

**BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA**

**TAJUK: PROCESS CAPABILITY OF TIN PLATING INSPECTION-A CASE STUDY**

**SESI PENGAJIAN: 2018/2019**

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**Faculty of Manufacturing Engineering**

**PROCESS CAPABILITY OF TIN PLATING INSPECTION –  
A CASE STUDY**

**Siti Nurul Hazlina Binti Mohamad**

**Master of Manufacturing Engineering (Industrial Engineering)**

**2019**

## **DECLARATION**

I declare that this thesis entitled “Process Capability of Tin Plating Inspection – A Case Study” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : Siti Nurul Hazlina Binti Mohamad

Date :

## **DECLARATION**

I declare that this thesis entitled “Process Capability of Tin Plating Inspection – A Case Study” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

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Date :

## **APPROVAL**

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Manufacturing Engineering (Industrial Engineering).

Signature :

Supervisor Name : Dr Nadiah Binti Ahmad

Date :

## DEDICATION

My one and only beloved husband, Khairul Sharnizan,  
my beloved father, Mohamad Awang Isa,  
my appreciated late beloved mother, Allahyarhamah Ruhani Ismail,  
my beloved kids, Affan, Afeera & Ayyad,  
thanks alot to my youngest brother, Zarim  
and also not forget to my beauty younger sister, Wani  
for giving me moral support, money, cooperation, encouragement and also understandings  
Thank You So Much  
&  
I Love You All Forever

## ABSTRACT

This project begins with an industrial visit to industry selected that is XYZ Sdn. Bhd, Pasir Gudang, focused at production site and inspection area. This industrial attachment is very helpful in achieving objective study because the work done involves coating weight inspection. This case study was concerning on process capability of tin plating inspection. In plating industry, the most popular option for coating is of tin plating. This option is popular because it is more economical and does not require high costs in manufacturing. Due to the characteristic properties of tin plating having good corrosion resistance, ductility, and reliability, it is widely used in various industries including buildings, food, electricity and electronics, heavy industries and oil and gas. There are issues that having problem on the business which is in the last few months, this company has found a lot of complaints and rejects from customers regarding its product related to tin coating. The specification of the product is on request from the customer but in this case, the customer has set a guarantee limit called the Lower Specification Limit value of 2.45 m / g<sup>2</sup> the Upper Specification Limit is not more than 3.0 m / g<sup>2</sup>. The customer has placed the most accurate capability index for a certain parameter which is coating weight was at least 1.33. However, it is still meet the customer's specification and acceptable if the index capability value is not less than 1.00. Therefore, this company has requested the inspection division to state whether a customer-ordered product meets the needs of the customer or not by proving through process capability. From the inspection process, the sample of data has been collected. Due to that situation, main focus of this study is to investigate whether the product produced by the company meet the customer's specification their capability index for a certain parameter which is coating weight was at least 1.33 using process capability study. Process capabilities is an increasingly popular method used by many of today's industry to see the capability of a process or the quality of a product. In the process of achieving the main objectives which is to determine the optimum parameters of coating process, hypothesis testing has been done. The other purposed of this for this case is to study the element of tin plating process and also to study about coating inspection process and tools. The success of an organization or company depends on a high quality product and meets customer requirements. All the sample data collected from inspection process has been recorded in MS Excel and analyzed using MINITAB software.

## **ABSTRAK**

*Projek ini bermula dengan latihan sangkutan industri ke industri yang dipilih iaitu XYZ Sdn. Bhd, Pasir Gudang, memberi tumpuan di kawasan pengeluaran dan pemeriksaan produk. Latihan sangkutan ini sangat membantu dalam mencapai objektif kajian kerana kerja yang dilakukan melibatkan pemeriksaan berat salutan. Kajian kes ini berkaitan dengan keupayaan proses pemeriksaan timah ke atas produk yang telah dipilih. Dalam industri penyaduran, pilihan yang paling popular untuk lapisan adalah penyaduran timah. Pilihan ini popular kerana ia lebih menjimatkan dan tidak memerlukan kos yang tinggi. Disebabkan ciri-ciri sifat penyaduran timah yang mempunyai ketahanan kakisan yang baik, kemuluran, dan kebolehpercayaan, ia digunakan secara meluas dalam pelbagai industri termasuk bangunan, makanan, elektrik dan elektronik, industri berat dan minyak dan gas. Dalam beberapa bulan terakhir, syarikat ini telah menemui banyak aduan dan penolakan dari pelanggan mengenai produk yang berkaitan dengan lapisan timah. Spesifikasi produk adalah atas permintaan daripada pelanggan tetapi dalam kes ini, pelanggan telah menetapkan batas jaminan yang dipanggil nilai Had Spesifikasi Bawah dari 2.45 m / g<sup>2</sup>. Had Spesifikasi Atas pula tidak lebih dari 3.0 m / g<sup>2</sup>. Pelanggan telah meletakkan indeks keupayaan sekurang-kurangnya 1.33 untuk dipatuhi. Walau bagaimanapun, ia masih memenuhi spesifikasi pelanggan dan boleh diterima jika nilai keupayaan indeks tidak kurang dari 1.00. Oleh itu, syarikat ini telah meminta bahagian pemeriksaan menyatakan sama ada produk yang dipesan pelanggan memenuhi keperluan pelanggan atau tidak dengan membuktikan melalui keupayaan proses. Oleh kerana itu, tumpuan utama kajian ini adalah untuk mengkaji sama ada produk yang dihasilkan oleh syarikat memenuhi spesifikasi pelanggan mereka indeks keupayaan untuk parameter tertentu yang berat salutan adalah sekurang-kurangnya 1.33 menggunakan kajian keupayaan proses. Keupayaan proses adalah kaedah yang semakin popular yang digunakan oleh banyak industri hari ini untuk melihat keupayaan proses atau kualiti produk. Dalam proses mencapai objektif utama iaitu untuk menentukan parameter optimum proses salutan, ujian hipotesis telah dilakukan. Antara objektif lain adalah untuk mengkaji elemen proses penyaduran timah dan juga untuk mengkaji proses pemeriksaan salutan dan alat. Semua data sampel yang dikumpulkan dari proses pemeriksaan telah direkodkan dalam MS Excel dan dianalisis menggunakan perisian MINITAB.*



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# CHAPTER 1

## INTRODUCTION

### 1.1 Background of Study

For plating industry environment, tin plating is the most popular option as it is more economical and does not require high costs in manufacturing. It is a silvery blue-white metal that offers excellent ductility, high solderability and good surface coverage. Due to the characteristic properties of tin plating having good corrosion resistance, ductility, and reliability, it is widely used in various industries including buildings, food, electricity and electronics, heavy industries and oil and gas. It is also known as a plating that does not endanger the health of consumers and environmentally friendly plating method. In this case study, XYZ Sdn Bhd had been chosen as an industry to collaborate in this research which is situated in Johor Bahru, Johor. XYZ Sdn Bhd is one of the prime magnificence tinplate manufacturer, was specialized in coating service. This company provides coating services that prioritizes the environmentally friendly concept. XYZ Sdn. Bhd is the premier producer and supplier of high quality Tinplate for both domestic and export.

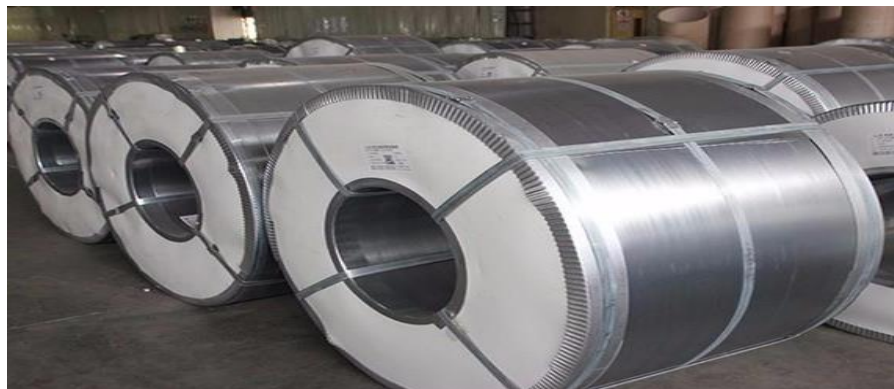


Figure 1.0: Product of tin plating

In the last few months, this company has found a lot of complaints and rejects from customers regarding its product related to tin coating. The specification of the product is on request from the customer but in this case, the customer has set a guarantee limit called the Lower Specification Limit value of 2.45 m / g<sup>2</sup> the Upper Specification Limit is not more than 3.0 m / g<sup>2</sup>. The customer has placed the most accurate capability index for a certain parameter which is coating weight was at least 1.33. However, it is still meet the customer's specification and acceptable if the index capability value is not less than 1.00.

Therefore, this company has requested the inspection division to state whether a customer-ordered product meets the needs of the customer or not by proving through process capability. Process capabilities is an increasingly popular method used by many of today's industry to see the capability of a process or the quality of a product. The purpose of the process capability is how the product will meet the design specifications. Today, most entrepreneurs in the manufacturing industry all over emphasize the quality assurance limits as to whether they meet the justification as requested.

In process capability, there are some important things to be followed, example is, in determining the quality aspects required in the manufacturing process. In addition, it also involves the process of collecting data from the process output. After that, a calculation process will be done on the data that has been collected. To determine whether a process meets the specified set of requirements, the capability index parameter value should be at least at the value of 1.33 (Support.minitab.com, 2018).

From the value, it may be assumed that a process is capable, correct and in accordance with the predetermined standards. If the process is in a state of specification, it means that the process can be continued and no improvement should be made. Process capability analysis is done in four ways i.e. by calculating the current process, process

performance evaluated through collected data, follow-up actions taken on the process and on the findings. As a result of this assessment, will determine whether the product will be accepted or rejected.

## **1.2 Problem Statement**

In this era, the manufacturing industries have grown rapidly. For each product, quality is the most important factor assessed by the customer. It is important to ensure that the ordered product meets the specification set by the customer. This quality is assessed through user feedback on the product. To ensure the highest quality of a product, the product defect should be taken care of. For most factories, when there is defect in the product, it must be immediately sent for the rework process. The faster decision analysis is obtained, the faster the rework process is performed. This will indirectly save time and reduce the complaint from the customer. In this case, the product specification has been provided by the customer. Defective product is a product that does not has enough installation, design, or manufacture or in other words, do not meet the prescribed standards. When the product does not meet the prescribed specifications, all the processes involved in the manufacture of the product need to be reviewed. In this case, the quality level is like the process capability index. Hypothesis testing is done to determine the distribution pattern on the analysis data sample of coating weight performance.

In order to maintain the quality of a product, the role of inspection and testing is the priority for all industries and organizations to be followed. The success of an organization or company depends on a high quality product and meets customer requirements. The most important of product inspection is verify quality at the source, avoid defective goods and reduce the cost due to over coating.

For this project, the coating weight is the main focus during inspection process. The coating weight is an important variable that plays a role in product quality, process control and cost control. Measurement of coating weight can be done with many different instruments. Understanding the equipment that is available for coating weight measurement and how to use it is useful to every coating process. There are certain methods and specific tools used to conduct inspection on the product in order to collect the data needed for case study. It will be discussed further in chapter 4.

Refer to the graph in Figure 1.1, can be seen in the value of the sample data which is not fixed value. From the graph, it can be seen that the data taken in April 2018 is unstable because the reading value is variable. This graph is plotted based on the data output taken from the inspection process. For this case, the customers have asked for part tolerances guarantee limits value is 2.45 g/m<sup>2</sup>. Depends on customer requirement, the Lower Specification Limit value (LSL) is 2.45 g/m<sup>2</sup> and the Upper Specification Limit (USL) value is 3.0 g/m<sup>2</sup>.



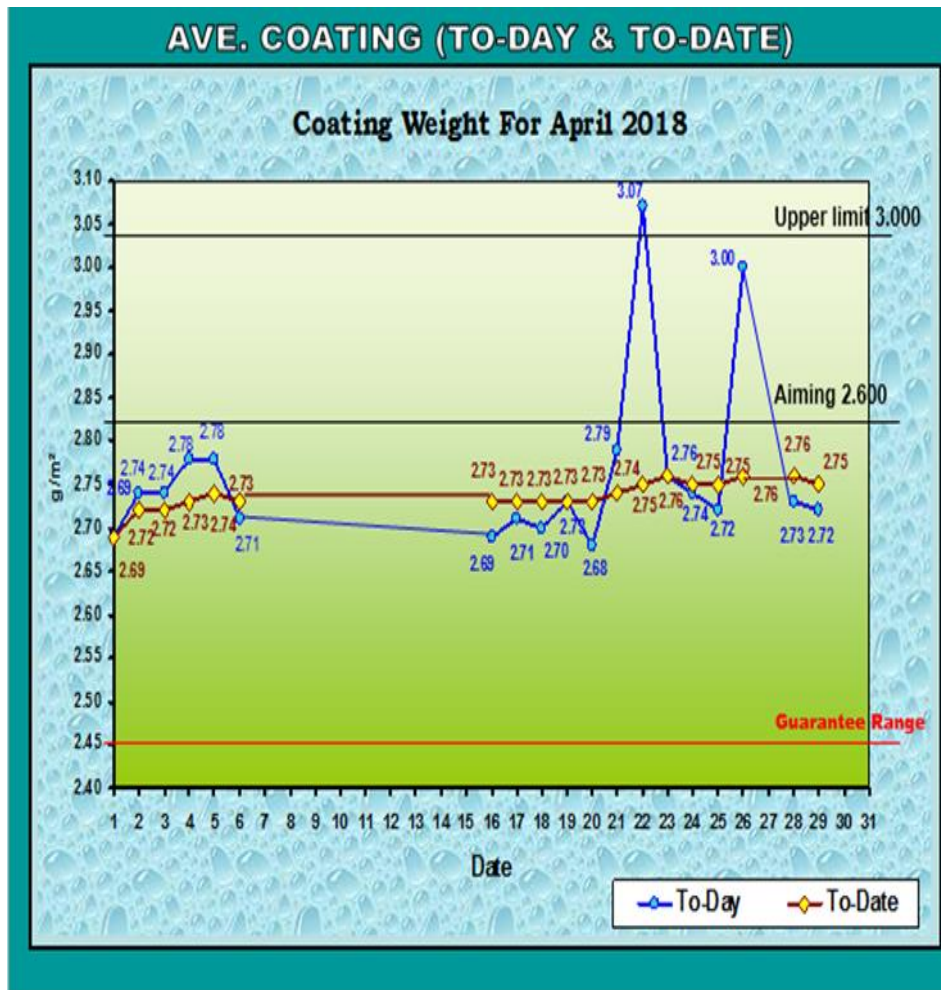


Figure 1.1: Daily average data in April 2018

By looking from the Figure 1.2 below, there were a variety sets of data of coating weight for 19 days. The data is recorded in MS Excel template. By looking at the day 13th, there was the highest data value which is 3.11 for top coating and 3.03 for bottom coating. That means process capability must be doing with the product in order to see whether the product meets the customer requirement or not. In addition, the important part is to find the optimal parameters that influence the occurrence of variability of sample data.

OBSERVATION DATA FOR 19 DAYS OF WORKING DAYS IN APRIL 2018								
DAY	TOP				BOTTOM			
	DR	CE	OP	AVE	DR	CE	OP	AVE
1	2.66	2.79	2.68	2.71	2.60	2.76	2.68	2.68
2	2.66	2.78	2.80	2.75	2.72	2.67	2.79	2.73
3	2.69	2.78	2.80	2.76	2.58	2.80	2.80	2.73
4	2.80	2.87	2.83	2.83	2.58	2.81	2.78	2.73
5	2.87	2.80	2.80	2.82	2.71	2.59	2.92	2.74
6	2.78	2.79	2.60	2.73	2.61	2.76	2.71	2.69
7	2.79	2.71	2.70	2.73	2.53	2.65	2.75	2.64
8	2.77	2.80	2.75	2.77	2.53	2.73	2.68	2.65
9	2.68	2.80	2.72	2.74	2.30	2.75	2.96	2.67
10	2.68	2.69	2.72	2.70	2.60	2.75	2.93	2.76
11	2.67	2.62	2.72	2.67	2.75	2.81	2.54	2.70
12	2.67	2.92	2.80	2.80	2.62	2.92	2.81	2.78
13	3.10	3.22	3.00	3.11	2.94	3.13	3.03	3.03
14	2.74	2.83	2.79	2.79	2.67	2.72	2.79	2.73
15	2.81	2.73	2.68	2.74	2.71	2.71	2.78	2.73
16	2.74	2.87	2.69	2.76	2.61	2.71	2.73	2.68
17	3.01	3.11	2.92	3.01	2.84	3.09	3.02	2.98
18	2.60	2.83	2.84	2.76	2.53	2.68	2.88	2.69
19	2.72	2.74	2.75	2.74	2.60	2.65	2.84	2.69

Figure 1.2 Observation Data for Coating Weight from MS Excel

From the graphs shown above, there were a variety sets of data of coating weight for 19 days. The data is recorded in MS Excel template. By looking at the day 13th, there was the highest data value which is 3.11 for top coating weight and 3.03 for bottom coating weight which means the result for the 13<sup>th</sup> day are overweight. It can be concluded that this data is unstable even go through the same coating proses. A statistically necessary approach needs to be applied to this unstable data. This means, the company has to investigate why this situation happened. In this case, the lowest guarantee limit value is

given by the customer. There were a variety sets of data of coating weight for 19 days. The data is recorded in MS Excel template. By looking at the day 13th, there was the highest data value which is 3.11. That means process capability must be doing with the product in order to see whether the product meets the customer requirement or not. Here, the company will set the LSL and USL values for a product based on the lowest guaranteed value provided by the customer. The USL value is  $3.0 \text{ g/m}^2$  while the LSL value is determined by the producer which is  $2.45 \text{ g/m}^2$ . The most desirable weight value for the plating is  $2.6 \text{ g/m}^2$ . So, if the weight value is between  $2.45 \text{ g/m}^2$  to  $3.0 \text{ g/m}^2$ , the product will be accepted. Otherwise, it will be rejected and sent directly to the rework section. There is no problem with the customer if the weight of the coating is more than a certain requirement but for the company it causes loss as they throw it more than desire. Therefore, this study will try to find the optimum setting parameter that affects the thickness of the coating. The unstable data output will be determined by using hypothesis test.

### **1.3 Objective of Study**

The objectives of this study are:

- i. To study the element of tin plating process, coating inspection process and tools
- ii. To investigate whether the product produced by the company meet the customer's specification their capability index for a certain parameter which is coating weight was at least 1.33
- iii. To determine the optimum parameters of coating process

### **1.4 Scope of Study**

- 1) This study is about tin plate process of in company production

- 2) This study is only at coating section inspection and restricted to outsiders
- 3) This study is about the certain parameters that effect coating characteristics in plating process.

## **1.5 Significance of Study**

The significant of study related for the company itself. The description of the result is related to all the work involved with the product which meets the specifications and requirements of the customer. During the process, the data coating weight will be collected and analyze using process capability analysis method. By the way, purpose of this case study is to reduce the cost of loss by a company which is caused by a product that does not meet the specification set by the customer. Besides, it is also to ensure that the product has a long life span. To achieve the objective of the study, the hypothesis test was conducted on the sample. Through the hypothesis test, we can find out the pattern of the analysis distribution that has been obtained after the inspection is carried out. Because of that, the scope of this study case is to investigate inspection process for coating weight based on company standard. During the process, the data coating weight will be collected and analyze using process capability analysis method. Discussion and findings on interpretation result will be described in Chapter 4. All the collected data are assumed as normal distribution.

Process capability refers to the capability of a process to consistently make a product that meets a customer specified specification tolerance. Capability indices are used to predict the performance of a process by comparing the width of process variation to the width of the specified tolerance. It is used extensively in many industries and only has meaning if the process being studied is stable which implement in statistical control.

Capability indices allow calculations for both short term ( $C_p$  and  $C_{pk}$ ) and or long-term ( $P_p$  and  $P_{pk}$ ) performance for a process whose output is measured using variable data at a specific opportunity for a defect. A process capability requires a predictable pattern of statistically stable behavior (most frequently a bell-shaped curve) where the chance causes of variation are compared to the engineering specifications. (APB Consultant.com), 2018

A capable process is a process whose spread on the bell-shaped curve is narrower than the tolerance range or specification limits. USL is the upper specification limit and LSL is the lower specification limit. All processes have built in statistical variability which can be evaluated by statistical methods (Bothe), 1997.

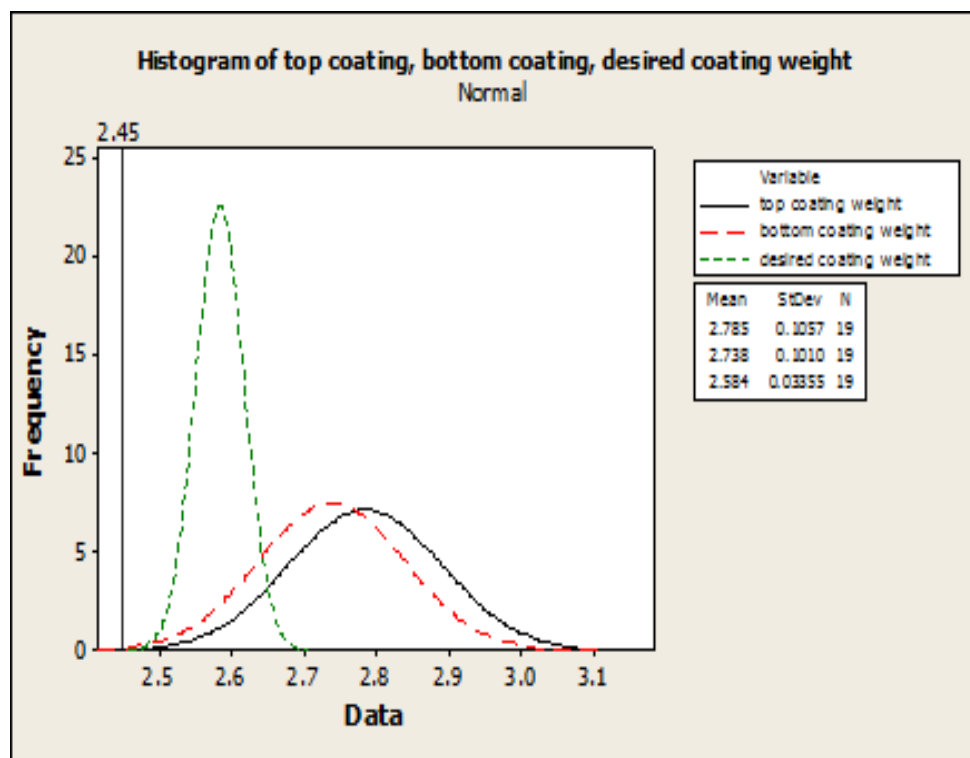


Figure 1.3: Histogram of Top Coating, Bottom Coating and Desire Coating

The analysis results in the diagram above show that 2.45 g / m<sup>2</sup> is guarantee low limit of the product as requested by the customer. There are different data analysis measurements performed for each sample. in this case study also, the unstable data distribution pattern can be known by studying the sample taken from the company using hypothesis test

analysis method The analysis result can be used to improve the quality of the product data and of course will reduce the cost.

## **1.6 Summary of Project**

In conclusion, the study can be done by observing the sample data obtained through inspection process at company selected. After data is collected, all the data by using will be analyze using Minitab Software to determine the desired result.

No.	<i>Author/Title</i>	Thesis description	Methodology
1	A Study of Sample Entropy towards Process Capability ( <i>Zheng Zhang, 2002</i> )	This thesis, is going to demonstrate a research towards process capability using Sample Entropy method. The desirable outcome would be that this method can avoid violating the assumptions.	- Find analysis parameters by using Process Capability approach. Analyzed using statistical method and used Minitab software.
2	Process Capability Analysis At Chaudry Textiles (Malaysia) Sdn Bhd (Mohamed Sallehsu Bin Kamaruzaman,	The main objective for this research are to predict current and future capability of the process to produce product within specification in the company and to investigate the product produced by the company meet the	Its indices are to measure the inherent variability of process and thus to reflect its performance by using Process Capability approach. Analyzed using statistical method and used Minitab software

	200	customer's specification.	
3	Experiments and Capability Analysis in Process Industry <i>(Peder Lundkvist, 2012)</i>	The overall purpose of this research is to contribute to an increased knowledge of analyzing DoE and capability in process industry, which is achieved through simulations and case studies of real industrial processes. This research focus on developing analysis procedures adapted for experiments and comparing decision methods for capability analysis in process industry	Analyzed using statistical analysis, such as process capability analysis and Design of Experiments (DoE), often plays an important role in such a strategy. Process capability analysis can determine how the process performs relative to its requirements or specifications, where an important part is the use of process capability indices. Analyzed using ANNOVA statistical method and used Minitab software.
4	<i>Sujeong Seo, 2017</i> Production	This paper will discuss about product level process capability with an example of the electronic	It will present several methodologies to calculate the product process capability with weighted arithmetic mean technique. Investigate characteristic effect on the