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ADOPTION OF DIGITAL TECHNOLOGY BY EMBROIDERY ENTREPRENEURS IN SALATIGA CITY (CASE STUDY ON SMALL BUSINESS CONVECTION PERSADA, TINGKIR)

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Abstract

This research explores the adoption of digital technology in embroidery in a case study at Konveksi Persada Tingkir. Technology adoption plays a vital role in determining productivity, innovation, and business journey. The development of embroidery technology will make the production process easier, starting from the use of computers in the sewing and embroidery process. The transition from manual embroidery techniques to computer-based embroidery is a strategic step to increase productivity, product quality, and business competitiveness in an increasingly competitive market. This research uses mixed methods, qualitative and quantitative with a case study method. At Persada Company, entrepreneurs who become owners and managers have considerations in adopting computer technology to increase customer satisfaction and expand target markets. When comparing the level of technological sophistication, computer embroidery relies more on technoware, while manual embroidery relies more on humanware. The adoption of computer embroidery technology was able to increase production speed up to five times compared to manual techniques, with an average production reaching 160 units per day. In addition, the accuracy of embroidery results increased by 1.16 times, with product defect rates reduced by 58%, providing a significant impact on operational efficiency. This technology also makes it easier for the production process, which previously relied heavily on the skills of human operators, to now become more automated and consistent in terms of final results. The results of this research show that the adoption of digital technology, especially computer embroidery, is an effective solution for improving the performance of small and medium enterprises in the textile and convection sectors.

Keywords: Computer Embroidery Technology, Productivity, Manual Embroidery, Small Businesses, Technology Adoption

INTRODUCTION

Adopting digital technology is an important strategy to increase productivity for entrepreneurs. The application of technology in the industry changes the speed of production and the efficiency of production process time, thereby increasing productivity. Technology and innovation have taken over jobs previously done by humans (World Economic Forum, 2018). Factories that keep up with the times, almost no longer need human labor, perhaps only skilled workers are left who are able to work (Adha Hadi, 2020). Thus, currently, technology is increasingly needed and is becoming an important aspect in various fields, especially the production process. Digital technology adoption is a process for selecting new innovations. This means that the process of adopting digital technology is not only related to how users accept it but is also considered a strategic step to generate added value and increase productivity.

Increasing productivity can be used to determine targets or goals in a company (Ramayanti, 2020). Productivity is often associated with two aspects that can be combined to determine the level of productivity, namely effectiveness and efficiency. The combination of effectiveness by determining activities in the process of resource management capabilities that support the smooth running of the production process. Efficiency is an activity that reduces waste to obtain maximum results with a minimum amount of input. Efforts that can be made to increase productivity are by adopting digital technology that is currently continuing to develop. One of the business sectors that has now begun to adopt digital technology is embroidery entrepreneurs.

In Dutch, embroidery known as *embroidery*, is an art that makes things look more beautiful. *Embroidery* is very attached to the term *sulam* because the word *embroidery* is taken from English, namely embroidery (in-broide) means embroidery (Soeharsono, 2004). Embroidery first appeared to be considered a luxury item because it could only be owned by certain people, especially royal people. The development of embroidery in Asia began with the Cing Dynasty where embroidery was used to decorate royal robes. Meanwhile, in Indonesia itself, decorative embroidery skills existed around the 18th century AD, which were introduced by the Chinese and continued by the Indians. Making this embroidery craft was initially done simply using tools in the form of a needle and thread. Along with advances

in technology, many embroidery sewing machines are now being produced, namely computer embroidery machines. Embroidery businesses can be found in many areas of Indonesia, and Salatiga City is one of them.

Salatiga is a small city with MSMEs as one of the pillars and drivers of the economy in this city (Shanti Y. et al., 2023). One of them is an embroidery business that has spread across Salatiga. Embroidery craftsmen in Salatiga initially still used manual techniques, namely by hand, then using sewing machines. However, along with the development of digital technology, embroidery entrepreneurs are starting to adopt digital technology in doing business. So, entrepreneurs started using computerized technology to make embroidery.

The convection village started in 1987, starting from PT. Damatex, which is the largest company in Salatiga City, is willing to give the remaining fabric it produces to 13 Tingkir Lor residents. People who are allowed to take cloth to factories usually sell it by the kilo. Some people started trying to make drawstring trousers, skirts, and clothes while waiting for customers. The clothes made were responded to well by the market. Convection activities are slowly but surely developing (Setyawan, 2014). The embroidery business at the Persada Tingkir Convection is the focus of this case study research, located on Jalan Raya Salatiga-Suruh Km.8, RT 03/RW 02, Singojayan, Tingkir Tengah, Tingkir District, Salatiga City, was founded in 2011, still using manual embroidery. As convection technology developed, Persada began to adopt embroidery technology using computers until now. The computer embroidery industry has a positive influence on the community around the Tingkir area because it is still rare to find embroidery businesses using computers.

This research uses a qualitative approach, based on research gaps from several previous studies. Research (Purnomo, 2011; Wibowo et al., 2023; Teknik et al., 2016) focuses on discussing the use of technology adoption in business as a condition for performance without considering the suitability of technology with the type of business being run, and the benefits of technology adoption on MSME performance and business sustainability. Research from (Faiza & Kristina, 2021) discusses the role of technology in the small embroidery industry, focusing on other aspects such as productivity, operational management, and the development of computer embroidery in manual embroidery businesses, emphasizing the factors that influence the sustainability of manual embroidery businesses amidst the

development of computer embroidery technology. So, from some research gap previous research, this research can fill the gap in previous research, namely knowing what is the background of embroidery entrepreneurs in Salatiga adopting digital technology, in addition to knowing the comparison of the level of sophistication of manual and digital embroidery technology and the impact of technology adoption on company performance.

RESEARCH METHOD

This research uses a case study design with a qualitative approach, which aims to explore the adoption of digital technology in the embroidery business at Persada Konveksi Tingkir. The case study was chosen because it allows an in-depth analysis of a specific phenomenon in one unit, namely an embroidery company. Through a qualitative approach, this research focuses on a subjective understanding of participants' behavior, attitudes, and opinions regarding the adoption of digital technology, such as embroidery business owners who have changed their operations from manual embroidery to digital embroidery. The data collection method was carried out through structured interviews and direct observation of the production process, performance, and efficiency of using digital technology in the embroidery business.

Data analysis was carried out using data reduction methods, data presentation, and concluding. Data collected through interviews and observations were tested using the Mann-Whitney Test, which aims to see significant differences between the productivity of manual embroidery and digital embroidery. This test helps measure the level of sophistication of digital embroidery in improving company performance by testing hypotheses regarding the comparison of the productivity of the two methods. The results of the analysis are expected to show the significant impact of adopting digital technology in increasing productivity and operational efficiency at Persada Konveksi Tingkir.

RESULTS AND DISCUSSION

Comparison of the Sophistication Level of Manual Embroidery and Computer Embroidery

The Persada Tingkir Convection, which was built by Mrs. Umi Hani, initially also used a manual embroidery machine. The use of manual embroidery depends entirely on the capabilities of human labor. The process begins by preparing the material, drawing a pattern on the fabric, and sewing by hand. The speed of work also depends on the ability and work experience in using traditional embroidery tools such as needles, threads, and cloth. To increase convection productivity, Persada switched to using computer embroidery technology. In contrast to manual embroidery machines, computer embroidery technology uses fully automatic machines to sew designs that have been programmed into embroidery design software. Based on the results of research conducted at Konveksi Persada Tingkir, the following are several comparisons using manual embroidery and computer embroidery:

Table 1.

Comparison of Manual Embroidery Technology with Computer Embroidery That Has Been Implemented at Konveksi Persada

	Manual Embroidery	Computer Embroidery
Function	• Manual embroidery is operated manually by skilled operators to control the movement of border machines, at that time there were 4 operators at Persada Convection • The operator uses his hands to move the embroidery needle to form an embroidery pattern on the fabric • The operator uses his foot to step on the pedal to regulate the speed of needle movement and control thread tension. • The operator must carefully adjust the position of the fabric and move the fabric to create the appropriate embroidery pattern	• The computer embroidery machine is operated digitally using a computer and special software, and currently there is only Mrs. Dayah as the computer embroidery operator who only commands the machine • The operator does not need to move the needle and cloth manually, but with digital commands. • The operator uses a computer to enter the embroidery design into the computer embroidery machine • The software will translate the design into precise embroidery needle movements • The computer will control the movement of the needle,

	• The fabric frame containing the embroidery pattern must be continuously moved manually by the operator to form the appropriate pattern • Each manual embroidery product will have different variations because it depends on the operator's ability to control the machine manually.	regulate the speed, and control the thread tension automatically • The fabric frame will move automatically following the programmed design pattern • The resulting embroidery is identical, precise, and consistent because it is controlled digitally.
Media Used	• Both manual embroidery and computer embroidery use cloth as the basis for making embroidery. • On manual embroidery machines, operators use embroidery patterns that are made manually on physical media such as cloth, plastic, or paper • Making manual patterns requires drawing skills and each manual pattern will be slightly different from one another because it is still drawn manually.	• In computer embroidery, operators use digital files to design embroidery patterns • This digital file can be created using design software, and currently Persada embroidery uses Corel Draw and AutoCAD. • The operator can create and save the embroidery pattern design on a flash disk, then send it to the computer embroidery machine which will read the digital instructions and move the needle automatically
Produced Products	• Produces embroidery that is unique and distinctive, and has a personal and handmade touch • Product variation is high because each item is made manually and each product will have slight differences because it is made manually • When using manual embroidery, Persada Embroidery is able to produce products such as small party logos, trousers, and children's clothes.	• Produces products that are more precise, consistent, and uniform • With computer embroidery, embroidery designs are more complex and varied, so the designs can be saved and reproduced with the same results • The production process is faster and more efficient • Persada Embroidery when using computer embroidery is able to produce products such as uniforms with full embroidery, and embroidered hats.

How to Order	• Customers can come directly to the embroidery place and order an embroidery design by asking the operator to make it according to the customer's wishes, using paper media • The operator will describe how to make an embroidery pattern manually and then use it as a guide for making embroidery with a manual sewing machine.	• Customers can order embroidery by sending designs via WhatsApp without needing to come to the embroidery place • The design files that have been sent are then created by the design team using Corel Draw, which will be made according to the customer's specifications

Source: Primary data is analyzed

Figure 2.

Computer Embroidery Used at Konveksi Persada

When compared directly, the time required to complete digital and manual embroidery is very different, for example, manual embroidery requires several hours to complete a simple design, while computer technology embroidery only requires a few minutes to complete a more complex design. Some factors influence production speed:

a. Embroidery Design: Computer embroidery technology is able to handle complex designs without spending a lot of time, while manual embroidery will take a long time to create a design

b. Production Quantity: Computer embroidery technology is much better for mass production because it can produce many embroidered uniforms in a short time. On the other hand, manual embroidery makes it difficult to meet large embroidery requests in a short time.
c. Manual Intervention: When using computer embroidery once the program is set up, the subsequent embroidery process is almost entirely automated, which reduces dependence on human labor and reduces waiting time.

Sophistication Level Measurement Results

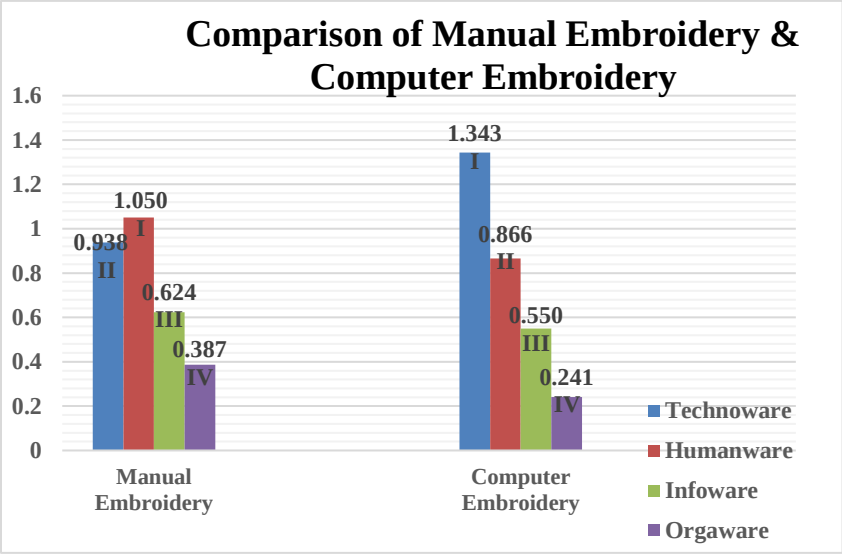

Figure 3.
Comparison Diagram of the Sophistication of Manual and Embroidery Computer Embroidery According to Technological Components

From Figure 3, it can be seen that there is a difference in the level of sophistication between manual embroidery and computer embroidery. If the computer embroidery measurement results show the highest value is found in the component Technoware because technoware has an important role in the production process using computer embroidery at Konveksi Persada based on the data above. Meanwhile, the measurement results from manual

embroidery which have the highest value are Humanware, because the embroidery production process is completely carried out by human labor.

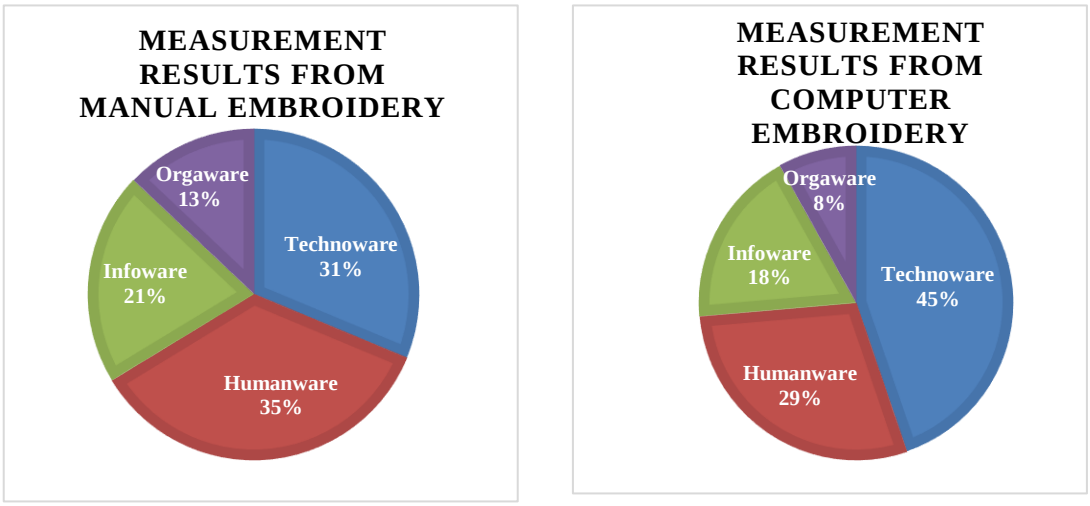

Figure 4.
Diagram of the Results of Measuring the Level of Sophistication Technology of Manual Embroidery

Based on the diagram above, the measurement results from computer embroidery show the value Technoware 1,343 contributed 45% of the measurement of the level of technological sophistication, compared with Humanware which has a value of 0.866 with a contribution of 29%, is ranked second in the results of measuring the level of technological sophistication because the operator means Humanware also contributed to operating computers to design images and operating computers to command embroidery machines in the production process. Meanwhile, the value of Infoware 0.550 contributes 18%, ranking third thus Infoware becomes important because computers are able to work based on information, both information requested from outside or information created by Humanware with a computer system. Whereas Orgaware has the lowest value in productivity priority value, namely 0.241, and contributes only 8%.

This is different from the measurement results in computer embroidery. Measurements in manual embroidery, the first rank which contributed the highest reached 35% with a value of 1.050, namely components Humanware. Based on the diagram above, Humanware has the highest value from manual embroidery measurement results because the production process still relies entirely on human power, such as in making sketches on cloth, the process of embroidering cloth by embroidering. With the skills and experience that the workforce has, they are able to produce embroidery of high value, because not everyone is able to make embroidery by embroidering or manually. Thus, the reason why Humanware has the highest value from the results of manual embroidery measurements. Technoware in the measurement results, manual embroidery was ranked second, with a value of 0.938 reaching 31%. Third place, namely Infoware with a value of 0.642 contributing 21% to the production process. Meanwhile, the lowest contributor to the results of manual embroidery measurements is Orgaware with a value of 0.387 only contributes 13%.

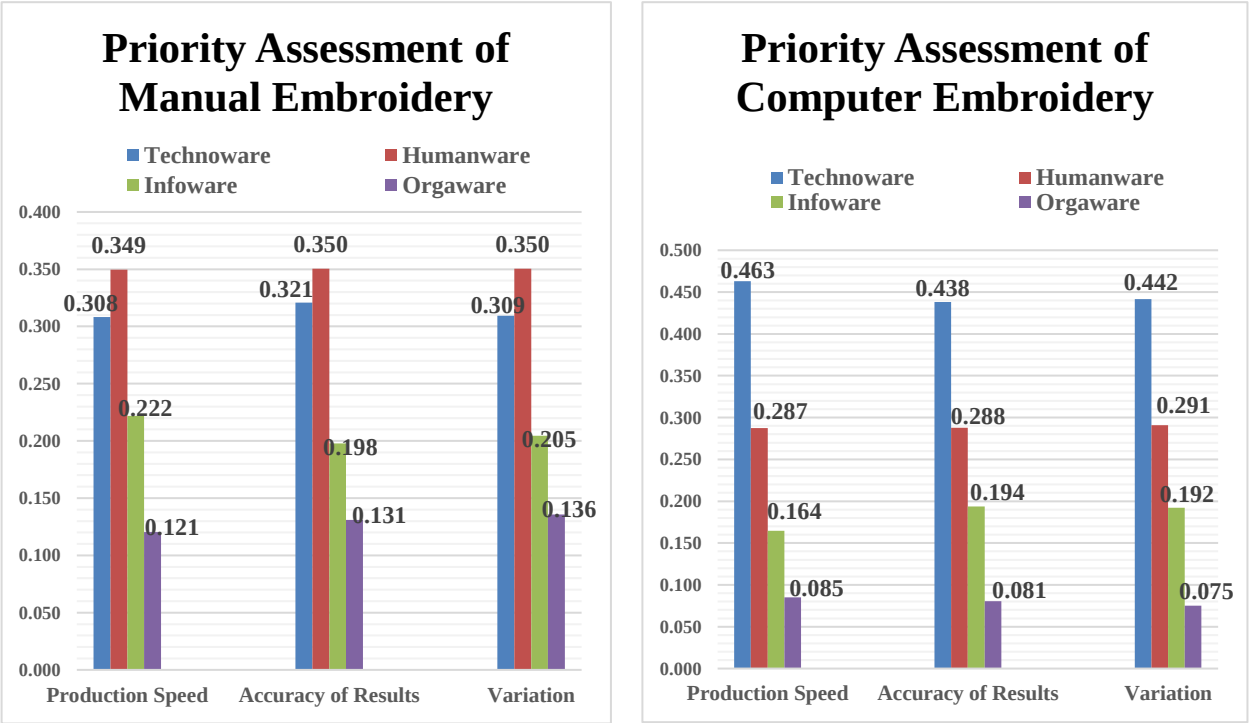

Figure 5.

Priority Assessment Diagram by Component Technology of Manual Embroidery and Computer Embroidery

Figure 5 explains the general division used in technology analysis, so that there are four technological components, namely technoware, humanware, infoware, and orgaware. By using assessments based on three criteria, namely production speed, accuracy of results, and variety, which are the focus of productivity aspects. It is explained that the total priority assessment according to computer embroidery technology components shows that technoware has a value of 1.343, which means the highest value among the other components namely humanware, infoware, and organization. It can be seen, that the results of the production speed assessment from Technoware are 0.463 so it shows that Technoware is able to speed up the production process, reduce cycle time, and increase production value. Technoware Modern computer embroidery machines are equipped with high precision control systems and have accurate measuring and working capabilities, this is reflected in the high accuracy value of 0.438. The study by Lee et al. (2020) says that the implementation of industry 4.0 technologies, such as advanced sensors and real-time monitoring systems can reduce production error rates by up to 35%, directly increasing productivity through reducing waste and improving quality. Mark techno ware in the variation aspect, namely 0.442, shows its ability to adapt to various production needs, as research by Zhang and Chen (2019) explains that technological flexibility contributes to increasing productivity in a dynamic manufacturing environment.

Meanwhile, the priority measurement results from manual embroidery in Figure 4 can be interpreted through percent values, namely from the Production Speed criteria with components Technoware contributed 30.8%, Humanware 34,9%, Infoware 22.2% and Orgaware 12.1% contributes to production speed. Apart from that, there is an Accuracy of Results with values Technoware 32,1%, Humanware reached a value of 35.0%, Infoware 19.8% and Orgaware 13.1%. From the Variation criteria with Technoware 30,9%, Humanware 35,0%, Infoware 20.5% and Orgaware 13.6%. So, it can be interpreted that these three criteria contribute the most to measuring the priority of manual embroidery Humanware.

Of the four technological components, there is one component that has the lowest value or ranking, both as a result of measurements from computer embroidery and manual embroidery, namely Orgaware. Management limitations in managing resources cause components Orgaware to have the lowest value among the other components, which was obtained from research at Konveksi Persada. When adopting computer embroidery technology, Persada convection management focused more on Technoware for computer embroidery technology, because the system is regulated by a computer that is able to work quickly and more efficiently. Meanwhile, in manual embroidery, Konveksi Persada's management focuses more on Humanware, such as producing quality embroidery which is done manually through the skills possessed by the workforce.

Impact of Adopting Computer Embroidery Technology on Company Performance

The adoption of computer embroidery technology is one of the strategic steps taken by Persada Convection in the textile and fashion industry. The adoption of technology allows Persada Convection to innovate and adapt to market changes. Therefore, these changes have an impact on the company's overall performance. The adoption of computer embroidery technology has increased the productivity, quality, and operational efficiency of the Konveksi Persada company. Several key performance indicators are used to measure this change, such as increased production speed, production variety, and output accuracy.

Table 2.

Mann Whitney Test Results, Performance Comparison Between Manual Embroidery and Computer Embroidery

Test Statistics[a]

Manual Embroidery Performance Comparison Computer Embroidery	
Mann-Whitney U	.000
Wilcoxon W	15.000

Z	-2.611
Asymp. Sig. (2-tailed)	.009
Exact Sig. [2*(1-tailed Sig.)]	.008[b]

a. Grouping Variable: Skor

b. Not corrected for ties.

Table 2, the results of the Mann Whitney Test via SPSS, shows that the Mann Whitney Test is 0.000 so it can be said to be significant. Apart from that, the value of Asymp.Sig. (2-tailed) is 0.009 < 0.05, so it is concluded that the hypothesis is accepted. Exact Sig. [2*(1-tailed Sig.)] with a value of 0.008 means it also shows significance because 0.008 < 0.05. Apart from that, the Z value shows -2.611, meaning that manual embroidery is smaller than computer embroidery. With this analysis, it can be seen that there is a difference in the productivity of Konveksi Persada between the use of manual embroidery and computer embroidery, so it can be concluded that there is a significant difference in influence when adopting computer embroidery technology on the productivity results of Konveksi Persada. Thus, the impact of adopting computer embroidery technology on the productivity of Persada Tingkir Convection has a positive impact and is able to increase the company's productivity.

Increased Productivity

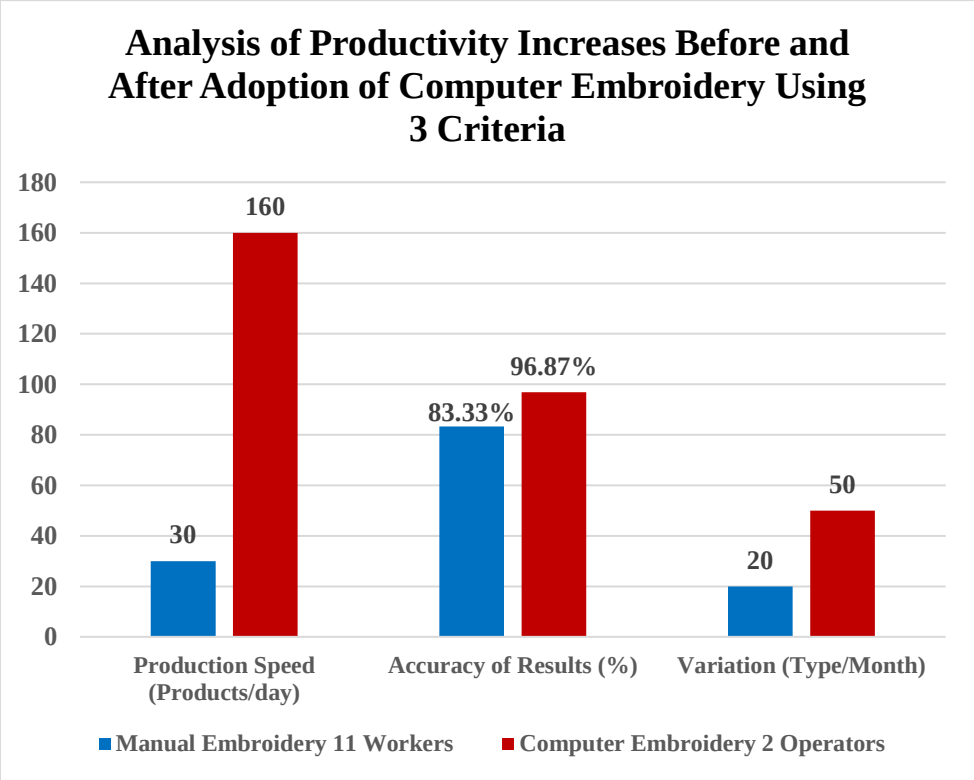

Figure 6.

Analysis of Productivity Increases Using Three Criteria

Production speed refers to the ability to produce products in larger quantities in a shorter time. The switch from Persada Convection to using computer embroidery technology was able to improve the quality of the products produced, with computer embroidery technology. Konveksi Persada is capable of producing 5 times more embroidery than producing manual embroidery. From the results of the research carried out, it can be seen in Figure 6, when the production process still used manual embroidery, a day with 8 working hours was only able to produce 30 pieces of embroidery with a total of 11 employees that time. So, the level of production speed produced by manual embroidery is 11 pcs in 3 hours. The production process results in 30 pcs a day and there are 25 pcs of embroidery that meet quality standards, so the accuracy level of the Persada Konveksi production process results reaches 83.33%. Meanwhile, design variations using manual embroidery are still limited to only 20 types/month.

After adopting computer embroidery technology, Konveksi Persada is able to produce 60 pcs in 3 hours, with the current number of workers or computer embroidery operators being 2 people. The production speed of Persada Convection is 20 pcs/hour. So, in a day with 8 hours of work we produce 160 pcs with 6 computer embroidery heads, and there are 155 pcs of embroidery that meet quality standards. Thus, the accuracy rate produced by Konveksi Persada reached 96.87%. Meanwhile, the variety of designs that can be done using computer embroidery technology reaches 50 types/month. Thus, it can be seen that there is an increase in productivity by analyzing 3 criteria before and after adopting computer embroidery technology, namely that production speed has increased quite significantly, reaching 5.33 times after using computer embroidery technology. Likewise, the accuracy of the results also increased by 1.16 times. Meanwhile, design variations increased up to 2.5 times after the adoption of computer embroidery technology.

Computer embroidery technology can increase productivity, especially through automation of the production process. By using computer embroidery, the production process is more efficient than using manual embroidery. Konveksi Persada currently uses XIONG DI brand computer embroidery with 6 heads. Computer embroidery machines can produce products at a much higher speed compared to manual embroidery machines, because computer embroidery is able to work automatically after the program is set, thereby increasing production speed, design variations, and consistency. Processes that previously required the involvement of human labor, such as selecting thread colors, sewing patterns, and changing threads, can now be carried out by computer embroidery machines quickly and precisely. Thus, the number of workers is reduced, because workers are more focused on operating and monitoring machines rather than the direct production process, but labor productivity continues to increase. Automation also helps the workforce avoid physical fatigue, which often occurs in manual processes and leads to higher embroidery errors.

The computer embroidery used by Persada convection is currently capable of storing thousands of designs in internal memory, usually, 100 MB, making it possible to adjust designs directly on the machine control panel and merge designs and design transfers and firmware updates can be done using USB. XIONG DI computer embroidery owned by Konveksi Persada is also equipped with process automation, including:

a. Auto thread Trimming: Automatic thread trimming system reduces turnaround time between design segments.
b. Auto Color Change: Automatic thread color switching between design elements.
c. Thread Break Detection: Advanced sensors detect thread breaks and stop the machine automatically to prevent design damage.

Apart from that, embroidery machine operators can easily operate it because it is equipped with a 10–12-inch touch screen. The existence of a touch screen in computer embroidery technology is a real form of application Technoware which allows operators without embroidery experience to use the machine easily and efficiently. The XIONG DI computer embroidery technology used by Persada Convection currently provides advantages in terms of production speed and flexibility. The sophisticated computer embroidery features and ease of operation are of course one of the considerations for business owners to adopt computer embroidery so that they will be able to increase the productivity of Persada convection.

Product Quality Improvement

By switching to computer embroidery technology, Persada convection is able to guarantee quality consistency which is difficult to achieve with manual methods, especially for large orders or repeat orders from regular customers. Current customer demand, which follows design trends using multiple colors in one embroidery, therefore requires computer embroidery technology that can handle color changes in the embroidery making process quickly and accurately. The adoption of computer embroidery technology will enable Konveksi Persada to receive and produce orders with more complex designs such as subtle color gradations and texture effects, thereby opening up new market opportunities and increasing the added value of Konveksi Persada products.

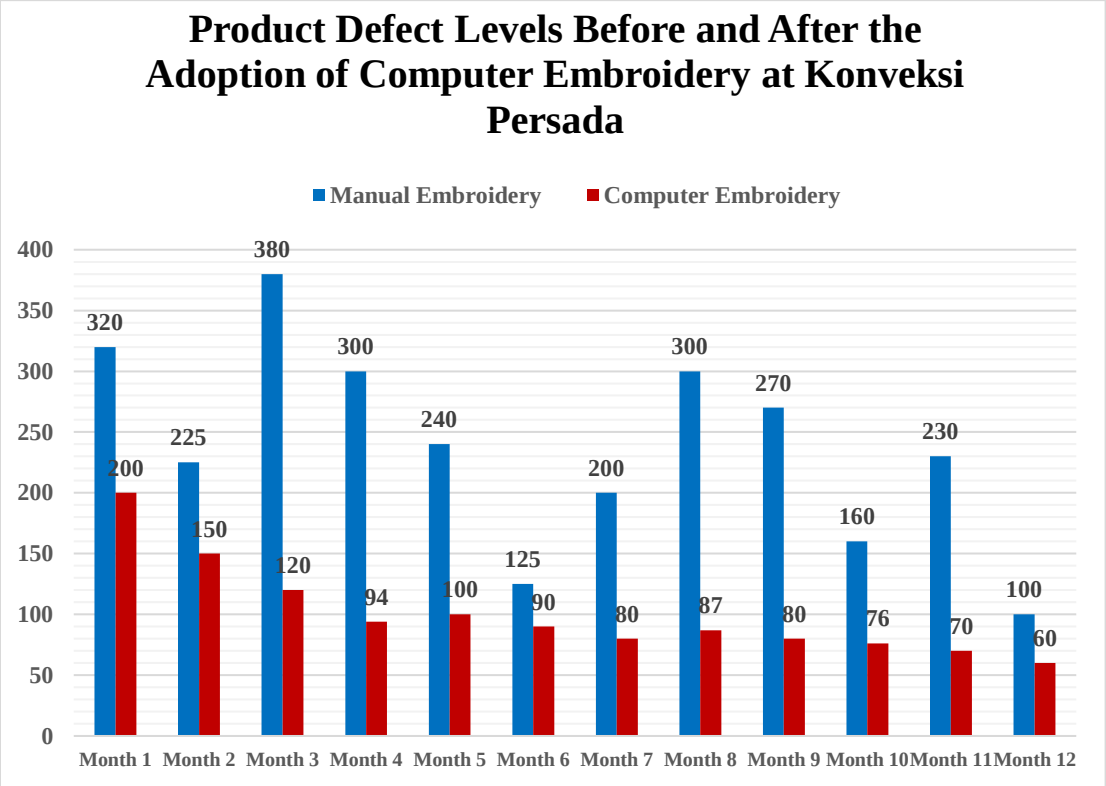

Figure 7.

Comparison of Previous Product Defect Levels and After the Adoption of Computer Embroidery

Based on research conducted, Konveksi Persada is able to produce more than 3,000 embroidery products per month. The analysis was carried out by taking time samples during the 12 months before the adoption of computer embroidery, meaning that manual embroidery was still used, which produced 1000 pcs per month and 12 months after the adoption of computer embroidery. Through Figure 7, it can be seen that there is quite a significant difference in the level of defective products produced before and after the adoption of computer embroidery. The production process carried out using manual embroidery still has many product defects, unlike when using computer embroidery, the defective products in the production process are much lower, no more than 200 defective products. The factors used to determine production defects at Konveksi Persada include color accuracy, neatness of seam edges, seam uniformity, seam strength, and accuracy of design position, so computer

embroidery technology will minimize defective products which previously often occurred in the production process with manual embroidery.

Computer embroidery technology can significantly speed up the production process, and is more accurate than the manual production process, thereby reducing waste of raw materials such as fabric and thread, with computer embroidery technology being able to calculate the number of threads precisely so that the materials used are as needed and reducing waste. Therefore, the use of computer embroidery technology is able to save raw materials because patterns and designs are stitched precisely, thereby reducing the possibility of damaged products, meaning that using computer embroidery technology will reduce the costs and time spent on repairing and replacing defective products.

CONCLUSION

The adoption of computer embroidery technology by the Persada Tingkir convection is the right step. From the results of research on computer embroidery technology, which means Technoware contributed the highest with a value of 1,343 reaching 45%, so it can be said that the adoption of computer embroidery technology is important to increase the productivity of a company. Because with the adoption of computer embroidery technology, Persada convection management is able to change and is able to provide and recruit competent people. Several important factors encourage the use of computer embroidery technology at Konveksi Persada, namely to expand the target market and increase the efficiency and quality of the products produced. There are still not many embroidery businesses that use computer embroidery technology. In this way, Konveksi Persada is able to use these technological advances to gain a competitive advantage in the Tingkir area, Salatiga. Apart from that, currently Konveksi Persada is able to expand its target market beyond the city of Salatiga.

It can be said that the adoption of computer embroidery technology was right for Konveksi Persada, because through the above analysis using computer embroidery technology the production speed reached more than 5 times that of before when manual embroidery was still used. Initially, we were only able to produce 30 pcs per day, until now the production process in a day is capable of producing approximately 160 pcs of embroidery.

The accuracy of the results also increased 1.5 times, while the variety of designs increased up to 2 times after adopting computer embroidery technology. Apart from that, sales of embroidery products have also increased by 200% to date. Initially, before adopting computer embroidery, Konveksi Persadaa produced approximately 1,000 pieces of embroidery per month, but after adopting computer embroidery technology, it was able to produce up to more than 3,000 pieces per month.

The use of computer embroidery technology has proven to be much more efficient and sophisticated compared to the use of manual embroidery, especially in several factors, namely production speed, accuracy of results and variations in producing embroidery designs. Apart from that, adopting computer embroidery technology can reduce defective products by up to 58%. Computer embroidery technology is able to increase the productivity of Persada Tingkir Convection, namely being able to increase the quality and speed of production. Thus, Konveksi Persada is able to receive many orders from within the city of Salatiga and outside the city. Apart from that, computer embroidery technology will reduce the level of defects in embroidered products, which will also reduce production costs and increase the efficiency of resource use.

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