Analysis of quality control of chippendale furniture products using seven tools approach (case study of PT. Bothwell Indonesia)

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\textbf{Abstract.} One of the products produced at PT. Bothwell Indonesia is a small shelf. This product requires a high level of accuracy because the product has a screw and has separate small parts which are then put together. This can be found on the Chippendale Lacquered Library Side Table product. On this product, according to the staff section production and marketing, these products often face problems. Therefore, in this study, an approach with quality control is carried out to conduct further analysis, and it can be seen how the quality control that occurs in the product. The method used in this research is to use seven quality control tools. Based on the results of the product defect analysis, which has the highest value is the type of uneven paint defects with the number of products of 7 pieces. Next followed by the type of gross defect by five pieces, broken/cracked by three pieces. Based on the results of the analysis and discussion of Chippendale products included in controlled quality control. This is because when viewed statistically the number of products that have defects does not exceed or be less than the control limit.

\section{Introduction}

Business to business is one of the business models that can be applied to company manufacture. Business to business itself is a trade interaction by using internet networks or between business people, i.e. buyers of products sold by non-sellers the final consumer but the fabrication or the individual business at which the product purchased will be processed again or sold directly to end consumers \cite{1}. The business model generally has the definition of a business that provides a product or service to give to other businesses or companies.

A company that runs this business model will have a strong relationship with his companies. That is because every product was given to the company others, always provide the best quality to meet client desires. This is to maintain trust between these companies. The quality that the company gives to customers is proof that they can provide high quality following expectations customers \cite{2}. Products that have not been able to satisfy the customer can be said to have a lower quality product. This can affect the decision customers to buy products \cite{3}.

PT. Bothwell Indonesia is one of the companies engaged in the field furniture making with business models used is business to business (B2B) and the production system used is make to order, the MTO system is one type of type production used by a company, where products are made by this company based on the wishes of the buyer/client directly. Companies based on B2B business models and MTO production systems, companies are required to provide services and quality products best to
the buyer/client with many product variations. Therefore, controlling the quality of a product becomes a challenge that must be met by companies with many types of products produced.

One of the products produced by PT. Bothwell Indonesia is a small shelf. This product requires a high level of accuracy because the product has a screw and has separate small parts which are then put together. This can be found on the Chippendale Lacquered Library Side Table product. On this product, according to the staff section production and marketing, these products often face problems. Based on data obtained on products using the Checksheet table, there are still defective products.

| Product       | Defect Type | Total |
|---------------|-------------|-------|
|               | Dirty       | Crack/Break | Uneven paint | Rough |     |
| Chippendale 1 | -           | -          | -            | -     | 0    |
| Chippendale 2 | -           | √          | -            | -     | 1    |
| Chippendale 3 | -           | √          | √            | -     | 2    |
| Chippendale 4 | √           | -          | -            | -     | 0    |
| Chippendale 5 | √           | √          | -            | -     | 2    |
| Chippendale 6 | -           | -          | -            | -     | 0    |
| Chippendale 7 | -           | -          | √            | -     | 1    |
| Chippendale 8 | √           | -          | -            | -     | 1    |
| Chippendale 9 | -           | -          | -            | -     | 0    |
| Chippendale 10| -           | -          | -            | -     | 0    |
| Chippendale 11| -           | -          | -            | -     | 1    |
| Chippendale 12| -           | -          | √            | -     | 1    |
| Chippendale 13| -           | -          | √            | -     | 2    |
| Chippendale 14| -           | -          | -            | -     | 0    |
| Chippendale 15| -           | -          | √            | -     | 1    |
| Chippendale 16| -           | -          | -            | -     | 0    |
| Chippendale 17| -           | -          | -            | -     | 1    |
| Chippendale 18| -           | -          | √            | -     | 1    |
| Chippendale 19| -           | -          | √            | -     | 1    |
| Chippendale 20| -           | -          | √            | -     | 1    |
| Total         | 5           | 3          | 7            | 0     | 15   |

Therefore, in this study, an approach with quality control is carried out to conduct further analysis, and it can be seen how the quality control that occurs in the product. The method used in this research is to use seven quality control tools. This method is an online type of quality control, which is quality control when the product runs during the production process.

2. Literature Review
2.1. Quality
Quality is the degree or level of perfection; in this case, quality is a relative measure of goodness [4]. Operationally, a quality product or service, is one that meets the quality attributes or is often referred
to as the quality dimension. In other studies, quality is a dynamic statement related to products, services, people, processes, and environments that can meet or exceed expectations [5].

Quality also has a part in the decision to purchase a product. Based on the calculation results of multiple linear regression tests, it is seen that the quality of the product has a low level of significance compared to the significance of service quality [6]. For this reason, the quality of products in CV Jati Endah Lodoyo, Blitar must be improved so that the quality of these products can attract more consumers to buy furniture at CV Jati Endah Lodoyo, Blitar [6]. This is seen from the t-test of service quality variables having the most significant regression coefficient compared to product quality variables [6].

Several factors need to be considered by the company so that consumers can be attracted to the products produced, namely product quality, product diversity, product design, and price [7]. Product quality is the physical condition, function, and nature of the product concerned that can satisfy the tastes and needs of consumers satisfactorily according to the value of money that has been spent [7].

### 2.2. Quality Control

Quality is the overall characteristics contained in a product in the form of goods or services that can provide satisfaction to consumers who use the product. Products with good quality will undoubtedly be very in demand by consumers; therefore, it is necessary to have quality control because it is one way to improve the quality of a product [8]. Quality control is a series of 37 activities carried out following the plan, and if deviations occur can be immediately corrected so that something will be achieved [9]. To produce quality products that can compete in the market and can be accepted by the community [10].

There are more tools for achieving operative quality management targets, and the most frequent method is probably measurement and evaluation of the capability of processes through capability indexes [11]. In addition to other histogram and Ishikawa diagram are the following frequently used tools for quality improvement processes [11].

### 2.3. Statistical Processing Control (SPC)

SPC is statistical quality control that has 7 (seven) main statistical tools that can be used as tools to control quality [12]. These tools include check sheets, histograms, control charts, diagrams, Pareto, causal diagrams, scatter diagrams, and process diagrams.

### 2.4. Control Chart

A control chart is one of the tools (tools) to control statistical processes (SPC). A control chart is used to analyze the output in a process. Analysis of the control chart carried out can be visualized graphically to monitor and evaluate whether the activity/process is in statistical quality control or not so that it can solve problems and produce quality improvements [13]. In this tool shows a change from time to time, but cannot know the cause of the deviation occurred [14]. The control chart is divided into two based on the object being measured, namely the variable control map and the attribute control map. A variable control map is a tool to measure quality control by taking measurements on objects obtained directly from the measurement results. On the attribute control map is a measure of quality control carried out based on the characteristics of an object.

### 2.5. P Control Chart

One of the measuring instruments on the attribute control chart is the control chart p. This control chart is to calculate the proportion of characteristics that have been determined. The following are the steps in carrying out quality control with the P control chart [15]:

\[
\text{Calculate damage percentage } \quad p = \frac{np}{n} \tag{1}
\]

\[
\text{Center line (CL)} \quad CL = \bar{p} = \frac{\sum np}{\sum n} \tag{2}
\]
Upper control limit (UCL) \[ UCL = \bar{p} + 3 \sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \] (3)

Lower control limit (LCL) \[ LCL = \bar{p} - 3 \sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \] (4)

3. Research Methodology
In this study, the method of analysis carried out is a seven tools approach. The subject used in the study was one of the products produced at PT. Bothwell Indonesia. The product is Chipandell. The object used as research is the quality of the product.

4. Result
In this study, based on observations and interviews. Can be known the types of defects found in a product. The following types of defects have been identified:

| Type of Defect | Picture |
|----------------|---------|
| Dirty          | ![Image](dirty.png) |
| Uneven paint   | ![Image](uneven.png) |
| Crack/Break    | ![Image](crack.png) |

4.1. Checksheet
Making a table (Check sheet) is useful to facilitate the process of data collection and analysis. Because making this table is the first step taken to analyze quality control statistically. The following is a defect data for each product in the Chipendalle Lacquered Library Side Table type in February 2020 at Table 1.

4.2. Control Chart
4.2.1. Percentage of Product Defects
The percentage of product defects is used to see the percentage of product defects in each sub-group (observation). The data is processed to find the percentage of damage from each subgroup (observation). The following is a table of data processing results:
| Observation | Product | Defective Product | Defective Proportion |
|-------------|---------|-------------------|----------------------|
| 1           | 3       | 2                 | 0.67                 |
| 2           | 4       | 2                 | 0.5                  |
| 3           | 5       | 3                 | 0.6                  |
| 4           | 3       | 2                 | 0.67                 |
| 5           | 5       | 3                 | 0.6                  |

In one product can have more than one type of product defect, in these conditions the product is still counted as one defective product.

4.2.2. Center Line (CL)
Central line / Central Line is the middle line that is between the upper control limit (UCL) and the lower control limit (LCL) or is the average value of the proportion of defective products. Based on formula (2) we get Central Line (CL).

\[ CL = \bar{p} = \frac{\sum np}{\sum n} = \frac{12}{20} = 0.6 \]  

4.2.3. UCL and LCL
The upper control limit and the lower control limit are statistically measured indicators that a process can be said to be distorted or not. The upper control limit (UCL) can be calculated using formula (3); the lower control limit can be obtained as follows:

\[ \bar{p} = 0.6 \]
\[ n = 5 \]

\[ UCL = \bar{p} + 3 \left( \sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \right) = 0.6 + 3 \left( \sqrt{\frac{0.6(1-0.6)}{5}} \right) = 1.257 \]  

\[ LCL = \bar{p} - 3 \left( \sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \right) = 0.6 - 3 \left( \sqrt{\frac{0.6(1-0.6)}{5}} \right) = -0.057 \]

4.2.4. Control Chart
After all the required values have been calculated, the next step is to create a p-chart. The control chart p is created using a spreadsheet. The products produced are still within the control limits. That is because for the 5 points in the observation are between the control limits (UCL) and (LCL). Besides that, the value of the proportion of defects is close to the average value of the proportion of defects.
5. Discussion

5.1. Control Chart

Based on the picture above, it can be seen that the products produced are still within the control limits. That is because for the 5 points in the observation are between the control limits (UCL) and (LCL). Besides that, the value of the proportion of defects is close to the average value of the proportion of defects.

5.2. Fishbone
5.2.1. Fishbone (uneven paint)

Uneven paint results due to poor lighting conditions. This causes the spray section officer to be less careful in giving the paint to the product so that there are parts that are not exposed to colour. Also, because the ability of the expert very much needs the spray process, so the products included in the spray process are not the same result. At the corner of the product cannot be reached by a large spray because it needs to be replaced with a small size spray to improve accuracy in colouring.
5.2.2. Fishbone (Crack/break)

Product breakage or cracking results from poor lighting conditions. This causes the putty section staff to be less careful in giving putty on every connection that is on the product so that there are parts that are not putty. Also, in every process of moving goods, especially at close distances, the transfer is carried out by sliding or pushing the product so that it causes vibrations to the product. The final cause of this type of defect is the type of raw material used because each type of wood used has different physical resistance.

5.2.3. Fishbone (Dirty)

The results of dirty products are caused by dusty environmental conditions resulting from the remnants of the refinement process that are not cleaned regularly. This causes the wind can easily carry the remaining refinement. The lack of a vacuum cleaner cause products to become dirty because the intensity of the refinement process is high enough to make the environment full of dust. Then the next cause is the absence of SOPs in moving goods. As with the use of gloves that are required in every transfer of the finished product. This is to reduce employees who do not maintain cleanliness, which is due to environmental conditions and every production process.
6. Conclusion and Recommendation
Based on the results of the product defect analysis, which has the highest value is the type of uneven paint defects with the number of products of 7 pieces. Next followed by the type of gross defect by five pieces, broken/cracked by three pieces.

In the type of paint defect that is not evenly caused by tools that have not been rearranged, lack of lighting around the spray room, lack of operator accuracy in spraying, and lack of written Standard Operating Procedures for tool use, and in spraying. In the type of defect cracked/broken caused by lack of lighting on the retarding. Resulting in less careful employees in doing putty on every part or connections on the product. Next is the removal of goods without written SOP and types of wood raw materials used in production. In the type of gross defect caused by environmental conditions that are different due to the remnants of the refinement process. Then the lack of a vacuum cleaner and SOP in moving goods. Based on the results of the analysis and discussion of Chippendale products included in controlled quality control. This is because when viewed statistically, the number of products that have defects does not exceed or be less than the control limit.

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References
[1] Rayport, J. F., & Bernard, J. J., 2001. Introduction to e-commerce. Boston: McGraw Hill.
[2] Mulyono, B., Yoestini, N. R., & Kamal, M., 2007. Analisis Pengaruh Kualitas Produk dan Kualitas Layanan Terhadap Kepuasan Konsumen (Studi Kasus Pada Perumahan Puri Mediterania Semarang). Semarang: Pasca Sarjana Universitas Diponegoro.
[3] Kodu, S., 2013. Harga, Kualitas Produk, dan Kualitas Pelayanan Pengaruhnya Terhadap Keputusan Pembelian Mobil Toyota Avanza. EMBA, 1251-1259.
[4] Hansen, D. R., & Mowen, M. M., 2009. Akuntansi Manajemen, Terjemahan Dewi Fitriasari dan Deny Armor Kwary. Jakarta: Salemba Emhat.
[5] Goetsch, D. D., & Davis, S. B., 2006. Quality Management; Introduction Total Quality Management for Production, Processing, and Service. Prentice Hall: Pearson.
[6] Muki, M.Y.D., 2015. Pengaruh Kualitas Produk Dan Kualitas Layanan Terhadap Keputusan Pembelian (Studi Kasus Pada Mebel Cv Jati Endah Lodoyo Blitar). Riset Mahasiswa Ekonomi (RITMIK), 2(1).
[7] Basyir, A., 2012. Pengaruh Kualitas Produk, Keragaman Produk, Desain Produk dan Harga Terhadap Keputusan Pembelian Konsumen pada Jati Jepara Furniture Kabupaten Jepara (Doctoral dissertation, Universitas Muria kudus).
[8] Susetyo, J., Winarni, & Hartanto, C., 2011. Aplikasi Six Sigma dan Kaizen Sebagai Metode Pengendalian dan Perbaikan Kualitas Produk. Jurnal Teknologi, 53-61.
[9] Assauri, S., 1998. Manajemen Operasi dan Produksi. Jakarta: LP FE UI.
[10] Montgomery, D. C., 1990. Pengantar Pengendalian Kualitas Statistik. Yogyakarta: Gajah Mada Universitas Press.
[11] Simanová, Ľ. and Gejdoš, P., 2015. The use of statistical quality control tools to quality improving in the furniture business. Procedia Economics and Finance, 34, pp.276-283.
[12] Heizer, J., & Barry, R., 2006. Manajemen Operasi. Jakarta: Salemba Emhat.
[13] Arsyad, A. G., Ferdinant, P. F., & Ekawati, R., 2017. Analisis Peta Kendali p yang Distantarisasi Dalam Proses Produksi Regulator Set Fujiyama (Studi Kasus : PT. XYZ). Jurnal Teknik Industri, 86-92.

[14] Ariani, D. W., 2004. Pengendalian Kualitas Statistik. Yogyakarta: Andi Offset.

[15] Ilham, M. N., 2012. Analisis Pengendalian Kualitas Produk Dengan Menggunakan Statistical Processing Control (SPC) Pada PT. Bosowa Media Grafika (Tribun Timur). Makassar: Fakultas Ekonomi dan Bisnis Unvirsitas Hasanuddin.