

Analysis Of The VDI 2221 Method On Yarn Winding Tools

Ernest Alfie

Abstract. *UKM KF Kayra, based in Troso Village Rt 04/01, Pecangaan District, Jepara Regency, is a producer of ikat fabrics. Currently, the production process at UKM KF Kayra is still carried out manually. They implement a make to order production system. One of the obstacles faced is the weft thread winding process. Using a manual thread roller extends the process time, where one pallet can take 3 to 4 minutes. A thread winding operator can only produce about 100 pallets in one day, which is still not enough to meet the daily needs of weavers. Apart from that, operators who do milling also experience discomfort and injuries to their wrists and shoulders because the wheel turning process is done manually. Therefore, it is necessary to propose improvements by developing and redesigning existing tools, as well as making several improvements to increase productivity. In designing this thread winding tool, the VDI 2221 method was used, which is a systematic approach in the design of engineering systems and engineering products. The result of this design is a tool with an electric dynamo drive that rotates at 2800 rpm using a vbelt as the drive shaft for a pulley with a diameter of 2.5 inches. The analysis results from 10 tests show an average rolling time of 1.23 minutes per piece, which is more efficient than the previous tool which took 1.38 minutes. This new tool is not only more efficient in use, but also provides comfort and reduces the risk of injury for UKM KF Kayra employees.*

Keywords : *Tool planning, VDI 2221, Thread Winding Tool .*

INTRODUCTION

UMKM KF Kayra is a business that produces ikat woven fabric located on Jl. Pecangaan – Bugel KM 1 Troso Village Rt 04/01, Pecangaan District, Jepara Regency. Ikat Woven Fabric is a fabric woven from strands of weft or warp threads that are previously tied and dipped in dye. The loom used in the production process is a non-machine loom (ATBM). In its development, this traditional ikat woven cloth has developed into a household industry which has made a major contribution to employment and the economy in Jepara Regency. There are various kinds of woven fabrics produced at UKM KF Kayra, including sarong cloth and endek cloth. The production system implemented by UKM KF Kayra is *make to order* . .

In each production process, UKM KF Kayra still carries out its work activities manually. Even though they use tools, the tools are still simple and human power still plays an important role in daily productivity. There was an obstacle during the production process, namely during the palletization of the weft yarn. Weft palletizing is the process of rolling weft threads that have been colored and drawn onto a pallet. A pallet is a small diameter tool used to place the weft threads which will later enter the warp threads on the loom and be arranged into woven fabric. In the milling process at UKM KF Kayra, a manual tool is used which uses an old bicycle rim as a swivel and is rotated manually by hand, thus hampering production and reducing time efficiency in the thread winding process. .

The use of a manual thread rolling tool affects the length of the process, the process of rolling one pallet can take up to 3 - 4 minutes. To make a cloth 120 cm wide and 220 cm long, 7 pallets are needed in the weaving process. In one day, thread winding operators are only able to produce around 100 pallets, this number is still not able to meet the daily needs of weavers. Another problem that arises is that operators who do the pelletizing also feel pain in their wrists and shoulders because the wheel rotation is done manually using human power. Complaints of pain in the right arm due to continuous turning of the wheel. Complaints in the back and buttocks due to operators working in a sitting position for too long .

In designing this thread winding tool, the VDI 2221 method is used. The VDI 2221 method is a systematic approach to design for technical systems and technical products which is described by (Pahl., 2007) in his book, namely *Systematic Approach To The Design Of Technical Systems And Products*. The advantage of the VDI 2221 method is that the design process can adapt to consumer capabilities from an economic perspective. Pradana et al (2018). The VDI 2221 method is a German engineer design method which is guided by designing embodiments into detailed designs in accordance with consumer expectations (Birkhofer, 2013).

LITERATURE REVIEW

Understanding Design

Jogiyanto (in Syahrin, A. 2017:26) states that design can be interpreted as a description, planning and sketch or arrangement of elements which are divided into a unified whole and have a function within it. Product design is a strategic step to be able to produce industrial products that must be commercially achievable in order to produce a rate of return on investment. Here it is necessary to prepare a product concept - both a new product and an old product that will be modified into a new product in the form of an engineering design (engineering design) and also an industrial design (industrial design) to meet market needs (demand pull) or motivated by encouragement. utilizing technological innovation (Ginting 2015).

Verein Deutscher Ingenieure (VDI) Method

The Verein Deutscher Ingenieure (VDI) or the German Engineers association, has produced several guidelines, including the VDI 2221 guideline, which contains a systematic approach to the technical design of systems and products. This guideline shows a systematic approach system where the design process as part of product creation is divided into general

work stages, making the design approach transparent, rational and independent of certain branches of industry (Cross, 1994).

Anthropometrics

Anthropometry is a part of ergonomics which specifically studies body size which includes linear dimensions and content and also includes areas of size, strength, speed and other aspects of body movement. By definition, anthropometry can be stated as a study related to the dimensions of the human body, including size, strength, speed and other aspects of human body movement. According to Nurmiyanto (1996), anthropometry is a collection of numerical data related to the physical characteristics of the human body, size, shape and strength and the application of these data to handling design problems .

RESEARCH METHODOLOGY

The framework used in this research can be seen in Figure 1 below :

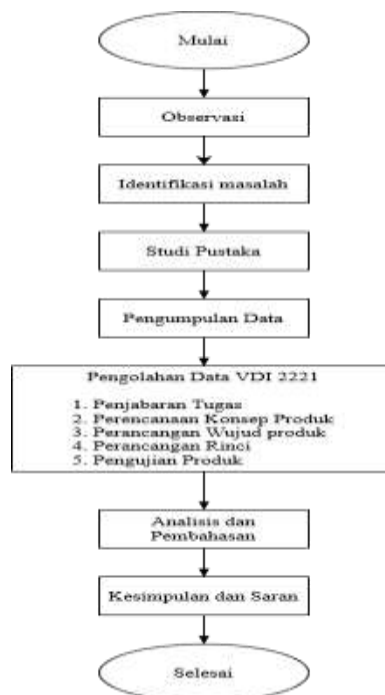


Figure 1 Research Stages

Source: Data Processing, 2022

In carrying out the product design above, the author uses the VDI 2221 method approach. Designing a product means describing the ideas you have to solve a problem. Ideas, however, are the brains of the design work . Overall, the work steps contained in VDI 2221 consist of 7 stages, which are grouped into 4 phases, as follows (Sutejo, 2012):

a. Task Description

This stage includes collecting information or data about the conditions that must be met by the design of the tool and its limitations. The results of this stage are in the form of requirements or specifications.

b. Product Concept Planning

This stage contains a discussion of abstraction problems, creating a function structure, then searching for suitable problem solving principles and combinations of these problem solving principles (variant concepts). The results of this stage are in the form of basic solutions or concepts.

c. Product Shape Design

The sketch of the combination of solution principles that has been created is a form of initial layout, then one is selected that meets the requirements in accordance with the specifications and is good according to the criteria, both from technical and economic aspects. The selected initial layout will be developed into a definitive layout which is a form of design that meets needs and expectations.

d. Detailed Design

This stage is the final stage in design. The detailed design results are in the form of documents which include machine drawings, detailed machine drawings, component lists, material specifications, operating systems, tolerances and other documents which form one unit. Then a re-evaluation of the product is carried out to see whether it really meets the specifications given

Product Testing

Products that have been designed are then tested and evaluated, the aim is to find out performance of the thread winder. If there are problems during testing, they can be reviewed again the design stage

RESULTS AND DISCUSSION

The results obtained after research and tool design using the VDI 2221 method showed that the design concept for thread winding tools was in accordance with its structure and function. Selection of materials that will be used to make the product at the design stage. The materials chosen are in the process of being elaborated into variants that can be realized, including: 4x6 Kalimantan wood leg frame, 2800 rpm 200 watt rotating AC dynamo, 2.5 inch pulley and 170 mm v belt . By utilizing the power of the driving motor as a substitute for human

power, then the power from the dynamo is transmitted to *the pulley* and *vbelt* which will rotate the shaft at the thread winding place. The tool image is shown in figure 2 below:



Figure 2 Thread Winding Tool

Source: Data Processing, 2022

After the tool is designed, then carry out tests on the newest thread winding tool to find out the effectiveness and performance of the tool that has been designed. The test was carried out directly by operating a tool that had been designed to calculate the thread winding time using *a stopwatch*, then comparing the resulting time with the old tool. Testing times are shown in table 1 below:

Table 1 Tool Testing Time

Testing	Using Manual Tools (Minutes/Pcs)	By Tools After Designing (Minutes/Pcs)	Information
Testing 1	2.40	1.25	Neat Roll
Testing 2	3.13	1.23	Neat Roll
Testing 3	2.41	1.15	Neat Roll
Testing 4	2.19	1.10	Neat Roll
Testing 5	3.05	1.25	Neat Roll
Testing 6	2.50	1.30	Neat Roll
Testing 7	2.55	1.26	Neat Roll
Testing 8	3.05	1.32	Neat roll
Testing 9	2.30	1.28	Neat roll
Testing 10	2.55	1.24	Neat roll
Average	2.61	1.23	1.38

Source: Olah Data, 2022

From table 1 of the results of the thread winding tool testing After it has been done, it can be seen that the testing of the designed tool is known to have a difference in the thread winding time between the manual tool and the designed tool powered by a dynamo drive of 1.38 minutes.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on the research that has been carried out regarding the design of thread winding tools for UKM KF Kayra, it can be concluded that the proposed design of thread winding tools is in accordance with the needs of UKM KF Kayra. Where the users of thread rolling tools are more efficient, this is proven by the average time for winding 1 piece of thread on a pallet which takes 1.23 minutes, where the difference between the winding tool times is 1.38 minutes. The design of the thread winding tool also does not cause pain to the employees who operate the tool. With a percentage of questionnaire attributes regarding tool operation of 64.2% - 96.4%. and the tools designed are able to meet production targets as expected by UKM KF Kayra.

Suggestions

Based on the research that has been carried out, several suggestions have been obtained as follows:

1. Can carry out regular maintenance on the new thread winding tool when finished using it in order to extend the tool's productive life.
2. It is recommended to always check *the belt* and *pulley* regularly, so that it does not slip when in use.
3. The design of this thread winding tool can be refined by further research

BIBLIOGRAPHY

- Agus Winanto, A., & Yohanes, A, N (2020) Redesign of Tofu Waste Biogas Stove Using the VDI 2221 Method (Doctoral dissertation, University of Technology Yogyakarta)
- Ato'Illah, M. (2015). Product Development Analysis to Increase Fertilizer Sales Volume. *Wiga*, 5(1), 68–73.
- Christly, BS, Halim, A., & Irawan, AP (2021). DESIGN OF A CORRUGATED CARDBOARD SLITTER MACHINE FEEDER SYSTEM USING THE VDI 2221 METHOD . 127–136.
- Conference, I., & Engineering, ON (2021). METHODOLOGY FOR A TASK-SPECIFIC AND PERSONALIZED DEVELOPMENT OF AN INITIAL EXOSKELETON DESIGN . August , 16–20. <https://doi.org/10.1017/pds.2021.469>
- Galih Pradana, A., & Nita, S. (2019). Design and Development of the Android-Based Regional Musical Instrument "AMUDRA" Educational Game. *Journal of the National Seminar on Information and Communication Technology 2019* , 49–53.

- J, WP, Lucitasari, DR, & Sutrisno, S. (2018). Economic Analysis and Design of Green Bean Peeling Equipment Using the Vdi 2221 Method. *Option* , 11 (2), 141. <https://doi.org/10.31315/opsi.v11i2.2555>
- Lee, A., Wu, S., & Aouad, G. (2006). Constructing the future: nD modeling. In *Constructing the Future: nD Modeling* . <https://doi.org/10.4324/9780203967461>
- Myasoedov, BF (2018). Design of a small press for extracting essential oil according VDI 2221 Design of a small press for extracting essential oil according . <https://doi.org/10.1088/1757-899X/393/1/012131>
- Myasoedov, BF (2020). Design of pick and place and color sorting system using VDI 2221 . <https://doi.org/10.1088/1757-899X/1007/1/012165>
- Pemula, PD (2017) . Covariance structure analysis of health-related indicators *Title* . 110265 (2014), 110493.
- Pratama, A., & Fitri, M. (2020). Design and Construction of a Spring Constant Test Equipment for a Capacity of 50 N/Mm Using the Vdi 2221 Method. *AME (Applications of Mechanics and Energy): Scientific Journal of Mechanical Engineering*, 6(2), 41. <https://doi.org/10.32832/ame.v6i2 .3316>
- Pranandita, N., Yunus, M., Manufaktur, P., & Bangka, N. (2021). *Manutech: Journal of Manufacturing Technology Designing a Pulling System for a Cassava Grating Machine Using VDI 2221* . 13 (01).
- Prima, F., Japri, BA, Kurniawan, E., Lubis, GS, Ivanto, M., Ivontianti, WD, & Oktaviani, EP (nd). DESIGN OF A COCONUT COIL PEELER USING THE VDI 2221 METHOD . 4 , 133–144.
- Scharfenberg, G., Elis, L., & Hofmann, G. (2019). NEW DESIGN METHODOLOGY – USING VHDL-AMS MODELS TO CONSIDER AGING EFFECTS IN AUTOMOTIVE MECHATRONIC CIRCUITS FOR SAFETY RELEVANT FUNCTIONS i. *2019 International Conference on Applied Electronics (AE)* , 1–5.
- Setyabudhi, AL, & Sirait, G. (2019). Mini Electric Power Source Product Development Using the VDI (Verein Deutscher Ingeniure) Approach 2221 . *2017 (1)* , 4–6.