

The Role of Technopreneurship and Innovation System for Commercializing Smart Backpack

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Abstract

Bags have become a necessity for the development of human civilization because bags allow people to store and transport luggage from one place to another easily. In this era of industry 4.0, a product must have advanced technology. This research develops a bag that has smart features, so it is called a smart backpack. This smart backpack will be smart enough to carry out various features for daily use, especially in study and work activities. Much effort has been made to make this bag product aesthetically pleasing, but rarely attempts to make it a smart backpack. A smart backpack is a typical application of intelligent technology, with functions such as supplying energy with a multiport to charge more than one device. In addition, this bag is equipped with a zipper password lock and LED lights. This bag is also made of material that can hold water safe from rainy weather and splashes of water. This study aims to determine the implementation of innovation and technopreneurship in developing an intelligent function bag. This intelligent function helps customers with their daily needs, especially the need to study and work everywhere. This research uses a technological entrepreneurship development framework combined with a business model canvas. Then, it discusses comparing innovative bag products with the same features as the innovation system approach and technopreneurship to learn from this research. Overall, this product aims to meet all basic human needs, especially in work and study activities.

Keyword

Smart backpack, Innovation system, Technological entrepreneur development, Business model canvas

1. Introduction

Researchers have been paying more attention to industry 4.0 in recent years. In November 2011, when the German government unveiled its high-tech strategy for 2020, the term was coined. It is often used to describe the fourth industrial revolution (Zhou et al., 2015). Due to these technological advances, the industrial landscape has changed over the last few years. The industry 4.0 concept includes a series of technological developments affecting products and processes, enabling the creation of smart products through integrating the digital and physical worlds (Schmidt et al., 2015). Industry 4.0 involves products and processes and is often linked to the Internet of Things and smart products. Smart products are multifunctional and user-friendly. The industrial era 4.0 is the era of smart products,

thanks to technological advancements and new ideas. Our phones, watches, televisions, and a slew of other items have become more intelligent.

Bags have become a necessity for the development of human civilization because bags make it easier for humans to store and transport luggage from one place to another (Chenoune and Farid 2005). Behind the simplicity of the function of bags and backpacks, many efforts have been made to make this backpack product attractive in terms of design and aesthetics. However, they rarely have tried to make it a smart backpack even though the need for this smart product is increasing in today's era. Several studies have shown that smart technology can improve the user's quality of life. Smart backpacks have considerable potential among the existing smart technology applications because today's backpack market is enormous (Persistence Market Research 2021).

Previous studies on the development of this smart backpack are, for example. Research conducted by Lee JH et al. (2013) designed a smart backpack equipped with an ultrasonic sensor on the strap to detect obstacles in front of the user to issue alerts for the visually impaired. Sankhe and Rodrigues (2018) designed a smart backpack with three smart functions. The first functions are detecting obstacles ahead (using ultrasonic sensors), then automatic travel (by moving the wheels so that the backpack moves forward by itself), and LED light alerts. Cruz et al. (2018) also designed a smart backpack primarily for indoor positioning. First, the attached photoelectric sensor detects the presence or absence of obstacles in front of the backpacker. Second, Zigbee modules and receivers are used for user positioning. Third, the built-in radio frequency identification (RFID) receiver receives signals from the RFID tag from nearby objects. Then, the backpacker is notified of the positioning result by the built-in vibrator in the strap. The names of the objects around him are also voiced to backpackers. The application of multiple positioning functions at the same time is to improve positioning accuracy. This backpack is specially designed for the visually impaired.

There have been several previous studies on technopreneurship and system innovation. Yuniaristanto et al. (2015) identified an incubator in the university innovation center as a means of developing the Indonesian economy. Wicaksana et al (2015) identified incusion schemes in universities to develop Indonesia's economy. A case study of a university incubator's framework system for university technology-based startup development by Sutopo et al. (2019). In 2019, Sutopo conducted research on how technology commercialization can be accelerated through better technology transfer and open innovation. The role of industrial engineering in technology commercialization and innovation was researched by Sutopo et al. (2019). Aqidawati et al. (2020) also investigated the role of technopreneurship and the innovation system in commercializing battery technology.

SME X is a brand that runs its business in the fashion sector by selling backpacks and various other bags where most of the target market is customers with work and study activities. Nowadays, people need products that support their activities, where most activities and jobs require cellphones and devices. This study aims to determine the application of innovation systems and technopreneurship in developing a backpack that has a smart function to help customers meet their daily needs, especially the need to study and work anywhere. This research makes smart products and designs products with designs that suit SME X's customer desires.

2. Literature Review

2.1 Innovation as a management process

The term innovation is closely related to newness (Johannessen et al., 2001). New products, new services, new production methods, new markets, new sources of supply, and new organizational structures are all examples of innovative activities. The process of commercializing a recently developed product or practice has been defined as innovation (Freeman 1982). There are three types of innovation: product innovation, process innovation, and market innovation. Product innovation provides the clearest way to generate income. Process innovation provides a way to maintain and improve quality and to save costs. Market innovation is concerned with increasing the mix of target markets and how the selected market is best served. Its purpose is to identify new or better potential markets and new or better ways to serve target markets (Johne 1999).

Innovation management encapsulates the management of the entire innovation process from the idea formation stage through the product or process development/adaptation to market launch or initiation. Innovation management includes strategic and operational issues (Dickson and Hadjimanolis, 1998). According to Ojasalo (2003), the new product development process can be divided into three stages: generating ideas, technical development, and commercialization. Innovation management is complex and risky. Innovation is concerned with various knowledge

sectors such as the creation of new ideas and concepts, model design and development, industrial development, R&D, business process redesign, marketing, Etc. Management of technological innovation is one of the challenges faced by management executives today is one of the most demanding to solve. The management of technological innovation involves all aspects of the company where the development and use of technological innovation allow the company to achieve its targets (Carayanis et al., 2015).

Innovation management usually occurs in several recognizable stages. Invention, the main central phase is preceded by a combination of dissatisfaction with the status quo (inside the company) and inspiration from others (usually outside the company). The invention is then followed by a validation process inside and outside the company (Birkinshaw 2006).

2.2 Innovation systems

Innovation systems is a tool for analyzing innovation processes and influencing them, without the strong restriction of innovation policy to market failures that characterizes the mainstream approach. (Soete et al 2010). According to Carayannis (2015) One of the main types of relationships in an innovation system involves the transfer or acquisition of technology, either through markets or through non-commercial interactions. Innovation is not just an isolated act of learning by a company or other entity; innovation is integrated into a larger system that fuels innovation and enables the innovation process to run smoothly. Therefore, the innovation system includes all the main actors and institutions that contribute to the creation, development, diffusion and use of innovation, as well as the interconnection and interaction between all these actors and institutions.

2.3 Technopreneurship

Technopreneurship is the innovative application of technical science and knowledge individually or by people who create and manage businesses and take financial risks to achieve their goals and perspectives. Engineers have high technical skills, but engineers do not have high skills in business and entrepreneurial thinking. (Prodan 2007). According to Dorf, RC, & Byers (2005), technopreneurship is a business leadership style. Including identifying highly technological economic opportunities with high capacity for growth, gathering resources such as expertise and capital, rapid growth, and great risk management through decision-making skills. Technology-based businesses take advantage of significant advances in science and engineering to provide customers with better products and services.

There are clear roles, opportunities, and challenges for entrepreneurs worldwide to accelerate and influence economic growth and take advantage of the Digital Divide through business initiatives in the private sector. Innovations related to moving resources to areas with higher yields. Therefore, knowledge and knowledge-based entrepreneurship will be the primary driver of innovation in the twenty-first century through real/virtual and global/local infrastructure such as a network of incubators (Carayanis et al., 2015). Technopreneurship is vital for a business because it can provide added value in buying and selling products, services, and information to be more effective. The goal of technopreneurship is to commercialization innovations developed by academic scientists through patents, licenses, creation of start-ups, and university-industry partnerships (Grimaldi et al., 2011).

2.4 Business Model Canvas

Business Model Canvas (BMC) describes the rationale of how an organization creates, delivers, and captures value. The business model canvas can best be explained by the nine basic building blocks that show the logic of how the company intends to make money. The nine blocks cover four main areas of business: customers, offerings, infrastructure, and financial viability. A business model is like a blueprint for a strategy to be implemented through organizational structures, processes, and systems (Osterwalder et al., 2011).

2.5 Framework Selection

This study uses the technological entrepreneurship development framework by Siyanbola (2011) in developing smart backpack products. Then develop a business model canvas to explain logically how SME X benefits from developing smart backpack innovation products. After that, compare the developed product with products already available in the market. It is hoped that this research can be used as a lesson learned in innovating a product. Figure 1 shows the framework discussed in this research.

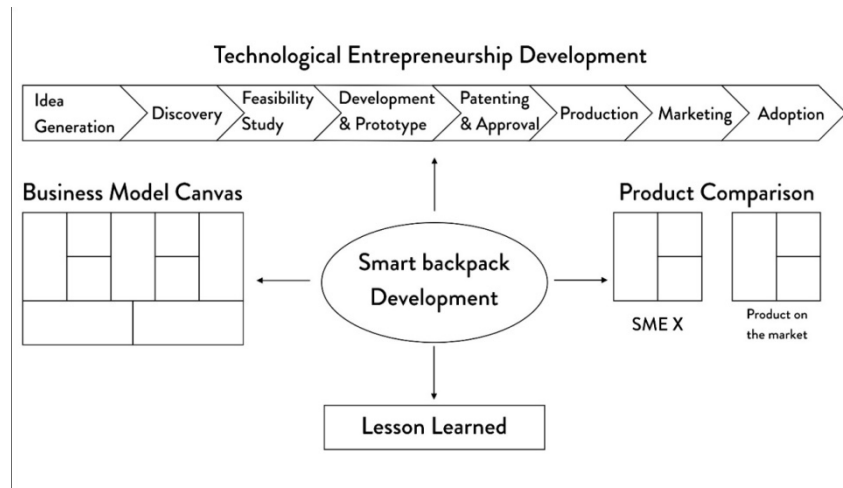


Figure 1. Framework of the study

3. Data Collection

Data collection is carried out using Google Search Engine by typing in keywords related to the technology being developed, which is a smart backpack. Meanwhile, in collecting data on the smart backpack developed by the author, using interviews with the owners of SME X who produce backpack products. In addition to interviews, researchers conducted random questionnaires to SME X's customers using SME X's social media (Instagram). This questionnaire asks about the features developed in the smart backpack product and how the customer responds to this product development.

4. Results

4.1 Technological entrepreneurship development

- **Idea Generation**

New product concepts and ideas can drive technological entrepreneurship development. A business idea is an individual's response to solving an identified problem or meeting perceived needs in the environment. A good business idea is not necessarily a good business opportunity until it has passed the profitability and feasibility tests. The strategy used in product development is carried out by using a weatherproof bag material. Then identify the basic needs of customers in smart backpack products. This Smart Backpack is an innovative idea with many interesting features. It has a charging system to charge cell phones and laptops. This bag is equipped with an LED light, so when the light is low, users can use LED for user activities. This bag is also made of material that can hold water safe from rainy weather and splashes of water. Overall, this is one bag that aims to meet all the basics.

- **Discovery**

This product is the development of a backpack from a simple function to a smart one. Much effort is put into making backpacks design and aesthetically appealing, but it is rare to make them smart. Nevertheless, today, almost all products have advanced functions or smart functions. For example, televisions, cell phones, watches, and even buildings have been designed with smart functions.

The product being developed is a backpack that meets the needs of people in this industrial era 4.0, where people cannot go far in using gadgets. Of course, this gadget needs more power when traveling; therefore, this product is designed to have a built-in power bank that can charge cellphones. The power bank is built-in because otherwise, it would be no different from carrying a regular backpack and a regular power bank. It also aims to provide user comfort when forget to bring a power bank.

The choice of backpack material is also chosen based on materials that have resistance to rainwater. So, users do not have to bother wearing a rain cover for their backpack when it is raining.

- **Feasibility Study**

This step is essential for the development of technological entrepreneurship and should be taken seriously. In the feasibility study, the analysis and interpretation of all the fundamental issues related to the project, the environment, and all available alternatives are examined (Awe 2006). According to Persistence Market Research, the trend of preferring and adopting smart devices in the market is expected to boost the global smart backpacks market in terms of value. This trend, as a result, is expected to be a vital driver of the global smart backpack market. Besides these, an increase in the awareness and participation of end-users in outdoor activities & sports across the globe has also encouraged the adoption of smart backpacks. It is expected to continue boosting the market during the forecast period. However, the high cost of smart backpacks is expected to be a major factor challenging the adoption of the same. Thus, the primary restraining factor for the global smart backpack market.

This research does not discuss the feasibility study comprehensively. The feasibility study is carried out only by calculating the cost structure, and revenue streams explained more fully on the business model canvas.

- **Development and Prototype**

In most cases, the knowledge required at this stage comes from formal R & D. In this stage, the idea on paper is translated into a physical product or process, and its production feasibility is assessed. A smart backpack can be very diverse; bags can be designed in the style that both male and female customers want. It can be with a simple style or fun style where the trend of Korean-style bags is currently still increasing sharply for students (Lee YL et al 2020). The next step is making a prototype and marketing the prototype. Marketing can be done by making a video on how to use the product. After the video is made, advertising can be carried out to become aware of the product.

- **Patenting and Approval**

Patenting is a critical but optional aspect of technology innovation entrepreneurship development. It is the right granted an inventor by the state (government), which allows the inventor to exclude anyone else from commercially exploiting his invention for a limited period, usually 20 years. This period would allow the inventor (innovator) to have maximum returns on his investment and idea. There are four basic ways the patentee (the patent owner) may exploit the patent. These are start-ups, spinouts (or spin-offs), the Sale of patent, and licensing. Patents can be made by registering a brand from the company or patenting an innovative product from the Smart Backpack.

- **Production**

All the necessary approvals must be obtained, then the full-scale production and marketing program is perfected, and the product is launched onto the market. Mass production is carried out when the product prototype has been marketing. Customers who have watched a video ad using the product can know and will be interested if they want. The mass production stage can be carried out if the customer has decided to place an order by pre-order or order before the products are mass-produced.

- **Marketing**

The marketing stage is carried out using online media such as social media and the web because products are marketed online. The initial stage of marketing is carried out by collecting the Voice of customers for related products. The product that will be developed is a weatherproof smart backpack. Customers' voices are collected by distributing a google form questionnaire to customers; the questions asked are related to the features that customers want in a weatherproof smart backpack product. Marketing considers seven stages of buyer psychology: exposure, interest, imagination, compare, convince, decision, satisfaction. The target market segments are students, students and employees who need facilities that support portable deep work or deep studying.

- **Adoption**

Once launched into the market, the product enters its life cycle, and the external competitive environment becomes the main determinant of its survival. In this process, the product is further developed according to the wishes of consumers or the market, for example, by adding custom design making, adding screen printing as desired, and so on.

The backpack design drawing that is being developed is described in Figure 2.



Figure 2. Smart Backpack Design

4.2 Business Model Canvas Smart Backpack

BMC has advantages in business model analysis. It can describe and comprehensively the company's current condition based on consumer segments, the value offered, value supply channel, customer relationships, revenue streams, vital assets, partners, and cost structure. BMC can also be called a strategy in management in the form of a visual graphic consisting of nine elements that can explain a business process comprehensively. The nine elements consist of:

- **Customer Segments**
 Customers that have the potential to produce a product or come from a problem that the business can solve. In this study, the selected customer segments are students and employees with study and work activities. In carrying out its activities, this customer segment requires backup power so that the device can be recharged when travelling anywhere using the smart backpack offered.
- **Value Proposition**
 Value proposition is an added value that will make the business look attractive and different from other businesses such as innovation or solutions offered and become the company's main advantage (Osterwalder et al 2014). The value proposition presented is explained more fully in Figure 3 below.
- **Channel**
 Business media used to deliver solutions that can be offered to consumers in the form of websites, applications, online advertising. In running its business, SME X uses an online marketing channel with Instagram. To sell products, it uses the Shopee and Tokopedia marketplaces. The distribution channel cooperates with JNT Express and Sicepat Express. These two expeditions have collaborated with the marketplace so that SME X only needs to use the management of the marketplace in managing it. SME X also uses official store to sell their product offline.
- **Customer relationships**
 Customer Relationships (knowing how) keep the business in touch with customers. The customer relationships that are built are customer retention, customer acquisition, boosting sales and social media engagement.
- **Key activity (creating a company value proposition),**
 The key activities designed in this business model canvas are as follows.

1. Research and Survey related to customer desires and trend.
2. Making bags design innovation according to customer desires and popular trend.
3. Product delivery to customer.

Detailed explanations related to key activities and the steps in carrying them out are presented in Table 1.

Table 1. Steps in key activities

Key activities	Steps
Research and Survey related to customer desires and trend.	<ul style="list-style-type: none"> • Researching popular bag trends • Collecting voices of the customer through surveys • Carry out product development based on designs according to trends and customer voice
Making bags design innovation according to customer desires and popular trend	<ul style="list-style-type: none"> • Designing product based on trends and customer voices • Choose the materials and components used • Calculate the cost of production • Prototyping
Product delivery to customer (packing products)	<ul style="list-style-type: none"> • Breaking down an activity into an OPC • Calculating the standard time of each activity • Make several alternative packing channels with line balancing • Reduce unnecessary activities • Make product packaging SOPs

- **Key resources**

Every business model requires Key Resources. These resources enable companies to create and offer Value Propositions, reach markets, maintain relationships with Customer Segments, and earn revenue. Different Key Resources are required depending on the type of business model. Key resources can be physical, financial, intellectual, or human. (Primary resources can be owned or leased by the company or obtained from key partners. The existing human resources are social media admins, marketplace admins, bag trend development research teams, design teams and product packaging employees. Intellectual resource is the registration of intellectual property rights at DGIP Indonesia with application number DID2021032949 (DGIP 2021). Patented the brand from UKM X with the Himeku™ label. The intellectual property rights application process has not yet been completed.

- **Key partner**

Key partners describe the people or organizations you need to collaborate with to run your activities and reach your customers. This may be an organization or a company that supports the business. Key partners may also be people who are considered suppliers, distribution partners and marketing partners. An explanation regarding the existing key partners can be seen in more detail in Figure 3.

- **Cost structure**

Table 2. Cost Structure

Raw Material Costs	IDR 1.680.000
Purchase components (battery, cables, etc.)	IDR 9.600.000
3D printing cost	IDR 480.000
Payment to convection	IDR 545.000
Advertising cost	IDR 350.000
Packaging cost	IDR 120.000
Total	IDR 12.775.000
QTY (pcs)	24
Cost of Goods Sold	IDR 532.292

The cost structure is obtained from making a smart backpack; this cost consists of purchasing raw materials, purchasing components, making 3D printing, advertising costs and packaging costs. Detailed breakdown of the cost structure is provided in Table 2.

• **Revenue Streams**

Revenue streams represent the cash generated by each Customer Segment (costs must be subtracted from revenue to generate revenue). The revenue stream generated by the product in development is transaction revenue from one-time customer payments. Table 3 shows the method for calculating the income stream.

Table 3. Revenue Streams

Total Costs	IDR	13,427,316
QTY (pcs)		24
Cost of Goods Sold	IDR	559,472
Selling price/pcs	IDR	799,000
Profit/pcs	IDR	239,528
Profit margin (%)		30%

Based on the discussion of the model design above, we obtain the elaboration of nine elements of business model canvas smart backpack. The BMC of the smart backpack created as a result of this research is depicted in Figure 3.



Key Partners Supplier <ul style="list-style-type: none"> • DOM Convection • ZAKWOOW Convection • Sobatas Convection Marketplace <ul style="list-style-type: none"> • Shopee • Tokopedia Distribution <ul style="list-style-type: none"> • JNT Express • Sicepat Express Social Media <ul style="list-style-type: none"> • Instagram 	Key Activities <ul style="list-style-type: none"> • Research and surveys related to customer desires and trend developments. • Making bag design innovations based on popular trends. • Product delivery to customers 	Value Proposition <ul style="list-style-type: none"> • The material is made of waterproof Cordura which is resistant to water. • The product offered is guaranteed if the product is defective or the order does not match, it can be returned and replaced • Direct delivery (orders entered today ship today) • Special offers for selected customers every month • The bag is pastel coloured and has a Korean style which is what the SME X market is interested in. 	Customer Relationships <ul style="list-style-type: none"> • Customer Retention • Customer Acquisition • Boosting Sales • Social Media Engagement 	Customer Segments Segmented <ul style="list-style-type: none"> • Student and Worker segment with learning and work activities • Customer who loves pastel coloured bag.
	Key Resources <ul style="list-style-type: none"> • Gadgets, Warehouse. • Human resources: packing staff, admin, shop assistant, data analyst • Patent from Himeku® Brand (still pending) 		Channels Online <ul style="list-style-type: none"> • Marketplace and Social Media. • Using the services of a third person in its distribution (JNT & Sicepat) Offline SME Official Store	
Cost Structure <ul style="list-style-type: none"> • Raw Material cost • Payment of production costs to convection • 3D Printing Cost • Advertising on social media and marketplaces • Packaging Cost 			Revenue Streams The revenue model is obtained from the sale of bag products. The profit margin taken is 30%.	

Figure 3. Business Model Canvas for Smart Backpack

4.3 Smart backpack product comparison

Table 4 below shows a comparison of products from smart backpacks on the market and smart backpacks developed by the author. Aspects that compare are product images, brief descriptions, prices, Technology Readiness Level (TRL), advantages and disadvantages.

Table 4. Smart Backpack Product Comparison

Aspect	Products that are being developed by the author	Products in the market
Product Image		
Brief Description	The product is still in the form of a design concept that has not been manifested in the form of a prototype and has not been tested on the customer.	The product is already on the market, but not yet in Indonesia.
Price	IDR 799.000	\$125 / IDR 1.826.862
TRL	TRL 4	TRL 9
Product Strength	<ul style="list-style-type: none"> • Waterproof • Built in Power bank • There is a lock for a zipper • There are lights for lighting in the dark • There is a secret pocket, laptop pocket, bottle pocket • There are several color variations of the bag design. • Headset socket 	<ul style="list-style-type: none"> • Waterproof • There are speakers • Mobile power bank • There is a lock for a zipper
Product weaknesses	<ul style="list-style-type: none"> • Relatively heavier 	<ul style="list-style-type: none"> • Prices are less affordable • There is no bag color choice

4.4 Lessons Learned

The lesson learned from the results of this study is that management systems and innovation are essential for growing successful technology-based entrepreneurs. With the technological entrepreneurship development framework, inventors can quickly formulate steps and strategies in developing an innovative product. With the incorporation of Business Model Canvas, companies and SMEs can efficiently deliver value to customers so that the resulting innovations can be successful in the market.

Business Model Canvas can be used as a detailed step that discusses how companies and SMEs develop innovative products that can generate profits. The challenge of developing a smart backpack can be solved. For example, we can register a copyright for the product to address legal concerns. Furthermore, to introduce the product/brand to the market, we can use advertising to create competition in the market. The value proposition offered by this innovative product is the most significant element in its commercialization. The value proposition explains "why" customers should choose the company's products over those of competitors.

5. Conclusions

From the research conducted, smart technology applications in the industrial era 4.0 are increasingly penetrating our daily lives. Smart backpacks with built-in power banks are one of the most common applications of smart technology. However, developing it with a technopreneurship approach and a business model canvas is a challenge. Because the high cost of smart backpacks is expected to be a major factor challenging the adoption of the same, and thus, the primary restraining factor for the global smart backpack market.

The innovation produced must generate profits. The approach taken can be used as a lesson for anyone who wants to develop a similar product. In the development of smart backpacks, it is not enough to generate ideas. There needs to be further development related to selecting materials and components for bags. This study has not examined the selection of the best alternative materials and components in developing this product. It is hoped that future research can do it with a morphological chart approach in designing a product.

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Biographies

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