ASSIGNMENT 3

NEW PRODUCT DEVELOPMENT

For

Group 4 / Backpack Wheeled Total Station Case

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EXECUTIVE SUMMARY

This report presents the development of a new product known as the Backpack Wheeled Total Station Case, designed to address ergonomic, mobility, and safety challenges faced by surveyors during field operations. With the increasing use of high-precision surveying instruments such as total stations in construction and geospatial industries, the need for a more user-centred and efficient equipment transportation solution has become increasingly important. Existing total station cases in the market primarily focus on structural protection while neglecting portability, ergonomic comfort, and operational efficiency, especially in challenging outdoor and tropical environments such as Malaysia.

Using the NABC (Need, Approach, Benefits, Competition) framework, this project identifies critical issues including physical strain, inefficiencies in carrying multiple equipment bags, and the lack of adaptive transport solutions in current products. The proposed solution integrates a dual-mode transport system, allowing the case to function as both a backpack and a wheeled trolley. This hybrid design improves mobility across various terrains while reducing musculoskeletal strain among surveyors.

The product incorporates high-density EVA foam for shock absorption, a water-resistant exterior, ergonomic shoulder straps, and modular compartments to securely store the total station and its accessories in a single unit. Compared to existing hard-case solutions from major manufacturers, the Backpack Wheeled Total Station Case offers enhanced versatility, improved user safety, and greater operational efficiency.

The New Product Development (NPD) process detailed in this report includes research and development, product design and feature analysis, test marketing, and prototype construction. Feedback from initial evaluations indicates strong acceptance of the product concept, particularly for its ergonomic design and potential to reduce fatigue during long fieldwork sessions. Overall, this innovation demonstrates strong potential to improve survey operations while aligning with modern occupational safety and health standards.

1.0 INTRODUCTION

The development and high speed of surveying and geospatial technology has greatly led to the use of high-precision equipment like total stations in construction, land surveying, and infrastructure development. These tools are extremely delicate, expensive, and often required in adverse outdoor conditions and therefore safe transportation and ergonomics is an essential area in its operation. Although there is unrelenting creativity in the design of the surveying tools, there has been a relatively low level of attention given to the support features such as the carrying cases in terms of the user centred design and technological advancement.

Today, the majority of total station carrying cases, including those offered by well-known manufacturers such as Topcon, are based on the design concepts of a rigid hard-plastic one, which does not put its focus on ergonomics and portability, but, instead, concentrates on the structural protection. Surveyors have to move heavy equipment over rough grounds and cover long distances and in bad weather, especially in tropical areas such as Malaysia, most of them have to do it by hand. Such circumstances lead to physical exhaustion, high chances of musculoskeletal trauma, inefficiencies in fieldwork, and damage of equipments that could happen because of the limitation of weather resilience and store flexibility.

Moreover, the current carrying cases have a small storage space, and surveyors have to carry several bags to carry necessary accessories including tripods, prisms, batteries, tablets, and field documentation. This disintegrated method facilitates reduced operational efficiency and an augmented logistical complexity when handling the site work. Moreover, the lack of intelligent functionality, including tracking, environmental control, or impact-sensing, reduces the opportunities to ensure the safety of valuable equipment in case it is lost or damaged.

These were recurring problems that point to an evident mismatch between existing total station carrying options and the requirements of contemporary surveyors. To solve this issue, this work is the starting point of the creation of the new Backpack Wheeled Total Station Case that would enhance ergonomics, mobility, storage, environmental protection, and utilitarian intelligence. The information used to enhance this product concept was gathered under the refining process

that encompassed literature review, comparative product analysis and questionnaire survey among surveyors and field practitioners. The results of these approaches are the basis of the New Product Development (NPD) process included in this report.

2.0 NABC

The NABC framework, which includes Needs, Approaches, Benefits and Competition, was used to assess the utility and viability of the proposed Wheeled Backpack. This need was evidenced by “surveyors’ struggle to carry large total station packages using traditional hand-held backpacks, particularly on long-distance assignments.” The proposed approach was to create a dual-purpose carrying solution that could function as a backpack or wheeled trolley, designed to be ergonomic and constructed from durable materials. Benefits included improved user ergonomics, ease of carrying, better protection of survey equipment and improved field task efficiency. The competition was assessed as follows: “current market products are primarily hard backpacks that offer little flexibility, compared to the proposed offering more versatility, making them more suitable for contemporary land surveying.

1. N - Need

   The surveying and construction industries in Malaysia face a significant, yet often overlooked, occupational health challenge: the physical toll of transporting high-precision equipment. Currently, the industry standard relies on rigid, "hard-carry" plastic cases like those from Topcon or Leica which are designed primarily for impact protection rather than human mobility. These cases weigh between 5kg to 10 kg excluding the instrument, forcing surveyors to carry them by a single handgrip over long distances and uneven tropical terrain. This creates severe asymmetrical loading on the body, leading to chronic back, neck, and shoulder injuries among field practitioners.Furthermore, a surveyor must often manage a tripod and prism pole simultaneously. When one hand is permanently occupied by a heavy case, the risk of slips, trips, and falls increases significantly. There is a documented need for a transportation solution that integrates ergonomic "hands-free"

carrying and mechanical mobility. The market requires a product that protects both the delicate $RM 30,000+$ instrument and the physical well-being of the professional operating it, particularly in challenging environments like construction sites or remote rural areas where traditional "suitcase-style" carrying is inefficient and hazardous.

2. A - Approach

Our solution, the Backpack Wheeled Total Station Case, is a hybrid mobility system designed to bridge the gap between heavy-duty protection and ergonomic transport. The approach utilizes a dual-mode transport architecture: high-durability trolley wheels and a telescopic handle for flat surfaces, paired with integrated, padded backpack straps for rugged terrain. This allows the user to switch modes in seconds based on the environment. Internally, we have replaced standard foam with custom-molded, high-density EVA foam, which provides superior vibration dampening to maintain the calibration of the total station during transit.Beyond the instrument, our design adopts a "multi-storage ecosystem." Unlike standard cases that only fit the device, our case includes dedicated, modular compartments for batteries, prisms, tablets, and field notebooks. The exterior is crafted from water-resistant synthetic polymers and includes integrated reflective strips for low-light safety which is a critical feature for roadside surveying. By combining a "hard-shell" protective frame with a "soft-shell" ergonomic exterior, we provide a versatile workstation that secures the equipment while drastically reducing the physical burden on the surveyor.

3. B - Benefits

The primary benefit of this innovation is the radical improvement in surveyor efficiency and long-term health. By distributing the weight across the hips and shoulders in backpack mode, or eliminating the weight entirely in trolley mode, we reduce the risk of musculoskeletal disorders (MSDs) that lead to medical leave and decreased productivity. Surveyors can navigate sites faster and arrive at their station points less fatigued, which directly correlates to higher data accuracy and faster project completion

times.Additionally, the centralized storage system offers a significant logistical benefit. By housing all peripheral equipment in one unit, the risk of losing or forgetting expensive accessories (like prisms or data collectors) is minimized. The shock-absorbing EVA interior also offers better protection than traditional hard plastic, potentially extending the lifespan of the total station and reducing the frequency of expensive recalibrations. For surveying firms, this translates to a lower "Total Cost of Ownership" (TCO) for their equipment and a safer, more motivated workforce, aligning with modern occupational safety and health (OSH) standards in the Malaysian construction sector2.2.

4. C - Competition

The current market is dominated by Original Equipment Manufacturers (OEMs) such as Topcon, Leica, and Sokkia. These companies provide proprietary hard cases that excel at static protection but fail miserably at portability. Their designs are essentially "boxes with handles," offering zero ergonomic support and requiring a free hand at all times. While some third-party universal "padded bags" exist, they often lack the rigid internal frame and custom-molded protection necessary to safely house a sensitive optical instrument like a total station.The Group 4 Backpack Wheeled Case differentiates itself through Additive Innovation. While competitors focus on the tool, we focus on the transit of the tool. Our product outperforms existing hard cases by offering: 1) Versatility (Wheels + Straps), 2) Enhanced Storage (One bag for all gear), and 3) Safety (Reflectors and ergonomic weight distribution). While a Topcon case is a specialized container, our product is a specialized mobility system. By targeting the specific pain points of field practitioners—fatigue, injury, and logistical clutter—we offer a unique value proposition that legacy manufacturers have overlooked in their quest for structural rigidity over user comfort.

3.0 NEW PRODUCT

This chapter introduces the proposed product “Wheeled Total Station Backpack”, which is designed to help alleviate these shortcomings in carrying and protecting survey instruments. Most conventional total station bags are heavy and designed only for handheld use, leading to physical injuries in the case of long-distance fieldwork or in difficult terrain conditions. In addition, carrying other equipment such as tripods increases the rate of fatigue and injuries, which has created the need for more ergonomic and flexible carrying.

The Wheeled Total Station Backpack has a dual-mode transport system, allowing one to carry it either as a backpack or a wheeled trolley. The product is designed with the user’s comfort and mobility in mind, featuring ergonomic shoulder straps, trolley wheels and reinforced handles. On the inside, the bag uses high-density EVA foam to absorb shocks that may affect the total station, while the waterproof exterior protects the equipment in outdoor conditions. Accompanied by additional compartments for storing survey accessories, this product will provide a practical and effective solution to increase safety, comfort and productivity during your survey operations.

3.1 Definition

The innovation described is called the Backpack Wheeled Total Station Case, which is a versatile equipment transportation device aimed to serve the needs of professional surveyors and the operators of the construction field. The product incorporates a hybrid carrying system whereby, the product is capable of functioning as a backpack and a wheeled trolley system whereby the user can change the means of transport depending on the terrain and the amount of work to be carried out.

The case is made with lightweight but high strength composite materials to make the entire weight low without compromising on the strong protection of delicate surveying tools. On the interior, the product has a modular and customizable compartment system, which is capable of fitting a total station, accessories, batteries, data collectors, tablets and other necessary field tools in one consolidated unit. On the outside, the design has weather resistant sealing to safeguard the

equipment against rain, dust as well as humidity that are normally experienced in the outdoor and tropical environment.

Besides physical design innovation, the Backpack Wheeled Total Station Case is innovated as a smart, protective case as opposed to a traditional storage container. There are optional smart modes like internal temperature or humidity monitoring, which can be added to increase the security of equipment, monitoring, and user confidence when the equipment is used in the field.

All in all, this product can be characterized as an ergonomic, portable, protective, and technology-based carrying product that meets the drawbacks of conventional total station cases besides being consistent with the changing operational needs of surveying and construction sectors.

3.2 Classification of New Product Development

New Product Development (NPD) is the process of developing new products or finding ways to improve existing products to meet the needs and wants of target consumers and also to increase competitiveness in the market. The classification of new products according to the analysis conducted in this case is “Total Station Wheeled Backpack Case”, shows that the product falls into the New Product Line and Improvements and Revisions to Existing Products category.

First of all, this product belongs to the New Product Line because this innovative product will provide a new way to carry and protect surveying equipment. Current total station products on the market, for example hard plastic cases, are mainly for carrying equipment when in the hands of customers. This new innovative product will be a combination of a backpack and a wheeled trolley in one package. This will provide a new line in surveying accessories as this new innovative product will provide a better way to carry equipment for surveyors.

Secondly, this product can also be said to be an example of Improvements and Revisions to Existing Products. This is mainly because the main function of the total station remains the same but the improvements come in terms of supporting product features. For example, innovations

such as the incorporation of an ergonomic shoulder strap, the use of wheels in the trolley design, the use of shock-absorbing EVA foam in the internal design which also includes a waterproof exterior which enhances the storage function.

In conclusion, the Wheeled Total Station Backpack can be categorized as a New Product Line and Improvements and Revisions to Existing Products. This product solves problems and issues related to field operations related to the efficiency, safety and protection of surveying equipment, making it an important and relevant product in the surveying equipment industry.

3.3 New Product Development Process

New Product Development (NPD) is the process of developing a product from an idea to a marketable product. It consists of a series of steps to ensure the satisfaction of the needs in the market as well as the development of a competitively functional product. In the case of the Backpack Wheeled Total Station Case study, the NPD process is based on the development of a solution to the challenges involved in field work conducted by the surveyor.

It commences with problem identification, where the shortcomings in the traditional total station case, including weight, lack of transportability and potential physical strain are identified. This stage is followed by idea creation and development which entails characteristics such as dual transport, ergonomic design and material protection. Lastly, there is design development, testing and refinement to ensure the creation satisfies functional and ergonomic needs.

3.3.1 Research and Development

Research and Development (R&D) plays a crucial role in ensuring successful product delivery. For this project, the objective of the R&D activities undertaken was to explore user needs, analyze current products and design a better solution for a backpack-type wheeled total station case.

The research phase included a study of total station cases available in the market and the limitations involved. This was followed by an understanding of the total station requirements through input from surveyors involved in terms of minimizing strain, facilitating long-distance mobility and protection for fragile devices.

The development stage focused on the creation of a prototype involving the integration of the backpack and trolley wheel design. The interior was covered with shock-absorbing materials such as high-density EVA foam, thus protecting the total station, while waterproof materials were used for the exterior. In addition, storage compartments were included for storing accessories such as prisms, batteries and field notebooks among others.

In conclusion, the R&D process ensured that the proposed product was user-centric, functional and feasible. The Backpack Wheeled Total Station Case was systematically developed through research and design development to address real-world issues surveyors face during fieldwork.

3.3.2 Product Design/Features & Technology Description

It has been designed to accommodate a conventional total station model along with necessary accessories for surveying such as batteries, prisms, notebooks and small tools. It can accommodate all these necessities in a way that the dimensions allow it to remain mobile while ensuring there is ample storage volume through a multi-compartment storage design. The interior design employs modular padding to make the interior adjustable to differ according to requirements, which will be compatible with any model available in the total station market.

1. Physical Design and Architecture

   The product adopts a hybrid backpack–trolley architecture, combining two transport modes in one unit:

   a. Backpack mode for hands-free carrying over uneven terrain, stairs, or narrow access areas.
   b. Wheeled trolley mode with integrated wheels and a retractable handle for long-distance movement on flat surfaces.

   Structurally speaking, the case features a hard external casing designed in combination with an internal frame for support. Internally, the case features high-density EVA foam cushioning designed to absorb shock and vibrations serving to safeguard delicate surveying equipment. Moreover, the case features functional padded shoulder straps and a breathing back panel designed to evenly dispense the weight and alleviate stress on the back and shoulders during prolonged use.

2. Artistic Design

   From an aesthetic perspective, the item is built according to a professional design style that befits the context of surveying. The item has been colored in clean industrial tones, reducing dirt visibility. Reflecting surfaces are also provided at the rear as well as sides of the item to improve visibility of the person carrying it, especially during dawn or roadside surveys. The item is modern, compact, and rugged, signifying reliability rather than consumer products like luggage.

3. Materials and Technology Used:
    a. Exterior Material: Water-resistant, durable synthetic fabric or polymer composite, designed to withstand rain, dust, and rough outdoor conditions. A rain cover further improves weather protection.
    b. Interior Technology: High-density EVA foam padding and adjustable cushioning modules to stabilize the total station and accessories.
    c. Mobility System: Heavy-duty wheels and a reinforced trolley handle designed for frequent outdoor use.
    d. Safety Features: Reflective strips and reinforced base panels to allow stable placement on the ground and improve durability.

The product is engineered to address the primary needs of the market by considering portability, safety, efficiency, comfort and versatility. Portability is addressed through the integration of a trolley wheel function and backpack straps to easily move the product around when it is carrying heavy surveying equipment. The product ensures the safety of the total station through the integration of a tough outer casing, high-density shock-absorbing padding and water-resistant materials. The design ensures increased work efficiency as the product enables the surveyor to rapidly move from one location to another when conducting surveys, especially over longer distances. The design also ensures that the comfort of the user is improved through the integration of padded shoulder straps, waist support and a comfortable back rest that aids in the balanced weight distribution of the product. The product design is also very versatile to fit the different surveying conditions within the markets, such as the construction site, the urban site and the rural site.

3.3.3 Test Marketing

During the test marketing phase, surveys were distributed to 30 respondents following a product demonstration of the Backpack Wheeled Total Station Case. The participants assessed the case based on how well it safeguarded delicate instruments while offering better mobility in the field. Overall, early responses were highly positive, highlighting its adaptability and the potential to lessen physical fatigue during extended work durations.

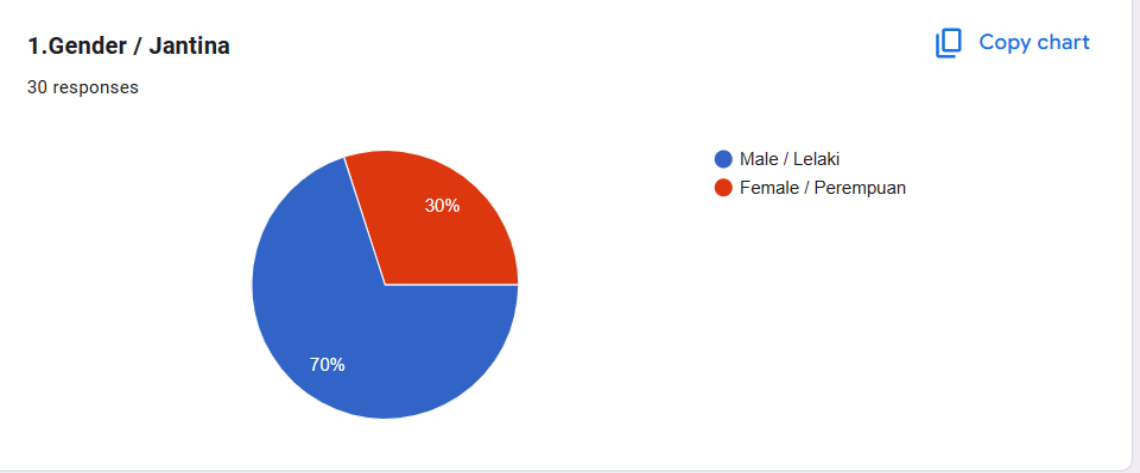

Figure 3.1 Response from gender

Based on the survey findings the majority of users face significant challenges with their current total station carrying cases. The most frequently reported issue is excessive weight with 83.3% of respondents indicating that their existing case is too heavy. In addition 40% experience back or shoulder fatigue during transport which highlights ergonomic concerns. Other notable problems include limited storage space and difficulty moving across uneven terrain both 26.7% as well as a lack of smart or security features 20% and waterproofing limitations 13.3%. In response to these issues a wheeled backpack total station case was developed to improve mobility, reduce physical strain and provide a more practical and user friendly solution for equipment transportation.

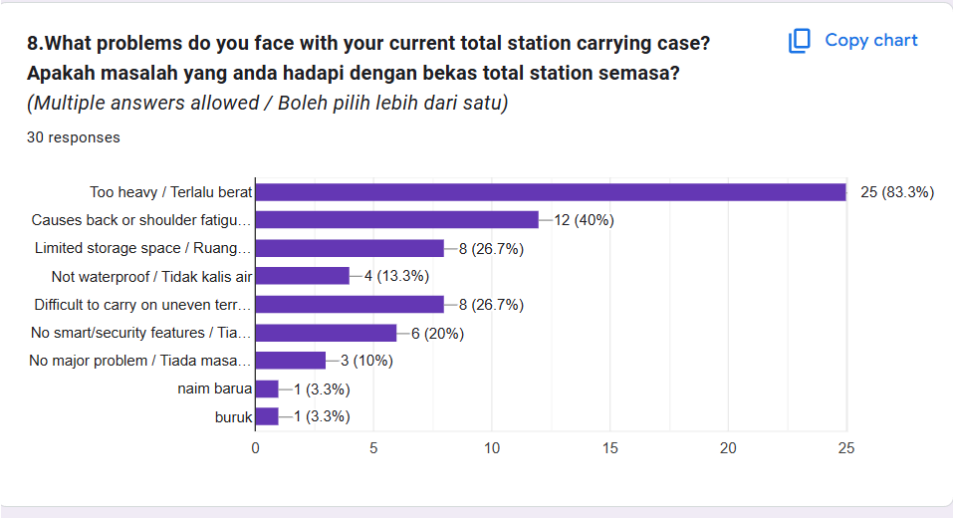

Figure 3.2 Problem faced by surveyor or students

Survey responses indicate strong interest in the Backpack Wheeled Total Station Case suggesting promising market potential. A total of 36.7% of respondents stated they would definitely purchase the product if available while another 33.3% reported that they would probably buy it. This shows that more than two thirds of participants expressed clear purchasing intention. Meanwhile 26.7% were unsure, indicating that further promotion, product demonstration or feature highlights could influence their decision. Only a very small number indicated they would not buy the product. Overall the results show that the Backpack Wheeled Total Station Case is well received and has a high potential for successful adoption in the market.

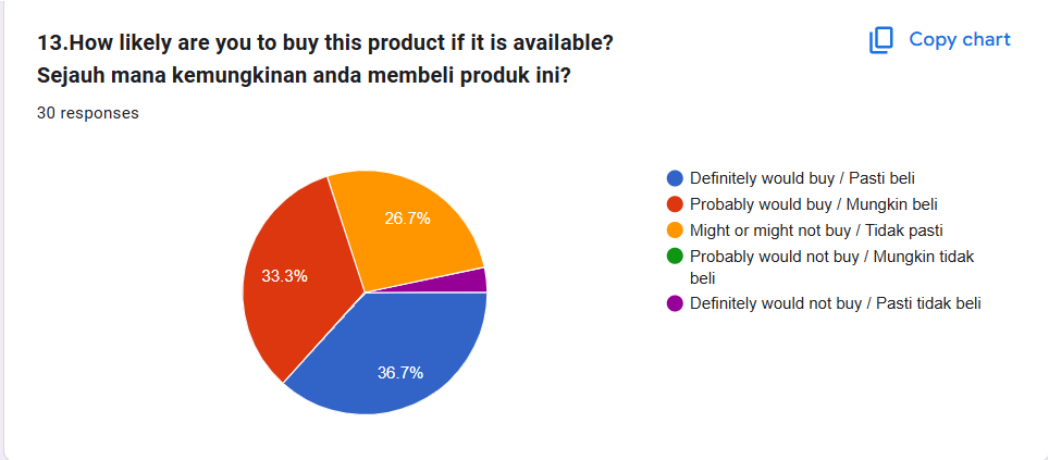

Figure 3.3 The level of user liking for this product

Survey findings show that the majority of respondents view the pricing of the Backpack Wheeled Total Station Case as reasonable in relation to the features provided. A total of 93.3% agreed that the price is fair, indicating strong acceptance and perceived value for money. Only a small portion of respondents disagreed, suggesting minimal concern regarding cost. Overall the results reflect that the proposed pricing strategy is appropriate and well aligned with user expectations supporting the product's potential for successful market entry.

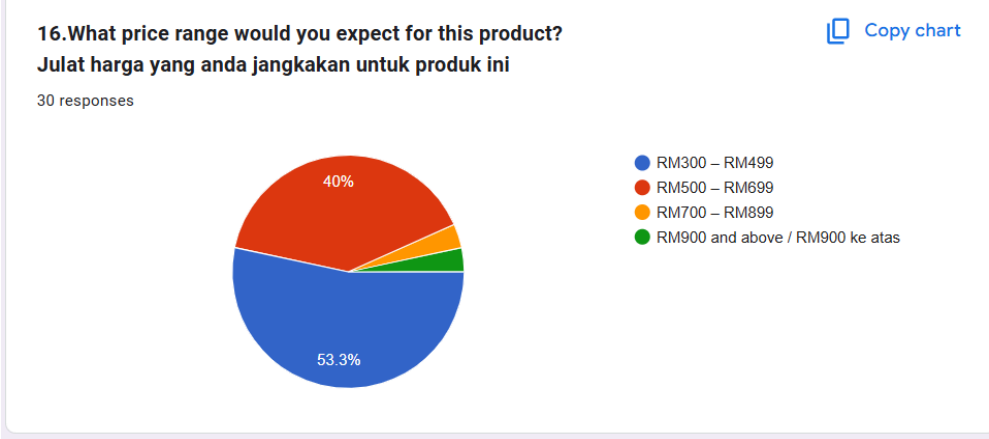

Figure 3.4 Expected price for consumers to buy

Figure 3.5 User opinions about price

In conclusion the Backpack Wheeled Total Station Case effectively addresses the main issues faced by users such as weight, mobility and comfort while transporting equipment. Survey responses indicate strong interest in purchasing the product and high acceptance of its pricing. These findings highlight the product's potential to be well-received in the market as a practical and user friendly solution for total station transportation.

3.3.4 Build Prototype

The figure below shows the prototype product for the Total Station backpack.

Figure 3.6 shows the bagpack from front view

Figure 3.7 shows bagpack from back view

Figure 3.8 shows bagpack from side view

4.0 CONCLUSION

In conclusion, the Backpack Wheeled Total Station Case was developed to address key issues related to ergonomics, mobility, and equipment safety faced by surveyors during fieldwork. By integrating a dual-mode backpack and wheeled trolley system, the product reduces physical strain and improves ease of movement across different terrains, making it more suitable for demanding outdoor and construction site environments.

Through a structured New Product Development (NPD) process, the product successfully combines protection, comfort, and functionality in a single carrying solution. Features such as shock-absorbing EVA foam, water-resistant materials, and organized storage compartments enhance both equipment safety and user efficiency. Overall, this product shows strong potential for practical application in the surveying and construction industries.

5.0 REFERENCES

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6.0 APPENDICES

Some Questions for the respondents:

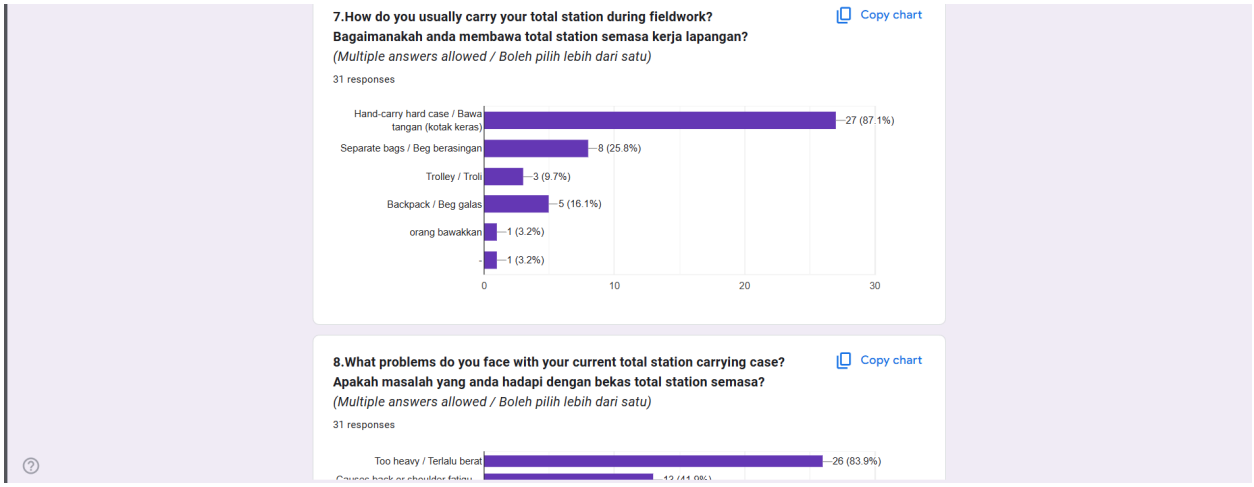

Figure 3.9

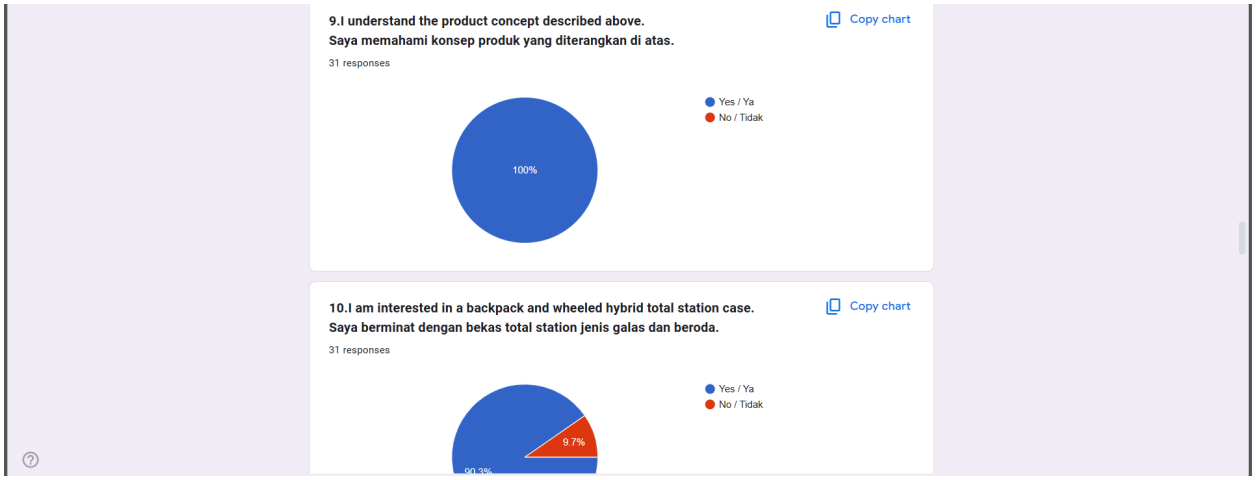

Figure 4.0

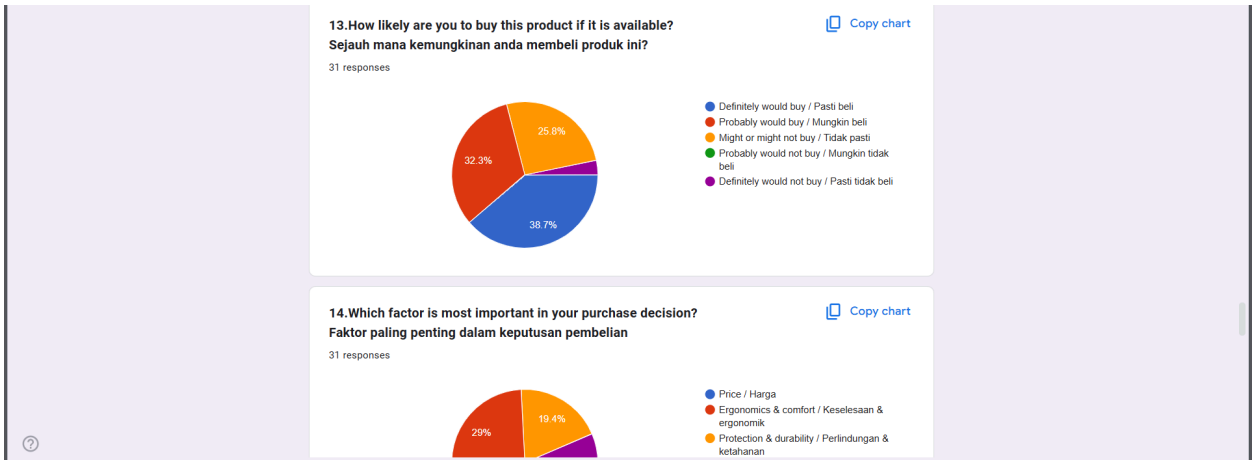

Figure 4.1

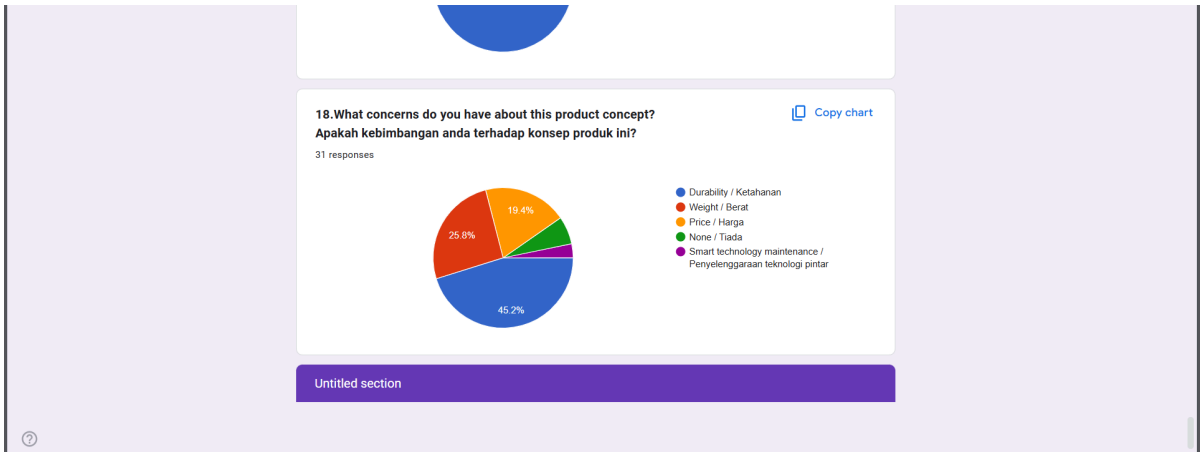

Figure 4.2

The prototype of the product:

Figure 4.3 : The prototype of Backpack Wheeled Total Station Case.