

Literature review: visible light communication system business model scheme for telecommunication business in Indonesia

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Abstract: The telecommunication sector mainly comprises operators, vendors, and regulators. In Indonesia, telecommunications operator companies tend to decrease profits from the first quarter of 2017 to the third quarter of 2018. This condition is due to the tight competition of telecommunication service providers, high operational costs, and digital transformation that does not provide substantial revenue for the company. Telecommunications operators need other service options that can expand target market segmentation. It aims to open up a new blue ocean as a new source of income. The world is getting closer to massive communication technology, so high-speed communication is needed. Therefore, telecommunications operators can open new service options based on the visible light spectrum as their communication resources. This option can be integrated with ambient lighting, a wide spectrum ranging from radio waves, and greater bandwidth, making visible light suitable for IoT-5G services. This research aims to design a wireless visible light communication business model. Several frameworks are used, such as the magic triangle of St. Gallen, Osterwalder Business Model Canvas, and PESTLE analysis. The business model design results in a business model with B2B market segmentation being the main focus and B2C market segmentation to acquire retail customers.

Keywords: business model canvas, telecommunication, PESTLE, St. Gallen, visible light communication

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Introduction

The telecommunications business consists of operators, vendors, and regulators. In Indonesia, there are currently four most popular telecommunications operators. However, telecommunication operators in Indonesia must face the existence of over-the-top (OTT) players [1]. These players have taken advantage of delivering huge amounts of data through telecommunication infrastructures owned by telecommunication operators. However, most benefits through application services directly go to OTT, such as high expenditures for building use costs, network maintenance costs, infrastructure development costs, and others. This condition has become one point for telecommunications operators' struggle in the last decade. Operators also must face competing with telecommunication service providers to reach customer loyalty. A price war among telecommunications operators is an effort to increase the number of users and revenue.

Indonesia's internet service market segment has begun to enter a stagnant phase. In the 2021 Indonesian Telecommunications Statistics report, the Central Statistics Agency (BPS) published that the composition of customers in the consumer segment has reached 91.53% [2]. The market penetration of the consumer segment is currently very high, so the space to develop for telecommunications business players, especially operators, in Indonesia, is increasingly limited. Meanwhile, market penetration in other segments, namely the enterprise segment, still reaches 8.45% [2]. This condition shows that the enterprise market segment still has much room for telecommunications businesses to enter.

Along with technological developments, network technology is currently moving towards the era of 5G network technology. Indonesia's telecommunications operator companies can use this momentum to open up alternative income. The alternative is to serve as an enabler of 5G-

based services. The Internet of Things (IoT) is one of the entities of 5G technology that telecommunications operators in Indonesia can utilize. IoT in Indonesia will show a promising prospectus in 2026. The revenue obtained by IoT service provider companies will be 225 million U.S. dollars. The estimated revenue value from IoT services shows that the development of IoT in Indonesia has increased over the past few years [1].

5G-based services must consider aspects that exist in the characteristics of their use case. 5G technology has three use cases, namely enhanced Mobile-Broadband (eMBB), ultra-Reliable and Low Latency (URLLC), and massive Machine-Type Communications (mMTC) [3]. The eMBB use case service on 5G technology allows for communication with very high data rates, up to 20 Gbps, resulting in a better and fast communication experience in large quantities. In addition, the features on the eMBB allow for reliable communication with high mobility, such as on trips at speeds of 500 kilometers per hour. While the use case URLLC allows for a very responsive communication service with less than 1 millisecond latency. Due to its extremely low latency and responsive capabilities, 5G-based communications have a higher relative reliability level than previous generations. In the mMTC use case, the communication services offer massive-scale connectivity of up to 1 million devices per square kilometer. In addition, the features in the mMTC use case must also be efficient regarding energy consumption so that users do not need to recharge the device in large quantities, which takes time [4].

Internet of Things (IoT) technology is one of the entities of 5G technology. IoT-based communication generally uses IoT modules with ISM (industrial, scientific, and medical) frequencies of 2.4 GHz or 5 GHz. Other service options are needed to widen the target market segmentation so that the potential for income increases to open new revenue alternatives for telecommunications operators. However, the visible light spectrum has yet to be widely studied as a communication resource, so the visible light spectrum can be an opportunity to provide communication service options to widen the target market segmentation.

The visible light spectrum has characteristics that support the implementation of 5G communication technology. For example, its use can be integrated with ambient lighting with implications for more efficient energy consumption, making it suitable for mMTC use case services on 5G technology. Based on frequency, visible light in the range of ~ 400 THz to ~ 800 THz interferes with visible light and is possible. Radio waves are very small because of their huge difference in the frequency range. Light-based communication seems reliable and suitable for URLLC use case services on 5G technology. The communication bandwidth is also increasing because the visible light spectrum range is very wide. Based on the Shannon-Hartley Theorem, a large bandwidth value makes the channel capacity for communicating larger so that the data rate capability of the communication system can be greater and produce minimum latency [5]. High data rates and minimum latency match URLLC and eMBB use cases in 5G or future technologies.

Based on the visible light spectrum's ability, visible light can be a potential communication resource in 5G technology. 5G and IoT technology (as one of the entities) can be an alternative income option due to the decline in telecommunications operators' income from their main services, telephone, SMS, and internet networks. Therefore, this research proposes a business model design based on wireless visible light communication systems for telecommunications operators in Indonesia to open up new income for telecommunications operators. Currently, visible light communication technology is still in the development stage. There is still room for research in designing business models related to visible light communication technology as a recommendation when the technology is mature and ready to use.

This research aims to provide recommendations for telecommunications business people, especially operators, in applying visible light communication technology based on frameworks of the St. Gallen magic triangle, Osterwalder Business Model Canvas, and PESTLE (Political, Economic, Social, Technology, Law, and Environmental) analysis. St. Gallen's magic triangle framework is useful for designing the main framework of the business model. Followed by the business model canvas framework to build an end-to-end business model. It concludes with a PESTLE analysis to design strategies related to external factors of visible light communication systems.

Methodology

This research considers the qualitative research method using the St. Gallen magic triangle thinking framework, the Osterwalder Business Canvas Model business model framework, and the PESTLE analysis assessment framework. The nature of St. Gallen's magic triangle framework as a business model navigator can be utilized to formulate a basic framework for designing business models. The Osterwalder Business Canvas Model is used to design a business model that is ap-

propriate by considering the focus of the business points of the previous formulation and the data that has been obtained. At the same time, the PESTLE analysis assessment framework is used to determine and anticipate external factors that can interfere with implementing the design business model. Then it ends with the conclusions and recommendations.

In the St. Gallen magic triangle framework, business points are arranged based on articles and papers from previous researchers. The first business model factor, namely "Who is the customer?" [6]. Furthermore, the second business model factor is "What is the customer value proposition?" [7]. Furthermore, the third business model factor is "how to build and distribute the value proposition?" [8]. Finally, the fourth business model factor is "why the business model is financially viable?" [9].

After obtaining business model points, the formulation continues to the Business Model Canvas framework. In this framework, the formulation of business model points from the St. Gallen magic triangle framework is detailed end-to-end. It aims to compile a comprehensive business model, from the target market to its revenue stream. The business model is prepared based on the existing business model of two leading companies in Indonesia, namely PT Telekomunikasi Indonesia and PT XL Axiata, with minor adjustments related to implementing visible light communication technology [10].

The research ends with the PESTLE analysis framework (political, economic, social, technological, law, and environment). This framework has several external aspects that determine the direction of the company's strategy, such as political, economic, social, technological development, law, and environment. Aspects of PESTLE analysis can be beneficial or detrimental to implementing a business model.

Results and Discussions

Analysis of the Magic Triangle Framework of St. Gallen

[Table 1](#) shows the formulation of the business points of the magic triangle of St. Gallen. It presents points arranged to identify the revenue model, the value offered, and the product's value chain (goods/services) for more detail on the Business Model Framework canvas.

The issue raised in this first factor concerns minimal resources to support the business model of visible light communication systems. Resources needed include marketing agents to penetrate the market, technicians to install services and ensure services function properly, service agents customers to accommodate and follow up on customer complaints, and Capex-Opex funding to make investments and infrastructure development operational funding. The next issue is the product. The product is a connectivity solution that can be tailored to the problems of an institution/person. "Customizable" points have a positive appeal because the services provided can be right on target for the problems that customers have.

The second factor in discussing St. Gallen's magic triangle in [Table 1](#) is "Who?". Raising the issue relates to who segments the market from the design business model and the business partners. In determining the market segmentation of a business model, we need to look at the actual conditions of the industry, especially the telecommunications industry in Indonesia. Based on data published by the Central Statistics Agency (BPS), the composition of consumer segment customers has reached 91.53%. This condition means that the consumer market segment in Indonesia has shown signs of stagnating. Therefore, there is a need for an alternative focus on new market segments or also known as the new blue ocean. The business and enterprise market segments can become a blue ocean for telecommunications operators in Indonesia. Based on data from BPS for the composition of enterprise segment customers, it still reached 8.45%. In addition, based on data from Statista, it is predicted that revenue in the enterprise segment on a year-on-year basis will continue to increase [11]. It means that the enterprise market segment

still has much room for growth. The other issue is the business partner needed to support the design business model. There are three crucial things in supporting this proposed business model, namely infrastructure, marketing, and society. Therefore, the business partners include infrastructure provider vendors, marketing and collection agents, and communities to disseminate information related to each other product, service, and business model design.

Table 1. The formulation of the business points of the magic triangle of St. Gallen

Factors	Factor Formulation	Point Formulation
What?	What are the minimum resources required to run the business model?	Marketing agents, technicians, customer service agents, and Capex-Opex.
	What products can be offered to customers?	Connectivity solutions that can be tailored to the problems of an institution/individual.
Who?	Who segments the target market?	Business, Enterprise, and Retail segments.
	Who are the supporting business partners needed?	Vendors of infrastructure providers, marketing-collection agencies, and communities.
Why?	Why are the business products offered profitable for customers?	Able to integrate needs based on customer problems.
	Why should the business model be designed to generate additional income for telecommunications business people?	Because this visible light communication system-based business model not only generates revenue from internet connectivity but also generates new sources of revenue from the digital solution services offered as an implication of the advantages of visible light communication systems.
How?	How to maintain revenue from the technology business model?	Research and development activities in terms of infrastructure and types of services offered.
	How to increase customer interest in using the business products offered?	It is by conducting good customer relationship activities and socialization related to futuristic technology.

The third factor relates to the surplus value of business products and the addition of profits as an effect of increasing income from business services. The advantage of business products offered from this business model is that because the product is a "solution", the business product can integrate needs based on customer problems. Therefore, the new source of income from digital solution services offered to customers has implications for increasing business people's income. Digital solution services will certainly be accompanied by internet connectivity from the same business people so that new sources of income are opened from connectivity internet and those digital services.

The last factor of St. Gallen's magic triangle discussion will lead to maintaining revenue from the design business model and increasing customer interest in relatively new business products. The crucial thing is the existence of research and development activities in terms of infrastructure and the types of services. It is because each technology has its life cycle, and the cycle follows the S-curve theorem [12]. There are four phases in technology development, namely the emerging phase (new technology), the growth phase (rapidly developing technology), the phase maturity (main technology), and the saturation phase (replaceable technology). The importance of conducting research and development related to infrastructure is that business products do not already enter the maturity or saturation phase without any new substitution product ready to replace and create another new S-curve. Currently, visible light communication technology is still emerging, which means it is still classified as a new technology in development. Therefore, increasing customer interest in using these business products to carry out customer relationship activities related to new technology is crucial. It also provides socialization related to the convenience of the business products offered.

Osterwalder Business Model Canvas Framework Analysis

The points obtained from the magic triangle of St. Gallen are then used in formulating business models using the Osterwalder Canvas Business Model framework to formulate a business model comprehensively. The aspects start from partners, activities, and selling points to expenses and income channels. This model design adopts the existing I.T. solution service business model in telecommunications companies (PT Telekomunikasi Indonesia and PT XL Axiata) in Indonesia [10]. Detailed questions and components of each aspect are listed in [Table 2](#).

Table 2. Components of each aspect

Aspects	Questions	Components
Key partners	What are your key partners to get a competitive advantage?	Electronic vendor provider, network hardware vendor, frontline agent, community, infrastructure management service provider
Key Activities	What are the key steps to move ahead with your customers?	Sales activation, marketing & promotion, RnD services, fulfillment & service assurances, channel activation (community, marketing partner, etc.), retention, loyal program activation
Key resources	What resources do you need to make your idea work?	Company employee, sales & marketing agent, community marketing agent, assurance & fulfillment technician, customer care agent, CAPEX & OPEX
Key propositions	How will you make your customers' life happier?	Customizable I.T. solution for business, enterprise, and retail
Customer relationships	How often will you interact with your customers?	Customer interaction, social media giveaways, loyalty program activation, retention program activation
Channels	How are you going to reach your customers?	Digital advertising, customer care, sales & marketing agent, website landing page, digital community agent, mobile apps
Customer segments	Who are your customers?	Business segment, enterprise segment, retail segment
Cost structure	What are the CAPEX and OPEX used for?	Infrastructure investment (CAPEX), asset investments (CAPEX), human resources cost (OPEX), general affair cost (OPEX), Marketing cost (OPEX), operational & maintenance cost (OPEX)
Revenue stream	How much are you planning to earn in a certain period?	Digital service revenue, analytic service revenue, OTC or recurring infrastructure charge

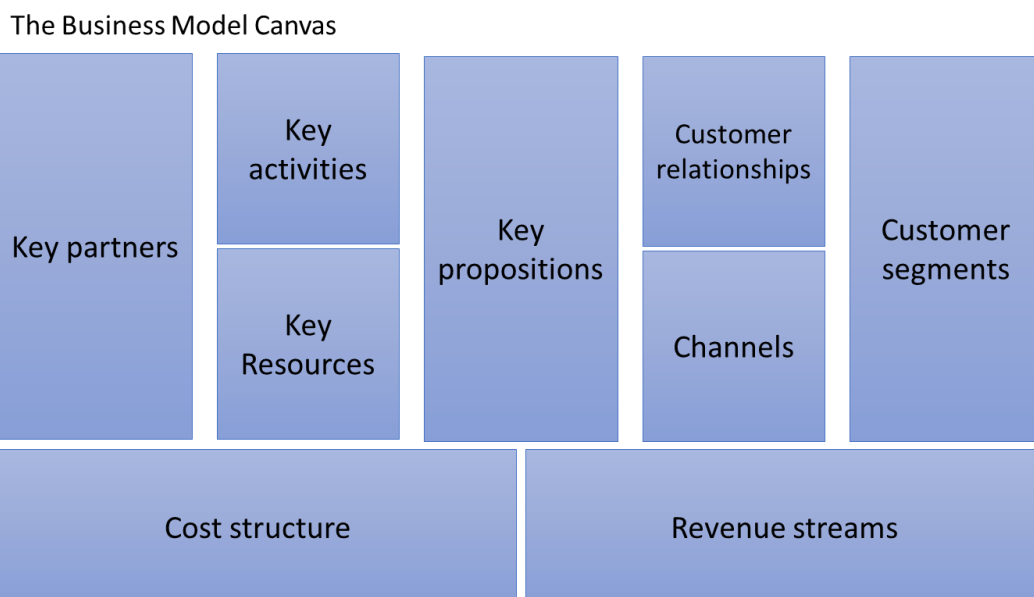


Figure 1. Business model canvas - visible light communication system

[Figure 1](#) shows aspects of designing a business model of a visible light communication system for telecommunications businesses in Indonesia. Market segmentation in an industry can be categorized into several groups, such as based on business scale, type of business, or geographical location. Market segmentation categories based on business scale can be divided into business size classifications, for example, small, medium, and large businesses. At the same time, the market segmentation category based on business type can be divided into business type classifications, such as home market or business to consumer (B2C) and business to business market (B2B). Market segmentation based on geo-graphical location can be divided into market location classifications, whether in mountains, low-lands, or urban areas.

Applying market segmentation based on business type would be more appropriate in the telecommunications industry. By classifying markets based on the type of business, telecommunications business people can adjust the services offered to the capabilities of the intended market. According to data from the 2021 Indonesian Telecommunications Statistics report published by the Central Statistics Agency (BPS), the composition of customers in the home market segmentation has reached 91.53% [\[2\]](#). The penetration of B2C market segmentation is already very high, so Indonesia's space to develop telecommunications businesses, especially operators, is increasingly limited. Meanwhile, market penetration in other segments, namely the enterprise segment, still reaches 8.45% [\[2\]](#). It means that the enterprise market segment still has a very large growth room for telecommunications business players to enter the market.

Regarding the propositions, based on information from Indonesian Telecommunication Statistics from BPS in 2021 regarding customer composition, the best market segmentation for the business model is in the segment enterprise (B2B). The characteristic of enterprise segment customers is that they have varied problems. Unlike the home segment (B2C), the products offered to the B2B segment also differ from B2C, whose products are uniform. Product offerings for the B2B segment must lead to solving the problems of each institution, namely in the form of adaptive I.T. solutions based on digital technology. The solutions offered can be more targeted and increase service rates based on customer needs.

With light-based communication products through visible light communication systems, new technology applications will be open because of the need for high communication speed. The visible light spectrum range is very wide, and the communication bandwidth that can be utilized is also getting bigger. Based on the Shannon-Hartley Theorem, a large bandwidth value makes the channel capacity for communicating larger so that the data rate capability of the communication system can be greater and produce minimum latency [\[5\]](#). High data rates and minimum latency suit URLLC and eMBB use cases in 5G communication technology or future technologies.

According to Osterwalder, service distribution channels have five distinct phases. Each such distribution channel may contain one or more phases. The five phases include awareness (interacting by providing information to customers), evaluation (interacting by requesting product or service evaluations from customers), purchase (how customers make transactions), delivery (how to deliver products or services to customers), and after-sales (post-transaction service) [\[13\]](#). In addition, the method of applying service distribution channels is also divided into two types, namely direct (interacting directly) and indirect (interacting through intermediaries or third parties) [\[13\]](#).

In the design of this business model, six distribution channels can be utilized to channel the five phases. The six channels include digital marketing, customer care, marketing agencies, web pages, community agencies, and applications. Digital marketing channels, customer care, web pages, and applications fall into the direct type. Meanwhile, marketing agent channels and community agents are included in the indirect type. The types of channels have their advantages and disadvantages, both direct and indirect. Indirect channels have a smaller margin value when compared to direct channels but are suitable if you want to do a major expansion. Conversely, direct channels can have a larger margin value but require more capital to carry out the same amount of expansion compared to indirect canals [\[13\]](#).

Today, business competition requires us to approach customers in various ways. One way is through digital marketing. Advertising is the most effective digital marketing strategy to build a product image and develop its business to be better known by its target market. Therefore, digital marketing channels contain one of the phases referred to by Osterwalder, namely, building awareness of the target market related to the product. In addition, through digital advertising, it can also directly invite the target market to make transactions. If digital advertising can be utilized optimally, digital marketing channels also contain a purchase phase.

The second channel to be maximized is the customer care (CC) division. The CC division is

one of the most important channels in this business model because it contains all five phases to become a complete channel. When there is a target market contact, the CC division has the authority to explain the most suitable product to be used as a solution. This function makes the CC division contain one of the channel phases, namely awareness. The CC division can also receive criticism or ask for opinions directly from customers to contain the next phase of the channel, namely evaluation. After the target market is satisfied with the information provided, the target market will enter the next phase facilitated by the CC division, namely purchase. The purchase phase will be continued with the delivery phase, where the CC division functions as an intermediary between the customer and the technician team to install the service. The last function owned by the CC division is the after-sales phase, where the CC division can function as a center for receiving service complaints against disruptions or damage for immediate follow-up.

Marketing agencies and community agents are indirect channels for large and short expansion. These agents can spread product awareness to the target market by jumping in and meeting it directly. Just like in CC channels, through marketing agencies and community agents, if the target market feels sufficiently informed and feels the right product to be used as a solution. Then it will proceed to the purchase phase. After the purchase phase, the agents will contact the engineering team to perform the installation. Another secure web channel can be a digital channel for conveying official information spread awareness about new products or the latest promos. This web page aims to build engagement between business people with the target market and customers who have subscribed. Target markets can also make transactions by submitting products from the web page.

Unlike a web page, an application is more personal and addressed to the product's customer. The application can contain content in the form of other available product and service information to increase customer awareness. Customers can use these other service products to apply for additional services as desired. In addition, businesses can enter a feedback column in the application channel to get customer suggestions and evaluations. In the after-sales phase, customers can also use the application to report disruptions or damage without contacting the CC team. The customer connection contains ways to communicate with customers so that customers can still feel comfortable subscribing. There are various ways to maintain customer interaction. This business model proposes four types of customer relationships: customer interaction, giveaways, customer loyalty programs, and customer retention programs.

Maintaining good customer relationships is important in doing business to create subscription sustainability. One of them is by conducting customer interactions. Customer interaction can touch all aspects of business, from marketing and sales to customer service. With a good customer interaction relationship, it will result in increased customer satisfaction in subscribing.

Customer interaction related to marketing can be obtained through how business people can convey information/advertising through social media and get responses from customers or potential customers. In addition, another example is the participation of business customers at a business event to increase engagement. Customer interaction in marketing can also be built by always updating relevant packages and promos in the community.

Customer interaction in other aspects, such as sales, is how businesses can leverage the voice of the customer to improve the quality of sales. For example, customers contact frontline agents to get information quickly and accurately. Customers can also do this in another way, namely by accessing the web page of the business person.

Customer relationships are related to the phases of the channel. As in customer interaction in the aspect of customer service, ways for business people to interact with customers to obtain an evaluation phase. For example, businesses provide a way for customers through various platforms to provide criticism and product suggestions. The results of the evaluation can improve service quality and product quality. The cycle will continue continuously until the customer experience improves.

Customer loyalty is a major factor in earning sustainable revenue. Customer loyalty can be improved with several activities. These activities can be done by always connecting with customers and offering benefits to make customers remember their products. Customer loyalty programs can also be synergized with customer retention programs. For example, providing fine relief for selected customers experiencing financial problems, giving giveaways, giving souvenirs to customers' acquisitions, etc. Customer loyalty programs aim to reduce the number of customer churns.

The most important part of a business is the profit scheme from the income earned. There are three additional revenue streams for businesses when implementing this business model. These revenue streams include revenue from digital services, analytics as a service, and one-time

or recurring rate schemes for supporting infrastructure. Revenue from digital services can be understood as a new source of revenue derived from enabled digital services due to the presence of visible light communication systems. For example, smart services (smart office, smart home, etc.), smart energy harvesting services as an alternative energy source, and communication system services between vehicles and vehicles to minimize accidents. These sources can be utilized to add revenue to business people because, based on customer segments, the enterprise market has a direction toward providing I.T. solution services. The second revenue stream source is analytics services, such as Analytics as a Service (AaaS). Data center market predictions in Indonesia projected by the end of 2022, the value of revenue from the market will reach USD 2.84 billion. In addition, it is also shown that the compound annual growth rate (CAGR) based on revenue from 2022 to 2027 is predicted to touch 5.03% or 2027, amounting to USD 3.63 billion [14].

AaaS is designed to process and manage information in massive sizes. AaaS is becoming important in a competitive industry due to a shift in focus from business-centric to customer-centric. Getting accurate and quality state findings can have implications for better decision-making, improving customer experience, and others. However, the complexity challenges of data processing are getting higher. In addition, it is also necessary to pay attention to data security from business customers so as not to fall into unwanted parties.

The third source of revenue stream is from one-time charges or recurring infrastructure charge schemes. Both schemes offer customers the choice of the desired scheme for using visible light communication system devices. The one-time charge scheme is like business people also sell visible light communication system devices to customers so that customers can enjoy I.T. solution services from business people. Meanwhile, the recurring charge scheme is like a business person implementing a monthly device rental policy for customers to enjoy I.T. solution services from business people. Both the one-time charge scheme and the recurring charge scheme are certainly beneficial for business people. It is because businesses can capitalize on devices to increase their revenue stream.

Key resources are important resources to support business activities. This business model has six key resources: employees, marketing agencies, community marketing agencies, technicians, customer care agents, and funds for expenses in Capex and Opex. All key resources owned by the company will be meaningless without a manager. Therefore, business employees have an important role in managing these products. Managing, developing, and being responsible for the entire product marketing cycle. The product marketing cycle covers how services are produced to how services are marketed to customers.

Sales and marketing agents are the "spearhead" in penetrating the market. Sales and marketing agents such as account managers are one of the resources that employees need to manage. Things that need to be managed start regarding operational activities, productivity, and field constraints. If previously sales and marketing agents were from internal resources, there need to be additional resources from external so that the market penetration movement is more massive. Community marketing agencies are external resources to penetrate more strategic markets. However, to activate the resources of this community marketing agency, there needs to be an approach from employees to make partnerships. It is intended to create a mutually beneficial relationship.

Apart from sales and marketing, there are other aspects for business employees to pay attention to: technicians. Technicians are included in important resources because they are the "spearhead" in installing and maintaining infrastructure. The technician team must be ensured and monitored for its performance by business employees to serve and prioritize the best customer experience.

In a telecommunications business, it is not enough to pay attention to aspects of marketing and sales. There also needs to be special attention to customers through customer care agents. CC agents are needed to handle customer complaints related to disruptions, infrastructure maintenance, to the submission of additional services.

One of the most important resources in a business model is funding. Funding in a business can be divided into capital expenditure (Capex) and operating expenditure (Opex). Capex is a source of funding for a business to invest in adding asset value to increase profits in the future. Meanwhile, Opex is a source of operational funding to maintain the continuity of these assets so that business activities can run well. Managing Capex and Opex can affect the sustainability of a business. Therefore, the role of business employees is needed to manage Capex and Opex wisely.

The key activities aspect is activities to support business activities that are eight key activities, namely sales activation, marketing and promotion, product development, technical mainte-

nance, channel activation, program retention, and customer loyalty programs. A sales activation is an activity to convert a prospect into a customer [15]. Efforts in activating sales can be done with marketing campaigns aimed at the target market. The strategy for doing this campaign is with 4P mixed marketing [16]. According to Kotler, mixed marketing is a mixture of marketing variables that an institution can control to achieve a certain level of sales in the target market [17]. McCarthy describes the concept of 4P mixed marketing as "Product", "Promotion", "Price", and "Place" [18].

The four factors are crucial in benefiting because the products offered to the target market must be by their wishes. A need will arise when the target market already wants products from business people. When the needs of the target market are by the pricing and promotions applied, business people will have the potential to acquire target markets into their customers. Place marketing can also help business people in marketing because, in addition to opening physical marketing places, business people can also use online marketing to expand market penetration.

In 2020, Boston Consulting Group released a list of the 50 most innovative companies in the world. The ten companies are Apple, Alphabet, Amazon, Microsoft, Samsung, Huawei, Alibaba Group, IBM, and Sony. These companies have one thing in common, namely, ICT service providers. Companies in the technology field generally rely heavily on their research and development teams to continuously develop their products to remain competitive in the competitive market [19]. The results of product development from the research and development team of each company will have implications for the emergence of new products with various types of innovations applied. New products will create a new competitive market, also known as a new blue ocean, so that the sustainability of an institution can be maintained.

After the creation of marketing activities, of course, infrastructure installation and maintenance activities by technicians are needed. Therefore, technicians are important in this business process because they can deliver services from business people to customers. In addition, technicians also spearhead infrastructure maintenance so that it can always be delivered to customers properly.

In the basic flow of business processes, operational activities can run when sales activation, marketing, and infrastructure installation and maintenance activities have been running. Furthermore, market expansion activities are required to develop business models. One of them is by activating marketing channels. Marketing with multichannel or omnichannel techniques can drive sales results significantly [20]. In its published article, McKinsey informs that in some use cases, there has been a 20% increase in marketing efficiency for marketing agencies [20]. It is planned that customers can need the necessary information without the presence of a marketing agency. Marketing channels in this business model can be websites, chatbots, communities, and call centers.

The networking activities of new customers will be meaningless if the subscriber subscription period is not as expected. Therefore, the retention program is an important activity to pay attention to because implementing a good retention program will produce loyal customers. Retention programs can be done in various ways, such as customer education programs related to products, using positive testimonials, spreading positive content on social media, Good and consistent communication with customers, etc.

After the retention program is successful, loyal customers will begin to grow. The last step is to make customers more comfortable using the service by carrying out customer loyalty program activation. Customer loyalty activities can also be interpreted as a form of appreciation from business people to customers for their loyalty in using services. According to a McKinsey survey, 50% of loyal customers will be more likely to recommend used services to others, and 31% will be more willing to pay more to stick with the services used [21]. Loyalty programs such as points-based and tiered loyalty programs can be activated. An example of a points-based program is activating a point redemption program for certain benefits, such as price deductions or certain souvenirs worth some points accumulated. At the same time, examples of tiered loyalty programs are grouping customers into a category based on transaction frequency or subscription duration. The higher the level of customer categories, the more benefits customers get.

In the key co-worker aspect, related parties support business activities. There are five partners in this business model, namely providers of electronic equipment supporting visible light communication systems, providers of connectivity supporting hardware, managing partners' device and infrastructure maintenance, frontline agents, and communities. The main factor that needs to be ensured for this business model's sustainability is network connectivity services. Network connectivity is required to connect customers with services from internet servers. If internet servers can be provided for customers to use, then the integration of visible light com-

munication infrastructure is carried out to enable high-speed I.T. solution services. Building a comprehensive visible light communication infrastructure requires electronic components. These electronic components include LEDs as signal transmitters, photodiodes as receivers, and operating systems to process signals. The existence of vendor partners providing these electronic components will be an advantage for this business person because vendor partners can enable mutually beneficial cooperation schemes for both parties.

Distributing services from the central office to customers requires a connectivity medium to be an intermediary. These mediums use devices such as Gigabit Passive Optical Network (GPON) devices to provide connectivity services, Optical Line Termination (OLT) for the starting point for distributing connectivity services, and Optical Network Terminal (ONT) for signal receiving endpoints from connectivity services. The specifications of these devices are crucial in providing optimal service quality. Therefore, the cooperation of partners in providing network hardware will make it easier for business people to ensure and determine the quality of the desired device.

After the electronic components and supporting hardware of the service infrastructure are available, partners are needed to ensure that the service infrastructure is always available optimally. Not only ensuring its availability but also ensuring its maintenance when a disturbance can be handled quickly. Partners in terms of infrastructure maintenance are needed so that disruption handling becomes more focused.

In businesses engaged in telecommunications, there are two main things to focus on business. These two things include in terms of infrastructure and terms of marketing. Business focus in terms of infrastructure has been discussed in the importance of having partners for providing electronic components, hardware supply, and infrastructure maintenance. Furthermore, the business focus in terms of marketing will be discussed through frontline agents and communities.

Marketing activities not only market penetration must be considered, but also customer retention needs to be considered. A frontline agent can help to handle both of these things. When carrying out market penetration activities, although the role of an account manager can also be used to do customer retention, frontline agents, such as customer care, are also needed to capture customer complaints. In addition, customer care is also needed to carry out activities in terms of customer relationships to maintain customers. External parties, such as communities, can also conduct market penetration activities. The community strongly influences the dissemination of information because it is massive and widely connected. If business people can empower the community, then business people will benefit in the form of rapid and widespread dissemination of product information and open up the potential of new marketing channels.

The cost structure of this business model is divided into two types: Capital Expenditure (Capex) and Operational Expenditure (Opex) costs. Capex costs are incurred by business people when there is a need for investment in adding asset value to support activities in increasing profits in the future. Meanwhile, Opex costs are a source of operational funding to maintain the continuity of these assets so that business activities can run well. Capex in this business model is divided into two main categories: infrastructure investment and asset investment. Meanwhile, Opex is divided into four categories: H.R. costs, general purpose costs, marketing and sales costs, and operational maintenance costs.

The cost of expenses so business activities can run is an investment in Capex. The first Capex cost in this business model is infrastructure investment such as fiber optic networks, visible light communication system networks, and other supporting infrastructure. In addition, Capex costs also include asset investment, such as technical tools and equipment to maintain or repair infrastructure and leasing or purchasing locations to place network support devices.

Furthermore, infrastructure and asset investment costs are necessary for operations after infrastructure and asset investment. This business model has four Opex cost categories: human resource compensation, general affairs, marketing, and maintenance. Human resource compensation costs include employee payroll costs, employee insurance costs, recruitment costs, and others. Furthermore, the cost of general affairs includes the cost of electricity, water costs, the cost of gasoline generators, and other general needs. In marketing costs, the costs in question include producing brochures and catalogs, subsidizing costs to issue promos and other costs to encourage sales of business products. Finally, maintenance costs include, among others, infrastructure repair costs, asset damage costs, and other operational costs.

PESTLE Framework Analysis

After obtaining a business model based on the previous framework, the next discussion is external factors that can benefit and harm the business model. Business people can prepare for the anticipation of adverse factors and take advantage of beneficial factors in operations. These

factors are designed using the PESTLE framework (political, economic, social, technological, law, and environment). [Table 3](#) lists external factors that influence the development of visible light communication systems.

Table 3. PESTLE analysis of visible light communication system

Politics	Economics	Social	Technology	Legal	Environment
US-China semiconductor chip war	Potential world recession conditions in 2023	“New Normal” Behavior	Not maximized semiconductor production	Chips and Science Act Bill – USA	Green Technology
China-Taiwan geopolitical conditions	Potential spike in global inflation	Digital Divide	Safer communication networks	Potential “Price Fixing” regulation from the government	
			VLC technology is still in the development stage		

The first factor in the PESTLE analysis is politics, one of which is the US-China semiconductor chip war. Today, the United States (U.S.) and China are waging a technological war. The United States government exercises export controls by targeting China. These controls include cutting off access to certain types of semiconductor chip manufacturing with equipment from the United States. The Chinese government responded by entering into a cooperation agreement with South Korea to integrate the semiconductor industry between the two countries. China reinvested funds in the semiconductor industry’s stock exchange in South Korean industries, such as Samsung and S.K. Hynix, and Chinese industries, such as Semiconductor Manufacturing International (SMI) Corp. and Montage Technology [\[22\]](#).

The impact of the chip war is the decline in world semiconductor production. As the world’s largest chip market, China experienced a decrease in imports of I.C. units in September 2022 by 12.8% year-on-year (YoY). Therefore, the number of Chinese semiconductor chips also decreased by 10%. This decrease in the number of semiconductor chip circulation in the world market can cause a reduction in the supply of semiconductor chips worldwide, potentially resulting in a scarcity of these components to produce tools and electronics [\[23\]](#).

Apart from the semiconductor chip war between the United States and China, another potentially hindering factor in semiconductor supply is the geopolitical conditions between China and Taiwan. Taiwan is the world’s largest producer of semiconductors. Tensions between China and Taiwan are suspected of political conflicts in which China mobilizes its military force to reclaim Taiwanese territory. This condition will certainly threaten the electronics industry in Indonesia, where the main material is semiconductors. The threat could arise because the logistics route between Taiwan and Indonesia generally goes through the South China Sea. Indonesia has a dilemma because if Taiwan sides with the United States and imports semiconductors from Taiwan or the United States, it will certainly disrupt the stability of Indonesia’s trading partners, where the United States and China are on the list of the top 10 largest investor countries in Indonesia [\[24\]](#).

The second factor in the PESTLE analysis is the economy, where the main influencing factor is the condition of a potential recession. From the country’s internal point of view, challenges related to public health due to the Covid-19 pandemic remain unresolved. Meanwhile, from the country’s external point of view, geopolitical pressures between Russia and Ukraine do not contribute positively to the global economic recovery. Both points of view increase global energy and food prices and trigger inflation [\[25\]](#). The impact of inflation on the entire industry. Including the electronics and telecommunications industries is the increase in prices of production materials, thereby increasing production costs and investment value. The third factor in the PESTLE analysis is social, where social factors that influence the telecommunications business, especially visible light communication systems, are “new normal” behavior and The existence of the Digital Divide. The Covid-19 pandemic has forced public life to utilize digital platforms daily. Today the world has entered the digital era, where technological advances continue to increase, and the need for online activities increases [\[26\]](#). Therefore, I.T. solution services based on light communication systems seem to be an attractive technological solution for integrating technology needs.

In Indonesia, rapid technological development is not matched by technology penetration, especially in the 3T (frontier, outermost, and underdeveloped) regions. This digital divide is an imbalance in the growth of information and communication technology in an area. Based on the digital divide value index (DIDIX), Indonesia has an index value between 19.39 and 25.49 [27].

The fourth factor in the PESTLE analysis is technology, where things related to technology affect the technical development of visible light communication systems. Considerations related to the technology include not maximizing semiconductor production, safer communication networks, and visible light communication system technology is still in development. The threat of not maximizing semiconductor production due to the semiconductor chip war between the United States and China makes the main components in producing electronic devices increasingly limited. Visible light communication systems require electronic devices, such as LEDs, photodiodes, and microcontrollers, as their main components.

However, currently, the visible light communication system is still in the development stage. The development of visible light communication systems has reached the stage of making dongles, but it has not yet been commercialized. This visible light communication system is attractive because of its advantages: high security, speed, and energy efficiency. High safety due to the nature of light that cannot penetrate thick objects. In addition, it is high in speed because the frequency of light is very high, so referring to Shannon's Theorem allows higher communication bandwidth to radio communication [28]. Meanwhile, the advantages of high energy efficiency are related to environmental factors in the PESTLE analysis because its function can be integrated with ambient, general, and room lighting.

The fifth factor in the PESTLE analysis is legal, where matters related to legal provisions, both domestic and foreign, can affect the application of visible light communication systems. From the provisions of foreign law, there is a phenomenon of semiconductor chip warfare between the United States and China which has been drafted in the Chips and Science Act Bill by the United States so that it has the force of law. Furthermore, from domestic legal provisions, there is the possibility of service pricing regulations, such as in the Omnibus Law, where the government sets the lower and upper limits of telecommunications services in Indonesia. It can positively or negatively impact the business model of visible light communication systems. Pricing can positively impact keeping market conditions healthy when the market is saturated. Meanwhile, when the market is still not saturated, pricing can have a negative impact because it can limit the profit margins of business people, so it takes longer to break even points or even record their first profit.

Conclusion

This research found that the business model design by implementing visible light communication systems results in a business model with B2B market segmentation being the focus for increasing revenue. Meanwhile, the B2C market segmentation should be kept acquiring retail customers. The main player of the support system is the I.T. solution which is very important in integration and transformation from the current condition to emerging VLC. By all its advantages, visible light communication technology can open new applications with high-speed and reliable communication characteristics.

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