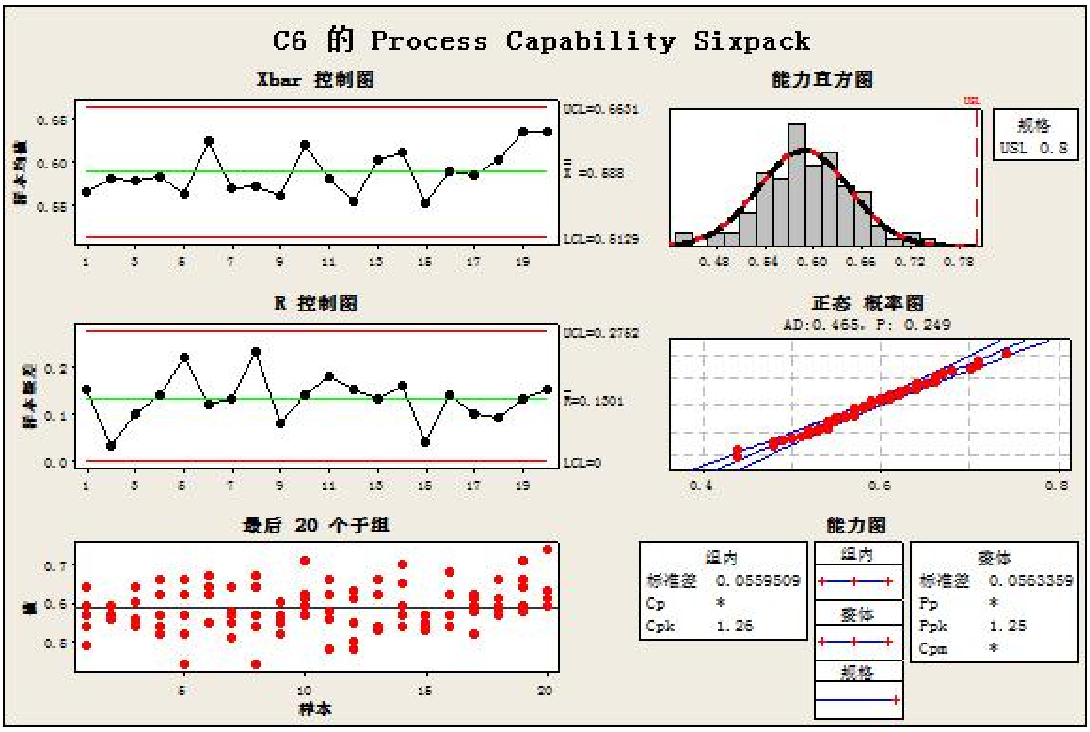

Figure 4.2 Process Capability Sixpack

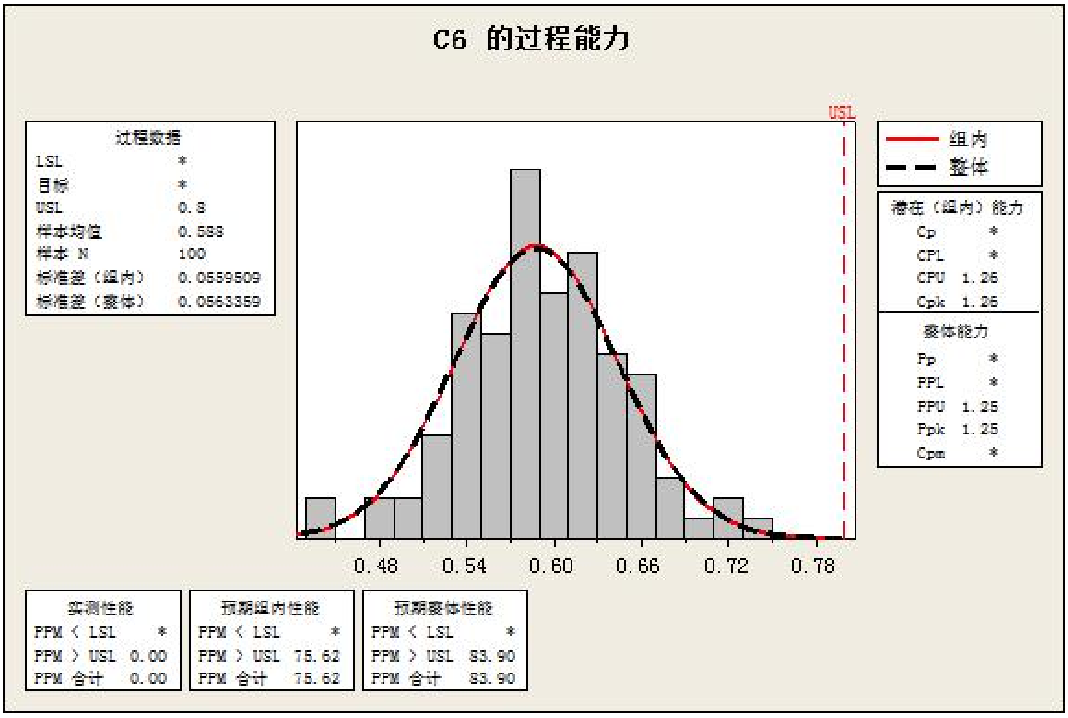

Figure 4.3 Process capability

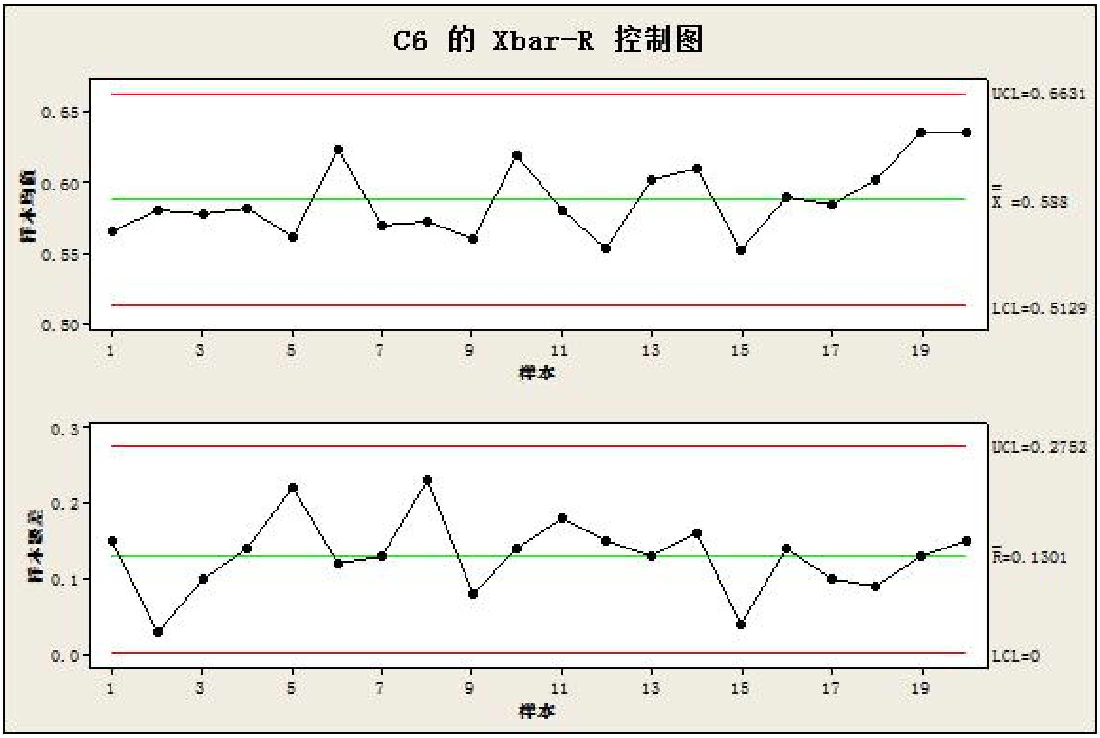

Figure 4.4 Control chart

4.3 Factor confirm

As can be seen from figure 4.3 and 4.4, for the quality characteristic of roughness, the process capability index Cpk is 1.26, less than 1.33, the process capability is ok but there is room for improvement. Through brainstorming and group discussion, the causal diagram of improving process ability was made. Figure 4.5.

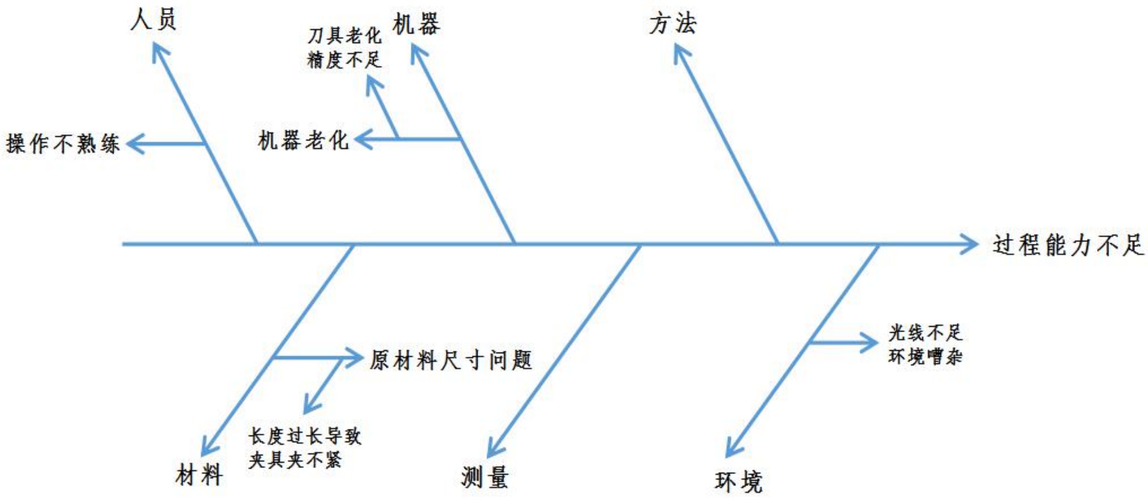

Figure 4.5 Cause and effect diagram

The following terminal factors are obtained from the causal diagram and confirmed.As shown in table 4.2.

Table 4.2 Terminal factors confirm

Number	Terminal factors	Confirmation method	Confirmation measures	Confirmation basis	Confirmation result
1	Unskilled operation	On-site verification	Observing whether the operation procedure of the operator is standard or not	Manufacture instruction card	No
2	Material length(too long)	Diagnoses	Using different lengths of materials for processing and measuring		Yes
3	Tools aged	On-site verification	Machining and measuring under various conditions with different degrees of used tools		Yes
4	Lightening	Diagnoses	Asking the inspector if he is affected by lightening.		No
5	Environment	Diagnoses	Consulting assembly and inspection personnel whether they are affected by the environment.		No

(1) influence of tools aging on process capability.

With the same tool processing, the first 100 pieces, the middle 50 pieces, after 150 pieces were divided into three groups, in order to distinguish the different degrees of tool use, and then to confirm the impact of tool aging on the processing process.

The measure data of 100 pieces before processing. As shown in table 4.3.

Table 4.3

Part No.零件号：40215-PLP020						Date 日期：2018-4-9			
Part Name 零件名称：POLE PIECE						Measuring instruments 测量仪器：Perthometer			
Dimension Study 尺寸研究：roughness 0.8									
No.	Data	No.	Data	No.	Data	No.	Data	No.	Data
1	0.47	26	0.48	51	0.53	76	0.48		
2	0.42	27	0.46	52	0.45	77	0.56		
3	0.41	28	0.55	53	0.49	78	0.49		
4	0.45	29	0.45	54	0.50	79	0.45		
5	0.45	30	0.50	55	0.48	80	0.50		
6	0.51	31	0.46	56	0.53	81	0.56		
7	0.53	32	0.53	57	0.42	82	0.46		
8	0.48	33	0.47	58	0.48	83	0.53		
9	0.55	34	0.51	59	0.53	84	0.57		
10	0.47	35	0.44	60	0.44	85	0.54		
11	0.40	36	0.42	61	0.61	86	0.62		
12	0.45	37	0.49	62	0.50	87	0.55		
13	0.51	38	0.40	63	0.45	88	0.51		
14	0.44	39	0.49	64	0.42	89	0.49		
15	0.48	40	0.52	65	0.60	90	0.53		
16	0.45	41	0.54	66	0.54	91	0.48		
17	0.52	42	0.46	67	0.47	92	0.51		
18	0.54	43	0.41	68	0.43	93	0.48		
19	0.47	44	0.50	69	0.46	94	0.47		
20	0.51	45	0.47	70	0.52	95	0.60		
21	0.56	46	0.53	71	0.48	96	0.48		
22	0.47	47	0.52	72	0.52	97	0.47		
23	0.46	48	0.47	73	0.43	98	0.53		
24	0.52	49	0.56	74	0.48	99	0.49		

25	0.43	50	0.47	75	0.63	100	0.50		

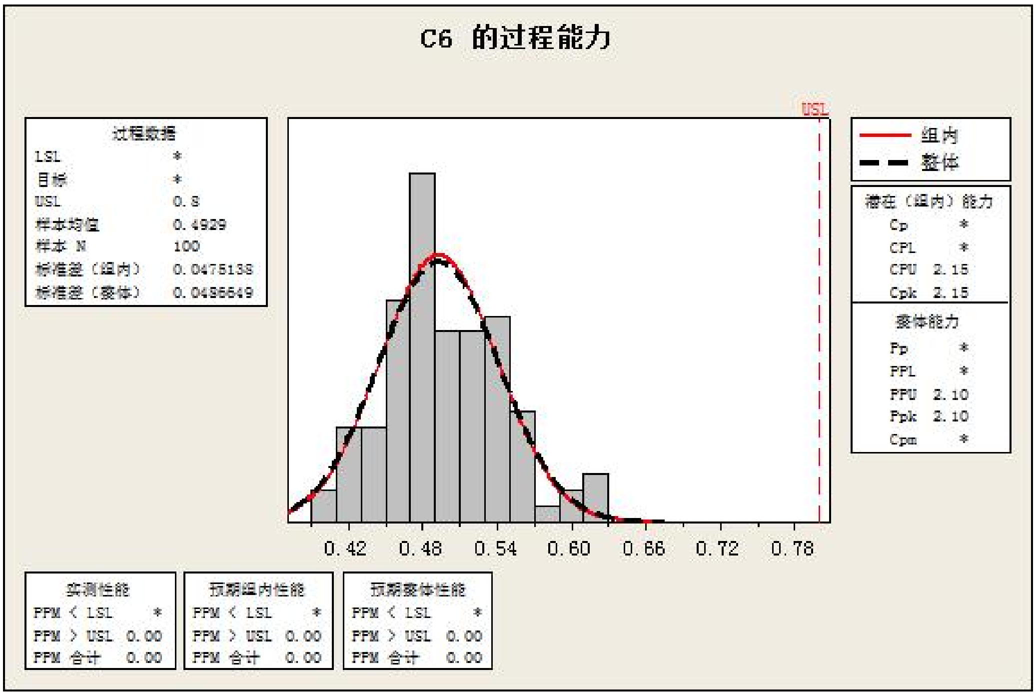

Figure 4.6 Process capability

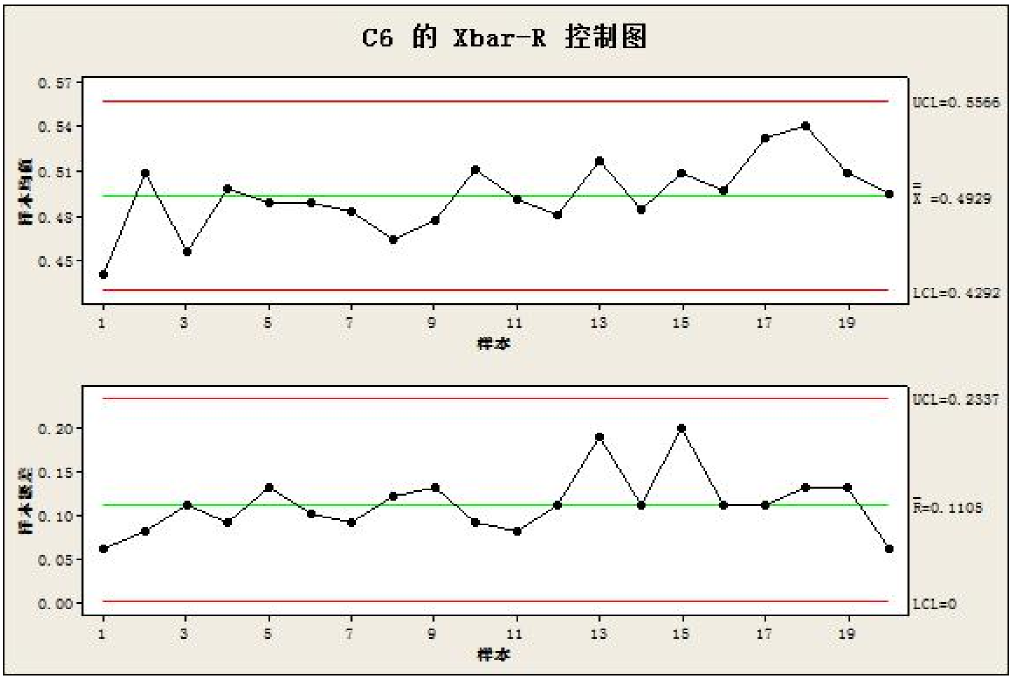

Figure 4.7 Control chart

According to the data, Cpk is 2.15 when processing the first 100 pieces, and the process is controlled.

The process capacity of processing 50 intermediate pieces is shown in table 4.4.

Table 4.4

Part No.零件号：40215-PLP020			Date 日期：2018-4-9

Part Name 零件名称：POLE PIECE						Measuring instruments 测量仪器：Perthometer			
Dimension Study 尺寸研究：roughness 0.8									
No.	Data	No.	Data	No.	Data	No.	Data	No.	Data
01	0.58	26	0.68						
02	0.62	27	0.71						
03	0.59	28	0.67						
04	0.52	29	0.62						
05	0.64	30	0.58						
06	0.57	31	0.66						
07	0.63	32	0.64						
08	0.67	33	0.58						
09	0.58	34	0.63						
10	0.55	35	0.68						
11	0.59	36	0.61						
12	0.6	37	0.65						
13	0.67	38	0.64						
14	0.58	39	0.66						
15	0.62	40	0.7						
16	0.66	41	0.72						
17	0.69	42	0.75						
18	0.63	43	0.69						
19	0.57	44	0.64						
20	0.61	45	0.71						
21	0.54	46	0.68						
22	0.62	47	0.74						
23	0.64	48	0.66						
24	0.59	49	0.72						
25	0.65	50	0.75						

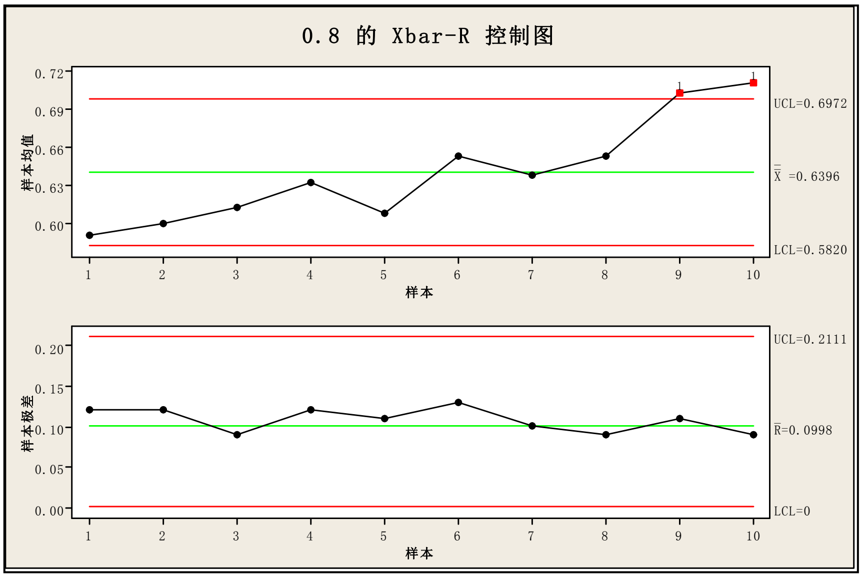

Figure 4.8 Control chart

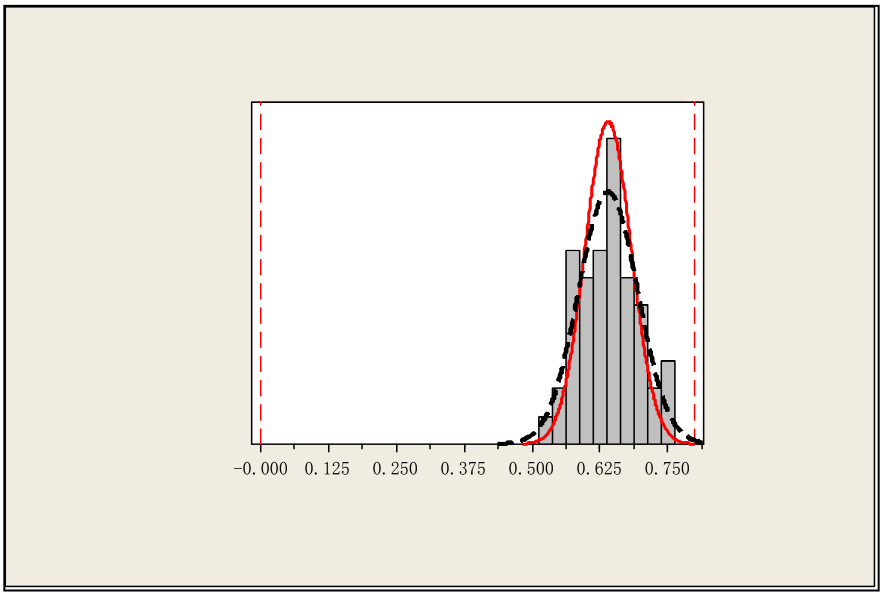

Figure 4.9 Process capability

As can be seen from the data and figure, Cpk is 1.29, and there are two points out of bounds in the control figure, showing insufficient process capability and uncontrolled processing process.

The measurement data of 150 pieces after processing. Table 4.5.

Table 4.5

Part No.零件号：40215-PLP020						Date 日期：2018-4-9			
Part Name 零件名称：POLE PIECE						Measuring instruments 测量仪器：Perthometer			
Dimension Study 尺寸研究：roughness 0.8									
No.	Data	No.	Data	No.	Data	No.	Data	No.	Data
1	0.49	26	0.48	91	0.58	136	0.67		
2	0.41	27	0.43	92	0.53	137	0.62		
3	0.49	28	0.55	93	0.61	138	0.6		
4	0.52	29	0.49	94	0.59	139	0.62		
5	0.54	30	0.53	95	0.63	140	0.66		
6	0.46	71	0.54	96	0.58	141	0.69		
7	0.41	72	0.46	97	0.57	142	0.71		
8	0.5	73	0.62	98	0.63	143	0.68		
9	0.51	74	0.48	99	0.55	144	0.74		
10	0.54	75	0.52	100	0.6	145	0.69		
11	0.5	76	0.49	121	0.63	146	0.64		
12	0.43	77	0.52	122	0.55	147	0.66		
13	0.49	78	0.56	123	0.64	148	0.71		
14	0.44	79	0.52	124	0.59	149	0.63		
15	0.49	80	0.59	125	0.61	150	0.65		
16	0.52	81	0.54	126	0.65				

17	0.54	82	0.61	127	0.56				
18	0.46	83	0.55	128	0.54				
19	0.41	84	0.53	129	0.62				
20	0.46	85	0.54	130	0.59				
21	0.43	86	0.49	131	0.66				
22	0.42	87	0.57	132	0.64				
23	0.45	88	0.53	133	0.58				
24	0.47	89	0.57	134	0.65				
25	0.42	90	0.52	135	0.62				

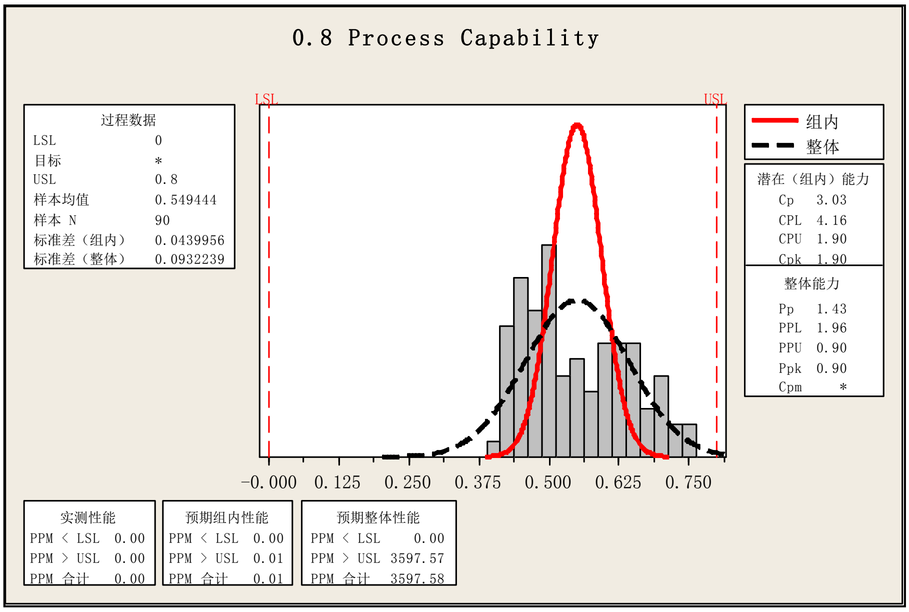

Figure 4.10 Process capability

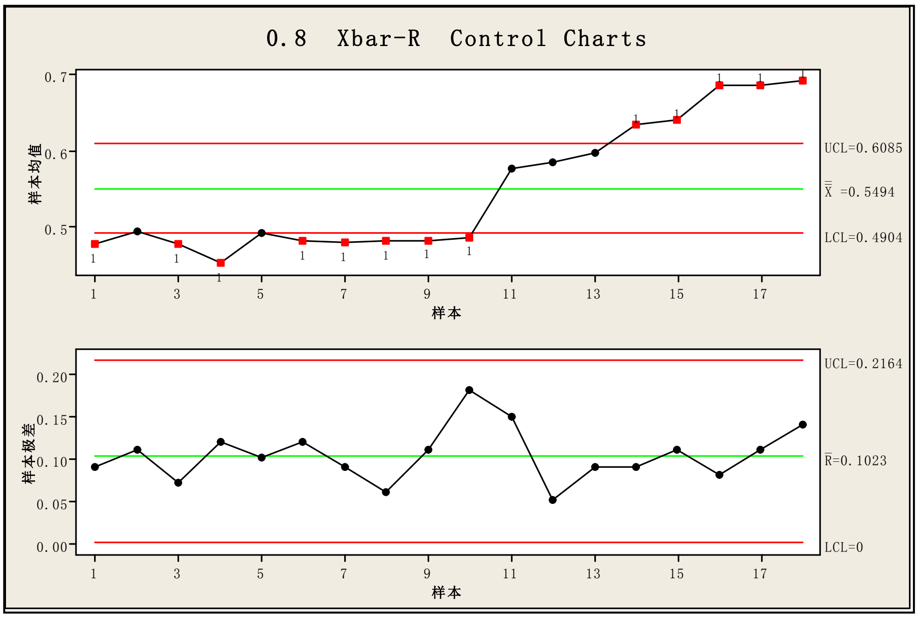

Table 4.11 Control chart

The last 150 pieces are out of control and need to be stopped for improvement.

Through the comparison, we can see that the tool aging has a certain degree of influence on the processing accuracy. So it is determined as essential factor and in need for improvement.

（2）Effect of material length on process capability before lathe working.

The original length of the raw material is 2.5 meters, which is cut to 35mm by special machine for lathe working. During the group discussion, it was proposed that the excessive length of the raw material loosens the clamping device and affects the processing accuracy. This end factor is confirmed as follows. Since the length of the work-piece is required to be 31.850±0.050mm in the part drawing, the length of the raw material before turning is determined to be 32mm.

The raw materials with a length of 32mm after length cutting were used for processing and the measured data are shown in table 4.6.

Table 4.6

Part No.零件号：40215-PLP020						Date 日期：2018-4-11			
Part Name 零件名称：POLE PIECE						Measuring instruments 测量仪器：Perthometer			
Dimension Study 尺寸研究：roughness 0.8									
No.	Data	No.	Data	No.	Data	No.	Data	No.	Data
1	0.49	26	0.48	51	0.53	76	0.55		
2	0.51	27	0.46	52	0.48	77	0.49		
3	0.53	28	0.46	53	0.43	78	0.53		
4	0.46	29	0.55	54	0.55	79	0.54		
5	0.48	30	0.45	55	0.49	80	0.46		
6	0.45	31	0.50	56	0.53	81	0.42		
7	0.61	32	0.46	57	0.54	82	0.48		
8	0.43	33	0.53	58	0.46	83	0.51		
9	0.48	34	0.47	59	0.62	84	0.48		
10	0.49	35	0.51	60	0.48	85	0.53		
11	0.41	36	0.44	61	0.51	86	0.55		
12	0.44	37	0.46	62	0.48	87	0.49		
13	0.43	38	0.54	63	0.43	88	0.60		
14	0.47	39	0.47	64	0.55	89	0.59		
15	0.51	40	0.52	65	0.59	90	0.52		

16	0.54	41	0.52	66	0.60	91	0.50		
17	0.50	42	0.58	67	0.47	92	0.54		
18	0.46	43	0.48	68	0.43	93	0.52		
19	0.50	44	0.56	69	0.46	94	0.49		
20	0.46	45	0.53	70	0.52	95	0.51		
21	0.49	46	0.50	71	0.48	96	0.50		
22	0.49	47	0.52	72	0.52	97	0.49		
23	0.48	48	0.57	73	0.61	98	0.51		
24	0.51	49	0.52	74	0.48	99	0.47		
25	0.47	50	0.54	75	0.57	100	0.50		

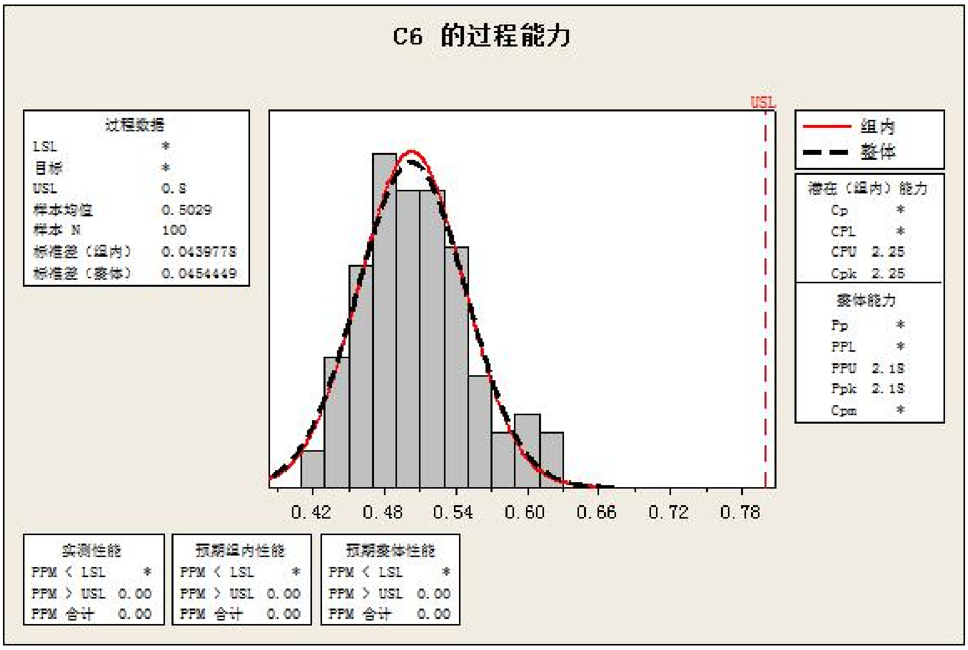

Figure 4.12

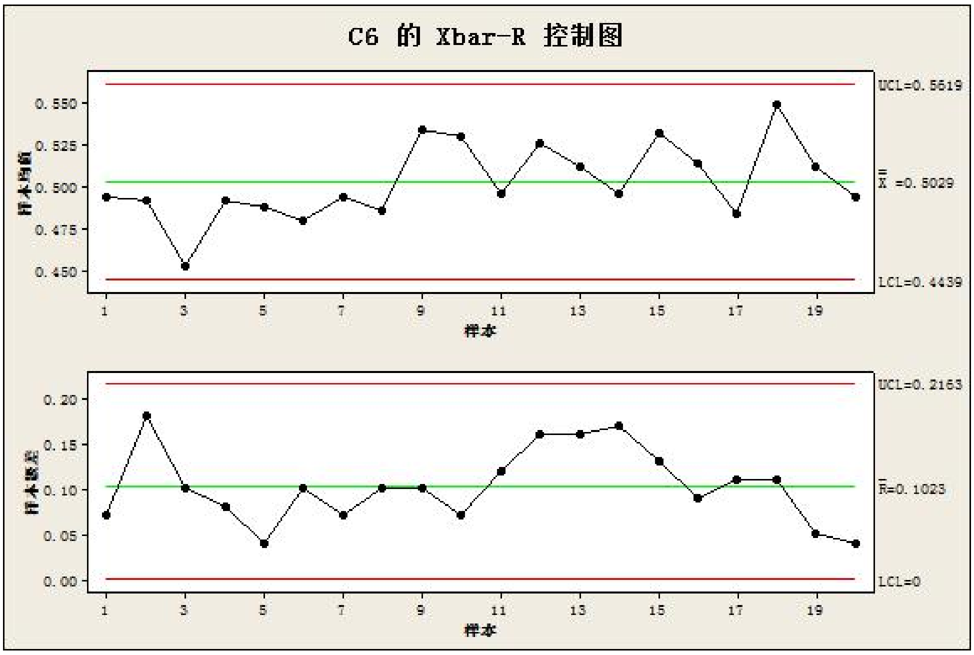

Figure 4.13

As what can be seen from figure 4.12-13 and table 4.6, after shortening the length of raw materials, the process capability index Cpk was increased to 2.25, and the process was controlled. Therefore, the length of materials was determined as the essential quality factor to be improved.

5 Improving phase

5.1 Improve plan

Based on the measurement results and the quality factors analyzed in the previous stage, and combined with the company's production experience, the following improvement plans were made:

(1) Change the turning tool replacement time from the original one day to one half day to ensure the accuracy of the tool.

(2) Shorten the raw material put into production from 35mm to 32mm, so that the clamping device can clamp the raw material without shaking to reduce the work-piece precision.

5.2 Plan implementation

After the implementation of the improvement measures, the work-piece is measured, and the measurement results are shown in table 5.1.

Table 5.1

Part No.零件号：40215-PLP020						Date 日期：2018-4-11			
Part Name 零件名称：POLE PIECE						Measuring instruments 测量仪器：Perthometer			
Dimension Study 尺寸研究：roughness 0.8									
No.	Data	No.	Data	No.	Data	No.	Data	No.	Data
1	0.57	26	0.62	51	0.56	76	0.54		
2	0.54	27	0.55	52	0.48	77	0.57		
3	0.51	28	0.64	53	0.58	78	0.62		
4	0.64	29	0.67	54	0.62	79	0.64		
5	0.59	30	0.64	55	0.64	80	0.54		
6	0.59	31	0.51	56	0.53	81	0.59		
7	0.59	32	0.55	57	0.63	82	0.61		
8	0.56	33	0.57	58	0.58	83	0.58		
9	0.59	34	0.58	59	0.61	84	0.62		
10	0.57	35	0.64	60	0.59	85	0.53		

11	0.55	36	0.57	61	0.64	86	0.57		
12	0.56	37	0.49	62	0.53	87	0.58		
13	0.64	38	0.66	63	0.54	88	0.61		
14	0.54	39	0.64	64	0.62	89	0.59		
15	0.58	40	0.56	65	0.66	90	0.66		
16	0.64	41	0.55	66	0.54	91	0.59		
17	0.52	42	0.57	67	0.57	92	0.58		
18	0.62	43	0.53	68	0.68	93	0.66		
19	0.57	44	0.6	69	0.59	94	0.64		
20	0.54	45	0.56	70	0.65	95	0.69		
21	0.62	46	0.62	71	0.57	96	0.59		
22	0.57	47	0.59	72	0.55	97	0.59		
23	0.63	48	0.61	73	0.56	98	0.63		
24	0.52	49	0.68	74	0.57	99	0.66		
25	0.49	50	0.57	75	0.53	100	0.61		

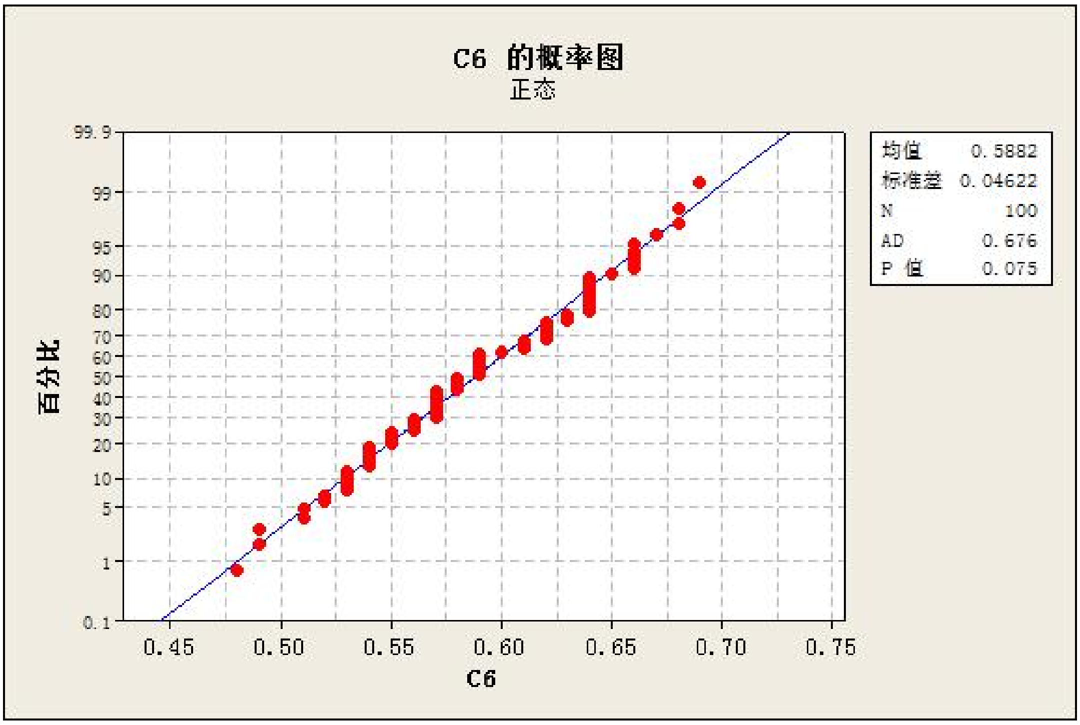

Table 5.1

As what can be seen from figure 5.1, P=0.075>0.05, so the measured data is considered to be normal distribution.

5.3 Improvement result check

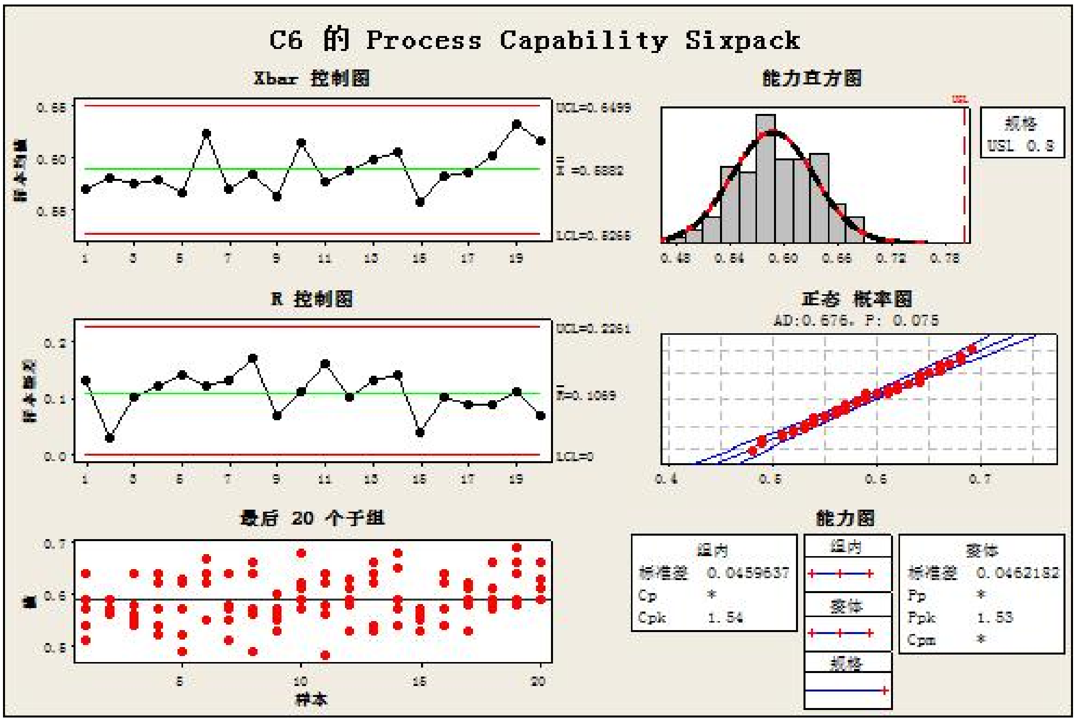

Figure 5.2 Process Capability Sixpack

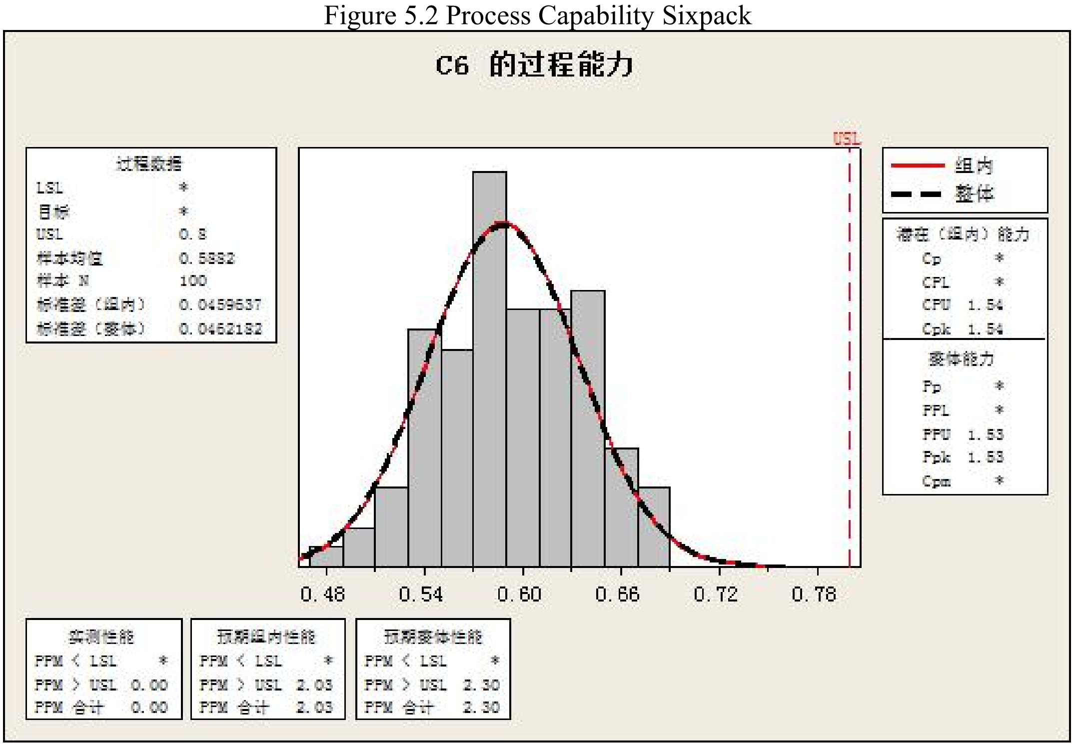

Figure5.3

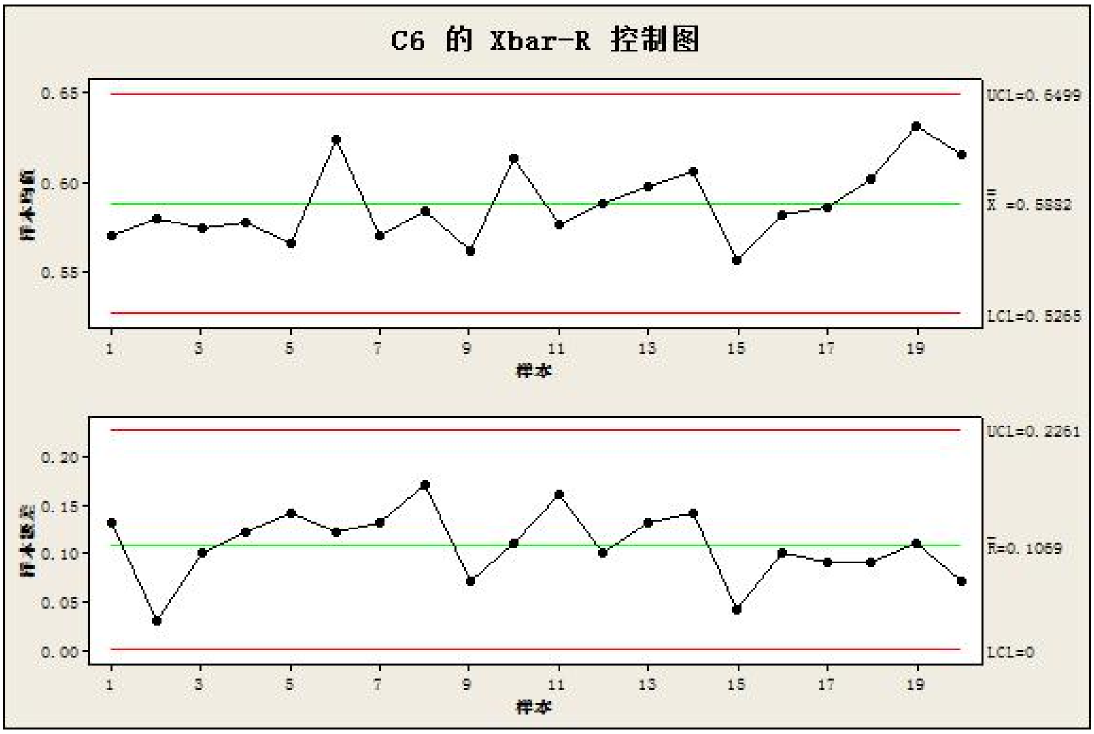

Figure 5.4

As what can be seen from above charts, after implementing the improvement measures, Cpk was increased to 1.54, greater than 1.33, and the process capability was significantly improved.

5.4 Implementation and documentation of improvement measures

In view of the above improvements and combined with the improvement results, a quality control improvement scheme for 40215-plp020 machining parts is proposed, as what's shown in table 5.2.

Table 5.2

Improve content	Solution	Operator
Lathe working tool	The frequency of tool changing is half a day	Manufacture department
Raw material length	Length of raw material is 32mm	Manufacture department

Through this round of PDCA cycle, accurately find the cause which affect the machining parts manufacture process capacity. Then according to the results of the data measurement the corresponding measures somehow improve the program and consolidate the results. In addition, temporarily existed bad methods of manipulation or problems to be settled will be carried over to the next PDCA cycle. Keep the cycling and it's sure to achieve the desired goals with satisfying results.

6 Summary and prospect

The control of work-piece quality covers the whole life cycle of processing and manufacturing, and the control of processing process is also an important part of the whole quality control.In this paper, using the PDCA cycle principle, a certain quality characteristic of 40215-plp020 machined parts is taken as the research object, and the quality problems arising from the processing process are analyzed and improved from the six aspects of human, machine, material, method, measurement and ring, and effective improvement measures are proposed to summarize experience and lessons while improving. After the start of the measurement system analysis, and then a large amount of data measurement and analysis, the more effective improvement measures are put forward, finally succeeded in machining process for the effective control of the Cpk up to 1.54, has obtained the good effect, and draws the following conclusion: the PDCA cycle to control the quality of machined parts has the scientific nature and effectiveness. This paper applies PDCA cycle method to the quality control of machining parts production process, improves the quality through the cycle, improves the production level, strengthens the team construction, and enhances the quality awareness of the staff, fully proves that PDCA cycle theory is applicable, feasible, scientific and effective in practice. The importance of quality problems to product production and processing is self-evident, the control of the process to some extent can be used as an important reference for whether the product is qualified.In the analysis of the main factors affecting the processing process, we are often faced with a dilemma, the predecessors put forward a variety of quality management methods have provided us with a good and effective way. As Nietzsche said, "man is great because he is a bridge, not a destination." Today, quality issues have received unprecedented attention, giving us a better chance to build on those who came before us and provide us with a bridge to higher quality goals. For enterprises, quality can directly affect their vitality. The quality problem is not simply right or wrong, but a concrete manifestation of survival of the fittest.We can not help but ask: "bottom line, what quality will bring?" In a narrow sense, the improvement of quality means not only the brand and efficiency, but also the vitality. Broadly speaking, quality is a powerful force for manufacturing. From the beginning of the 20th century, F. W. Taylor put forward the theory of scientific management, and it has been more than 100 years since then, from scientific management, to statistical quality control, to total quality management. TQM is more suitable for the objective requirements of modern mass production on the integrity and comprehensiveness of quality management, which promotes the shift from localized management to comprehensive and systematic management. To this day, we still marvel at the impact of the development of quality management on industrial progress. Finally, this graduation project further deepened the author's knowledge and application ability of machining parts and quality management, especially the use of the software tool Minitab, in the collection and analysis of data experienced its uncanny craftsmanship. Similarly, the author also has a deep understanding and experience of the machining process and production process in the work, which promotes the author to enhance the competitiveness in the future work, and also enhances the confidence of solving problems in the face of difficulties. As a result of the author's ability is limited, the article unavoidably has the insufficiency, also asks the reader to be able to put forward the valuable suggestion, thanks!

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Author Introduction

Education experience

2014/9—2018/6 China Jiliang University- Quality management engineering, Zhejiang Province, PRC

2011/9—2014/6 Dalian Yuming High School, Liaoning Province, PRC

2008/9—2011/6 Dalian Attached School of Dalian University of Technology, Liaoning Province, PRC

2002/9—2008/6 Dalian Attached School of Dalian University of Technology, Liaoning Province, PRC

Practical experience

- **Dalian ShenHua electronics co., LTD**

Jobs including data quality system maintenance, daily work including the updated KPI data and send the test form, making VQ, EOL monthly report, check the report from the logistics department, etc., within the prescribed working days to download Warrenty data system, update the report, in the early to make monthly report, including the content of VQ, customer complaints, the experiment test etc., after finish all table updates, whiteboard content to update the department, in addition with the quality engineer to production line, inspection area, laboratory, familiar with the product, to participate in the production workshop 5 s audit, to participate in numerous training such as 3 c certification, certification of DSP, TMS system training, also learn to use 8D reports to solve problems etc.

Xu Tianyuan

2018. 5

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