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Development of a Portable Cool Box to Increase Milk Distribution Capacity

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Abstract

The SN Multipurpose Cooperative has a business of collecting pure cow's milk from dairy farmers. Milk is processed by cooling it to a certain temperature. Pure milk from cooperatives sent to milk factories can be rejected by milk factories for various reasons so that dairy farmers experience losses. The SN Multi-Business Cooperative carries out business development, namely pure milk is further processed by the cooperative into ready-to-drink processed milk products. Business development in the field of processing pure milk products will provide a greater selling value compared to pure milk sold directly to milk factories. Distribution and delivery of processed milk to consumers is carried out using motorbikes. To carry processed milk, every motorbike rider uses a basket bag made of thick cloth which is placed on the back and contains around 30 liters of milk. Inside this bag, ice cubes are placed to maintain the temperature of the processed milk. Over a long period of time the ice cubes will melt into water and seep into the basket bag and damage the basket bag. With the development of a portable toll box, it is possible to maintain milk temperature for longer as well as anthropometric arm length and upwards. The cool box installed on the motorbike is equipped with foam in the cooling box. The distributed capacity is greater to 64 liters.

Keywords: *anthropometry, increasing distribution capacity*

Abstrak

Koperasi Serba Usaha SN mempunyai usaha menampung susu sapi murni dari peternak sapi perah. Susu diproses dengan cara didinginkan hingga mencapai suhu tertentu. Susu murni dari koperasi yang dikirim ke pabrik susu dapat ditolak oleh pabrik susu dengan berbagai alasan sehingga peternak sapi perah mengalami kerugian. Koperasi Serba Usaha SN melakukan pengembangan usaha yaitu susu murni diproses lebih lanjut oleh koperasi menjadi produk susu olahan siap minum Pengembangan usaha dalam bidang pengolahan hasil susu murni akan memberikan nilai jual yang lebih besar dibandingkan susu murni dijual langsung ke pabrik susu. Distribusi dan pengiriman susu olahan kepada konsumen dilakukan dengan menggunakan sepeda motor dengan tas keranjang yang terbuat dari kain tebal yang di letakan di belakang memuat sekitar 30 liter susu, di dalam tas ini dimasukkan es batu untuk menjaga suhu susu olahan. Untuk jangka waktu yang lama es batu akan mencair menjadi air dan meresap di tas keranjang serta merusak tas keranjang. Dengan pengembangan *toolbox portable* dapat menjaga suhu lebih lama serta anthropometri panjang lengan ke atas. Cool box yang terpasang pada sepeda motor dilengkapi dengan busa yang ada dalam kotak pendingin. Kapasitas yang didistribusikan lebih banyak menjadi 64 liter.

Kata Kunci: *Cool box portable, anthropometri, peningkatan kapasitas distribusi*

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1. Introduction

The SN Multi-Business Cooperative was founded in 2011 in Semarang Regency. This cooperative has a business collecting pure cow's milk from dairy farmers. The number of dairy farmers is approximately 300 people who live around the cooperative. Pure cow's milk stored in this cooperative is processed by the cooperative by cooling it to a certain temperature. The results of the processing of pure milk are then sent to milk factories, restaurants, and cafes according to demand. Problems that often arise are usually in milk factories. Pure milk from cooperatives sent to milk factories can be rejected by milk factories for various reasons so that dairy farmers experience losses. Then at the beginning of 2022, the SN Multi-Purpose Cooperative will carry out business development. Developments carried out in pure milk production. Pure milk can be further processed by cooperatives into ready-to-drink processed milk products so that they can be marketed directly to the public or wider consumers. Business development in the field of processing pure milk products will provide greater selling value than selling pure milk directly to milk factories. In the field of marketing and distribution, the SN Multipurpose Cooperative established a business entity with the name CV. MSN is located on Jalan Tirto Agung, Semarang city. Distribution and delivery of processed milk to consumers is carried out using motorbikes. To carry processed milk, every motorbike rider uses a basket bag made of thick cloth which is placed at the back. The cloth basket bag contains around 30 liters of milk, inside this bag are put ice cubes to maintain the temperature of the processed milk. Using a basket bag is less practical because if the driver wants to fill up with fuel, the basket bag must be taken first. Apart from that, using this basket bag cannot maintain the temperature of the milk because over a long period of time the ice cubes will melt into water and seep into the basket bag. By seeping ice water into the fabric, over time it can damage the basket bag. With the development of this portable cool box, it can maintain milk temperature, be ergonomic and increase milk storage capacity.

[1] With the portable toll box design, it is hoped that the duration of milk storage time will be increased so that the marketing and sales departments can distribute milk products longer and distribute more capacity. Ice cubes are used to maintain the quality of fish, but they do not last long and are expensive. When fishing takes a long time, the quality of the fish decreases. With this condition, an analysis was carried out using the HOQ method to create a Portable Cool Box to maintain the quality of fishermen's catch and assist the loading and unloading process of the catch [2]. [3] Cooler boxes can keep breast milk temperature cool, preventing damage to breast milk contents. Inside the cooler box, ice gel is inserted which keeps the temperature cool. The ice gel can keep the temperature cold for 3-4 hours. The design of the corn sheller machine is an improvement over the previous machine which was operated in a squatting position. The data needed in this research is body dimension data or shoulder height anthropometry in an upright standing position to determine the height of the corn sheller [4][5][6]. This cooler bag can make it easier for mothers who work outdoors as a container or place to store breast milk, so that giving breast milk to babies remains exclusive and is able to produce a temperature of 15° C - 18° C, so that it can keep the breast milk temperature stable.

Design a portable refrigerator that aims to enable breastfeeding mothers to store breast milk for longer [7][8]. Refrigerators are made using Peltier modules with a thermoelectric working concept that is powered by electric current or batteries so that they can be carried on trips. [9] With the REBA (Rapid Entire Body Assessment) method approach which is used to measure and analyze workers' body posture. The score obtained is used to consider improving work posture. Making a cooling system in a cooling box for storing Sinovac vaccine with thermoelectric (TEC)1-12706 which can maintain the temperature of Sinovac vaccine in the standard temperature range, namely 2-8 °C [10]. [11] By using the RULA (Rapid Upper Limb Assessment) method approach, results were obtained with ergonomics, such as tools that are suitable for the height of the worker, do not cause complaints, fatigue, do not cause MSDs, and increase the comfort of workers who previously roasted melinjo seeds traditionally. Bacteria in fresh ASIP show higher numbers compared to ASIP stored in pasteurized cooler bags [12]. [13] The stages in HOQ begin with identifying consumer needs and desires by determining the Voice of Customer (VOC), creating a planning matrix, determining the customer's level in competition, determining the technical description. [14] With this semi-automatic machine, the process of cleaning the intestines for every one kilogram takes sixty minutes, with the semi-automatic machine, the process for cleaning the intestines for every one kilogram takes thirty minutes.

In this design, attention is paid to aspects of workforce anthropometry and percentiles. [15] The results of the research are the design of a semi-automatic rolled plastic cutting machine that is adapted to the worker's body dimensions or anthropometry. In the development and manufacture of this portable cool box, the anthropometry or body dimensions used are forward span length with a percentile of 50 so that all workers can use this tool.

2. Material and Methods

Data processing, the data that has been collected is then processed/tested using:

1. Test data adequacy

   Data adequacy is calculated using a formula:

$$N' = \left[\frac{k/s\sqrt{(N\sum X^2) - (\sum X)^2}}{\Sigma X} \right]^2$$

………………………………….. (1)

2. Test data uniformity

   Data is said to be uniform if it is in BKA and BKB. The formula used to calculate BKA and BKB:

   Upper Control Limit (BKA) = $\bar{x} + k\sigma$

   Lower Control Limit (BKB) = $\bar{x} - k\sigma$

3. Percentile

This data processing aims to determine the size of a product through the 50th percentiles. The object of observation is the employees of the marketing department of the milk producer.

Percentile to – k : $\mu \pm z\,\alpha$ ………………………….…….. (2)

Percentile k	10 or 90	5 or 95
z value	± 1.28	± 1.645

The research flow diagram is as follows:

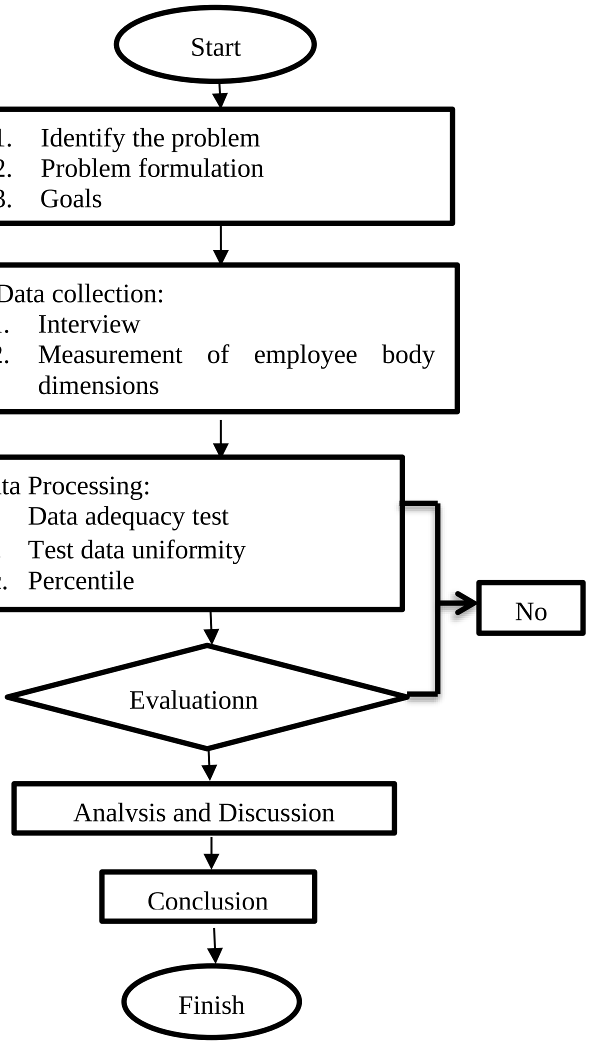

Figure 1. The Research Flow Diagram

3. Results and Discussion

3.1. Data collection

From observations at the CV MSN marketing office for milk distribution and milk marketing to cafes using motorbike transportation using a basket placed on the back of the motorbike as in the **Figure 2.** The basket bag above uses cloth material and is added with ice cubes so that it can maintain the temperature of the milk for a long period of time. The weakness of the basket is that over a long period of time it will be damaged due to exposure to ice water and the temperature of the milk will not be stable because the ice water will absorb the fabric. Meanwhile, processed milk is carried using a basket bag as shown in **Figure 3.**

Figure 2. Basket Bag on Motorbike
Source: CV MSN Semarang

Figure 3. Processed Milk
Source: CV MSN Semarang

From the measurements of the employee's body dimensions, the relationship is the length of the upper arm with the results in the **Table 1.**

Table 1. Data from Measurement Results for Marketing Department Employees

No.	Name	Gender	Body Dimensions
1.	Ali	Male	39 cm
2.	Rind	Male	40 cm
3.	Hag	Male	38 cm
4.	Yed	Male	41 cm
5.	Dar	Male	42 cm

Source: CV MSN Semarang

3.2. Data Sufficiency Test

Data adequacy is used to determine whether the data obtained is sufficient or insufficient
If N' < N then the data is sufficient
If N'> N then the data is lacking and needs to be added
The level of confidence used (k) is 95%

$$N' = \left[\frac{40\sqrt{40050 - 40000}}{200}\right]2$$

$$N' = \left[\frac{40\sqrt{50}}{200}\right]2$$

$$N' = \left[\frac{40(1{,}414)}{200}\right]2$$

$$N' = 2$$

N' < N then the data is sufficient

3.3. Data Uniformity Test

Dimensions length from sleeve to top

a. Standard Deviation

$$\sigma = \left[\sqrt{\frac{\Sigma(\overline{X} - Xi)^2}{N-1}}\right]$$

$\sigma = 2{,}5$

b. Upper Control Limit
BKA = $\bar{\bar{x}}$ + kσ
BKA = 40 + 3 (2,5)
BKA = 47,5

c. Lower Control Limit
BKB = $\bar{\bar{x}}$– kσ
BKB = 40 – 3(2,5)
BKB = 32,5

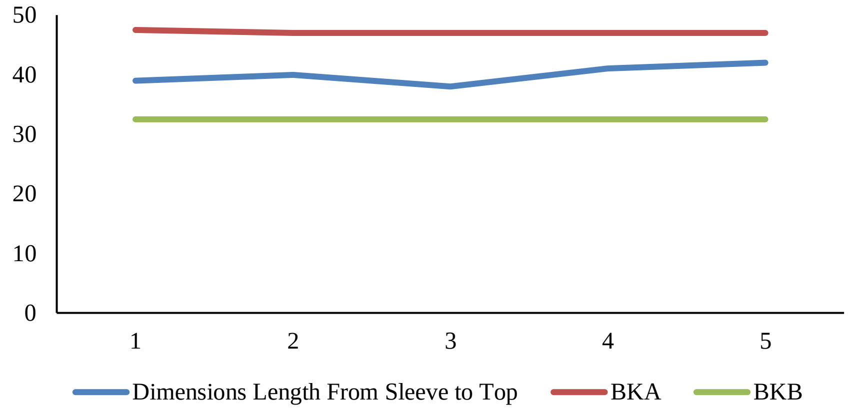

Figure 4. Data Uniformity Chart
Source: Data research

3.4. Percentile

Selection of the 5th percentile means that the measurement was carried out on 5% of the small population, while the 50th percentile means the measurement was carried out on 50% of the average-sized population and the 95th percentile means the measurement was carried out on 95% of the large population. For the size of the portable toolbox, use the 50th percentile so that all employees can reach the height of the portable toolbox.

3.5. Coolbox Development

The data that has been obtained and processed then determines the size of the tools and materials used. The size determination is based on anthropometric data and tool data. The dimensions per box are 32 liters so that for two boxes the capacity is 64 liters. The size of the cool box is 40 cm long, 25 cm wide and 33 cm high. The following is a picture of the portable coolbox:

Figure 5. Front View
Source: Product Development

Figure 6. Top View
Source: Product Development

Figure 7. Side View
Source: Product Development

If you want to fill the coolbox with petrol, you don't need to remove it because the coolbox is attached to the screws on the motorbike and is installed on the right and left of the motorbike as shown in the **Figure 8.**

Figure 8. Installation of a Portable Cool Box on The Motorbike
Source: Product Development

4. Conclusion

After carrying out observations, calculations, and measuring anthropometric data on body dimensions, as well as overall analysis and discussion, conclusions can be drawn regarding the development of a portable toll box that can transport milk more effectively, can maintain product temperature, and is ergonomic. The cool box installed on the motorbike is equipped with foam in the cooling box and the cool box can be removed so that it does not disturb the rider, especially when you have to add or refill fuel. With this cool box, the milk is more durable and lasts longer and can increase the duration of milk storage time so that the marketing and sales departments can distribute milk products longer and the distributed capacity is greater from 30 liters to 64 liters.

5. References

[1] E. N. Hayati, M. Riza Radyanto, F. A. Ekoanindiyo, and E. Prihastono, “Portable Coolbox Design for Milk Storage,” *J. Appl. Eng. Technol. Sci.*, vol. 4, no. 1, pp. 561–567, 2022.

[2] A. Mustakim *et al.*, “Pembuatan Cool Box Portable dengan Sistem Pendingin Air Guna Mendukung Cold Chain pada Distribusi Ikan dan Menjaga Kualitas Ikan Tangkapan Nelayan,” *Sewagati*, vol. 7, no. 1, pp. 56–66, 2022.

[3] G. K. Naufal, “Rancang Bangun Cooler Box Termoelektrik Dengan Air Sterilizer Sebagai Tempat Pengiriman Air Susu Ibu (Asi),” *J. Rekayasa Mesin*, vol. 14, no. 3, p. 87, 2019.

[4] E. Prihastono, A. Yohanes, and F. A. Ekoanindiyo, “Solar Corn Sheller Machine Design Based on Ergonomics Principles,” *J. Serambi Eng.*, vol. VIII, no. 4, pp. 6923–6928, 2023.

[5] F. A. Ekoanindiyo, A. Yohanes, and E. Prihastono, “Perancangan Mesin Pemipil Jagung Ramah Lingkungan Dengan Pendekatan Nordic Body Map,” *J. Rekayasa Sist. Ind.*, vol. 6, no. 1, pp. 26–31, 2020.

[6] F. A. Ekoanindiyo, A. Yohanes, and E. Prihastono, “Pengembangan Desain Mesin Pemipil Jagung Tenaga Matahari,” *J. Sains dan Teknol. J. Keilmuan dan Apl. Teknol. Ind.*, vol. 22, no. 2, p. 283, 2022.

[7] K. Febriansyah, “Perancangan Cooler Bag ASI (Air Susu Ibu) Otomatis Menggunakan Thermoelectric Berbasis Arduino,” *Skripsi*, 2022.

[8] M. G. Suryanata and K. Ibnutama, “Lemari Pendingin Portable Untuk Penyimpanan Air Susu Ibu (Asi) Menggunakan Termoelektrik,” *JURTEKSI (Jurnal Teknol. dan Sist. Informasi)*, vol. 7, no. 1, pp. 53–60, 2020.

[9] K. F. Hafeze and F. A. Ekoanindiyo, “Design Of Portable Lawn Mower Using Rapid Entire Body Assessment (Reba) Method,” *J. Sains, Teknol. dan Ind. Sains, Teknol. dan Ind.*, vol. 21, no. 1, pp. 27–34, 2023.

[10] Y. K. Luqiana, B. P. Manunggal, I. Yuliyani, and K. Kunci, “Pembuatan sistem pendingin pada cooling box untuk penyimpanan vaksin Sinovac dengan Thermoelctric (TEC) 1-12706 yang disusun paralel,” *Ind. Res. Work. Natl. Semin.*, pp. 302–307, 2021, [Online]. Available: https://jurnal.polban.ac.id/ojs-3.1.2/proceeding/article/view/2709/2097

[11] B. Praditya and F. A. Ekoanindiyo, “Perancangan Alat Penyangrai Biji Melinjo Menggunakan Metode RULA (Rapid Upper Limb Assessment) Di UMKM Melinjo Sukorejo,” *J. Tek. Ind. J. Has. Penelit. dan Karya Ilm. dalam Bid. Tek. Ind.*, vol. 9, no. 2, pp. 521–528, 2023.

[12] D. N. Mustika, S. Nurjanah, and Y. N. S. Ulvie, “Identifikasi Total Bakteri dan Keasaman Air Susu Ibu Perah (ASIP) yang disimpan di Cooler Bag,” *J. Gizi*, vol. 8, no. 1, pp. 28–36, 2019.

[13] E. N. Hayati, F. A. Ekoanindiyo, and M. R. Radyanto, “Peningkatan Kualitas Produk IKM Rumah Sabun Dengan Pendekatan QFD,” *J. Rekayasa Sist. Ind.*, vol. 8, no. 1, pp. 13–21, 2021.

[14] F. A. Ekoanindyo, A. Yohanes, and R. Ernawati, “Perancangan Mesin Pembersih Usus Untuk Mengingkatkan Produktivitas Di UKM Kabupaten Batang,” *J. Sains dan Teknol. J. Keilmuan dan Apl. Teknol. Ind.*, vol. 20, no. 2, pp. 196–202, 2020.

[15] A. Yohanes and F. A. Ekoanindyo, “Perancangan Mesin Pemotong Plastik Gulung Semi Otomatis Dengan Anthropometri,” *J. Sains dan Teknol. J. Keilmuan dan Apl. Teknol. Ind.*, vol. 20, no. 2, p. 132, 2020.