TilaLOOK: A PLS-SEM Study for an Agile-based Online Platform for Frozen Processed Chicken Meat Supply Chain

**Abdullah Galo, Gwyneth Panganiban, Venusmar Quevedo
and Sheila Mae Carungay**
Department of Industrial Engineering
College of Engineering
Adamson University, Manila, Philippines

jr.galoabdullah@gmail.com, gwynethkatecastillop@gmail.com,
venusmar.quevedo@adamson.edu.ph, sheila.mae.carungay@adamson.edu.ph

Abstract

This research paper aims to create an integrated online platform that can address the issues faced by members of the supply chain of frozen processed chicken products in the Philippines during the Covid-19 pandemic. These groups are namely the customers, retailers, and producers/suppliers of the mentioned product. As a mixed-methods study consisting of a quantitative and qualitative aspect, two modes of data gathering were executed. A survey questionnaire was given to the group classified as the customers. For the retailer and producer/supplier group, a semi-structured interview was conducted. The respondents were from Region IV-A and NCR. The researchers first identified the significant factors as well as the direct and indirect relationships existing between the latent variables Covid-19 challenges, Market Opportunities, and Supply Chain Effectiveness based on the survey responses. This was carried out using Partial Least Squares and Bootstrapping in Structural Equation Modeling (SEM) with the help of SMART PLS 3. A formative measurement model was also constructed. According to the results, Closure of Markets, Inter-city/municipality Transportation Restrictions, Labor Shortage, and Purchases from Home all significantly affect and directly contribute to the latent variable Covid-19 challenges (C19C) - signifying their contribution to the difficulties in the pandemic supply chain of frozen processed chicken products. For Market Opportunities (MO) and Supply Chain Effectiveness (SCE), it was observed that Price Increases, Purchasing Frequency, and On-site Purchase were directly related to MO while Quality of Online Ordered. Products, Courier Availability, Sufficient Number of Drivers, and Price Differences of Delivery Services were all directly related to SCE. Indirect observed constructs were referred to as relatively important factors. As for the creation of the agile online supply chain platform, the researchers utilized content analysis for the qualitative aspect. Existing literature was used to further back up the features and functions to be included in the agile integrated platform for customers, retailers, and suppliers. The following are the topmost features that were prioritized as part of the design of the product based on the responses: Product Transparency, Shared Information on Real-demand, Order Visibility, and Fast Communication.

Keywords
Covid-19 Challenges, Supply Chain Effectiveness, Bootstrapping, Structural Equation Modeling, Agile System

1. Introduction

The Micro Small Medium Enterprises (MSMEs) of the Philippines have their fair share of Covid-19 disruptions that greatly affect their productivity. Amounting to 99.5% of the total number of business establishments in the country, and also employing about 63% Filipinos (Philippine Statistics Authority, 2020), it is evident that these enterprises contribute significantly to the Philippines' development. Now, with the pandemic greatly affecting the whole world, another set of challenges are immensely being experienced by every factor involved in the business world.

The Philippines is not alone when it comes to facing the onslaught of the covid-19 pandemic. In order to mitigate the spread of the disease, the government focused its direction on setting up lockdowns disguised as community quarantines. These year-long restrictions are aimed to lessen interaction between people but cause severe disruptions in the supply chain processes (e.g. agriculture) [World Bank, 2020a]. This led to fewer people engaging in the outside world resulting in the closure of service industries such as hotels and restaurants. Some businesses had to raise their product prices in order to compensate for the damages imposed by the lockdowns. This also puts more

burden on the lower-income households as food insecurity was reported by more than half of the sample families (about 56%), with at least one family member lowering meals in the previous seven days owing to a lack of resources [Cho et al., 2021].

The difficulties being experienced by most MSMEs in the country during the pandemic can be related to the factors affecting their supply chain. Just like in other countries in the Southeast Asia region, the MSMEs in the Philippines have supply chains that are deeply coordinated into other supply chains. In return, this has caused a great impact on the sales and profitability of MSMEs since most problems are frequently passed by leading corporations to the end pipes, which include the MSMEs (UNICEF ROSA AND EAPRO, 2022). Other parts of the supply chain can be attributed to the agricultural side. According to the 2020 report by the National Economic and Development Authority, farmers and fishermen were unable to market their products which accounted for a great loss in revenue, amounting to 35% of unmarketed products. This can also be connected to the foodservice industry's experienced loss of sales amounting to $6.9B from $14.9B, relating to the lack of customers to entertain and suppliers to contact (Arcalas, 2020).

To explore the Covid-19 effect faced by the MSMEs in the country, specifically the food industry, the researchers will be using Structural Equation Modeling (SEM) in mapping out the challenges involved in the global problem. A model will be devised using the following latent variables: covid-19 challenges, market opportunities, and supply chain effectiveness. Furthermore, the relationship between the latent variables and their observed constructs will be studied with the data obtained from the respondents under three categories: consumers, retailers, and producers. The focus in carrying out this study is towards frozen processed chicken products. An agile supply chain flow will be patterned in developing an online platform for the mentioned products above. Therefore, the main contribution of this SEM-based paper extends the studies that are currently being conducted with regards to the Covid-19 pandemic and its effects on the food businesses under the business industry.

The restrictions and safety measures imposed were contributing factors to the unfavorable situation faced by the people in the whole country. Due to the unending challenges and uncertainties brought by the pandemic, all groups of people (producers, retailers, and consumers) involved in the supply chain are then faced with unfortunate circumstances. Hence, supply chain disruptions are one of the many issues that need to be addressed and improved during these times. $1.14B is expected to be lost by the food service industry in the Philippines this 2022 which is also due to the mentioned supply chain and market availability problems above (Market Research, 2022). As the value of chicken products constantly increases at every stage of the supply chain due to the processes involved in the production, transportation, retailing, etc., fully understanding the impact of the supply chain on chicken products is essential. Continuous production of food and its marketing are essential even in this pandemic, directly resulting in a substantial need to support it with a better supply chain (World Bank, 2020b). An efficient and flexible supply chain will enable producers, and retailers to develop a sustainable system to provide a better service to their consumers, regardless of any abrupt changes in the industry. Hence, a continuous flow of selling goods would not only keep the micro-small business afloat but would also greatly sustain and benefit the country's economy.

This study aims to devise an online platform using gathered Covid-19 challenges mapped through structural equation modeling. Specifically, this research aims to answer the following questions:
  i.   What are the significant factors that contribute to the difficulties brought by Covid-19 in the supply chain of frozen processed chicken products?
  ii.   What are the direct and indirect relationships existing between covid-19 challenges, supply chain effectiveness, and market opportunities?
  iii. What online supply chain platform for frozen processed chicken products can be developed using an agile system?

1.1 Objectives
The fundamental objective of this research is to develop an agile online platform. Specifically, the following are the objectives of the researchers:
  i.   To identify significant factors that contribute to the difficulties brought by Covid-19 in the supply chain of frozen processed chicken products.
  ii.   To determine the direct and indirect relationships existing between covid-19 challenges, supply chain effectiveness, and market opportunities.

iii. To develop an online supply chain platform for frozen processed chicken products using an agile system. The primary objective of this research is to identify the level of loyalty of the customers in relation to their satisfaction.

2. Literature Review

Covid-19 has greatly affected the way people live in general. It does not center on one specific aspect of everyone's lives but encompasses everything from daily routines to important life events. Unfortunately, the global pandemic isn't seeing its way outside the door just yet. The chain-like effect it has propagated throughout the world is still affecting millions of people, with the majority not being able to cope and survive this misery of a crisis.

2.1 Covid-19 Challenges

A study done in Pakistan has shown how MSMEs were greatly affected by the global Covid-19 pandemic crisis. The main challenges observed were mainly financial constraints, demand decrease, supply chain disruption, and reduction in their company's sales and profits (Shafi et.al., 2020a). It was recorded that 83% of the enterprises didn't have contingency and risk-based plans in place and were unsure of business continuity when the nationwide lockdowns persist (Shafi et.al., 2020b). Similarly, the situation here in the Philippines greatly connects with Pakistan's situation. A 1-month rapid survey was deployed last March to April 2020 to assess the initial state of MSMEs during the strict nationwide lockdown. The results showed that even though there were enterprises that benefited from the transition to the online setup, the majority of the MSMEs in the Philippines is still on the verge of shutting down their businesses due to various financial difficulties (Rao & Shinozaki, 2021).

2.2 Supply Chain Flow

A supply chain flow is an end-to-end process focused on overseeing the core activities in an organization and ensuring that the whole system beginning with the sourcing and procurement stage until the final delivery to the consumer, is performing at an optimal level (FAO, 2021a). Similar to other companies, the supply chain flow begins with sourcing raw materials, then shipped to the supplier and processed to be transferred to the manufacturer. The materials will then be manufactured to their designed product and then transported by the distributor to different retailer shops where consumers have direct access (Corporate Finance Institute, 2021). This type of supply chain network has other underlying processes involved at every stage, signifying how complex supply chain management is. Analyzing the results of the study by Adaryani et al., 2021, the greatest affected part of the supply chain are the sectors involved in transportation. This is mainly because of the lockdowns and other forms of restrictions carried out by the government to mitigate the spread of Covid-19 (FAO, 2021b).

2.3 Supply Chain Effectiveness

In a study by Cariño et al. 2020, the bottlenecks encountered in the overall supply chain of transporting products from rural areas to urban areas (NCR) have been identified. The study reveals that there is a constant stoppage in the flow of goods during the Covid-19 pandemic from the raw materials (inputs) up until the end consumption. As the pandemic continues, the restrictions in movement within Metro Manila have resulted in a decrease in customer numbers in several industries. Due to the fear of people acquiring the Coronavirus, there is limited foot traffic in establishments, resulting in business closure, increased underemployment, lower-income, and more so limited food access due to quarantine restrictions. These Covid-19 impacts bring massive disturbance and significant loss in the supply chain flow of businesses, crucially affecting the effectiveness and performance of their existing supply chain network. At every stage of the distribution process, the value of chicken products constantly increases due to the added cost of activities and materials used along the process. Considering this, organizations should clearly understand how frozen processed chicken product distribution works as it brings significant impact in order to develop a sustainable network. One way of establishing an effective distribution process is by optimizing the route of vehicles delivering processed chicken products to their consumers (Burgos et al., 2014). Determining optimal routes with the least cost and the minimum travel time will substantially affect the efficiency of distributing frozen processed chicken products to different areas in Region IV-A as it will enable organizations to reduce any associated costs.

2.4 Market Opportunities

A study released last 2021, it was shown how Covid-19 mitigation plans imposed by the government affected the market of chicken meat businesses (Aslam et.al., 2021a) This study described nationwide lockdowns as measures that can help the people against the spread of the virus but not with everyone's businesses. National market

disruptions make it difficult for businesses to meet the demand of the consumers (Aslam et.al., 2021b). There is also a huge blockage in reaching many markets which limit the access to food for the people (Yu et. al, 2020). When markets aren't readily available for consumption, it can create a continuous 'ripple' effect on other parts of the supply chain because of present dependencies between its aspects (Aslam et.al., 2021c). In addressing concerns related to chicken products, Philippine Agriculture Secretary William D. Dar mentioned the importance of linking farmers directly to markets to ensure sustained food consumption during the nationwide lockdowns (DA-AFID, 2020a). Although quite a challenge, the mentioned idea can ensure the stability of food sources in each Filipino's home (DA-AFID, 2020b). The connection between these ideas supports the initiative of having an agile online platform between producers, retailers, and consumers.

2.5 Agile Supply Chain

In this current time, adaptation to abrupt changes is highly considered in most businesses. Having an agile supply chain means a more responsive operation to changes that happen quickly (Collin & Lorenzin, 2006). The adaptation of an agile supply chain will have great results when the nature of the business and its products adhere to a trending product type, market-based product demand, short product life cycle, and a popular assortment of consumer drivers. An agile supply chain can be a great fit for a chicken product supply chain as chicken meat has a short product life cycle, and its demand is based on the changing market.

2.6 Digitalization of Supply Chain

The pandemic has changed the way how the supply chain works. May it be locally or globally, the drastic effects of Covid-19 have halted the productivity of businesses, especially those in the agricultural sector. In order to combat the continuous challenges imposed by the global crisis, the digitalization of supply chains can be a great solution as it has enhanced the potential of higher densities and mobilities of food information in the growth of infrastructures (Donaldson, 2021). The transition to online platforms does not only help in easier data collection and analysis but also in making sure that an increase in productivity and efficiency is observed (Klauser, 2018). Employing digital technologies aids in establishing a direct relationship between producers and consumers by eliminating intermediaries (Samoggia et al., 2021). This related literature has shown how huge of an impact digitalization can have in doing complex processes such as an improved supply chain of frozen processed chicken products in this pandemic.

2.7 Structural Equation Modeling (SEM)

In doing Structural Equation Modeling studies, the use of measurement theory is a part of the SEM model that aids in examining the relationship between latent constructs and observed variables (Knoke, 2005). According to Munim & Schramm's study (2018a), the use of SEM is preferable in analyzing observed variables together with multi-faceted variables. Their study labeled logistics performance and seaborne trade as latent constructs with multiple observed indicators. The use of measurement theory comes in as their study focuses on analyzing the relationship between their defined measurable indicators and the latent variables. Upon further analysis of their study, the results gathered adhere to the literature centered on transport economics. They were able to conclude that improving the quality of logistics performance and corresponding port infrastructure equates to the most beneficial results to the economy of a country (Munim & Schramm, 2018b). This study can be of great help with this current study because it explores the use of SEM in areas like logistics and the application of measurement theory in dealing with observable and latent variables.

The type of measurement model that will be incorporated in this study is the formative model as it is utilized when the observed variables are considered to be the cause of the latent variable. In the case of this study, being Covid-19 Challenges as the main latent variable, and the supply chain effectiveness and market opportunities as its sub-variables, then the observed variables under these sub-variables are assumed to be the causes of the Covid-19 challenges. To further understand the relationship of every variable, this study employed two segments of SEM, specifically the partial least squares algorithm and the bootstrapping method.

The theoretical framework of this study is presented below. Figure 1 shows the topics, represented as variables, that will be analyzed through the use of structural equation modeling (SEM). The latent variables are inserted in circles which will be measured by the observed variables drawn in boxes. The framework illustrates that Covid-19 Challenges in Supply Chain directly affect market opportunities, and supply chain effectiveness.
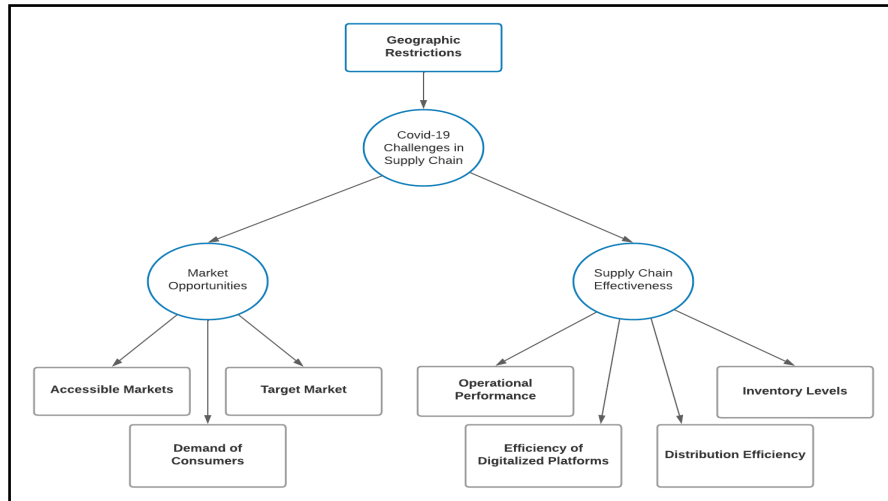
Figure 1. Theoretical Framework

The conceptual framework represents the schematic diagram of this research. It incorporates the Input-Process-Output (IPO) Model, providing the methodologies to be utilized in the study, which will be further elaborated in chapter three.
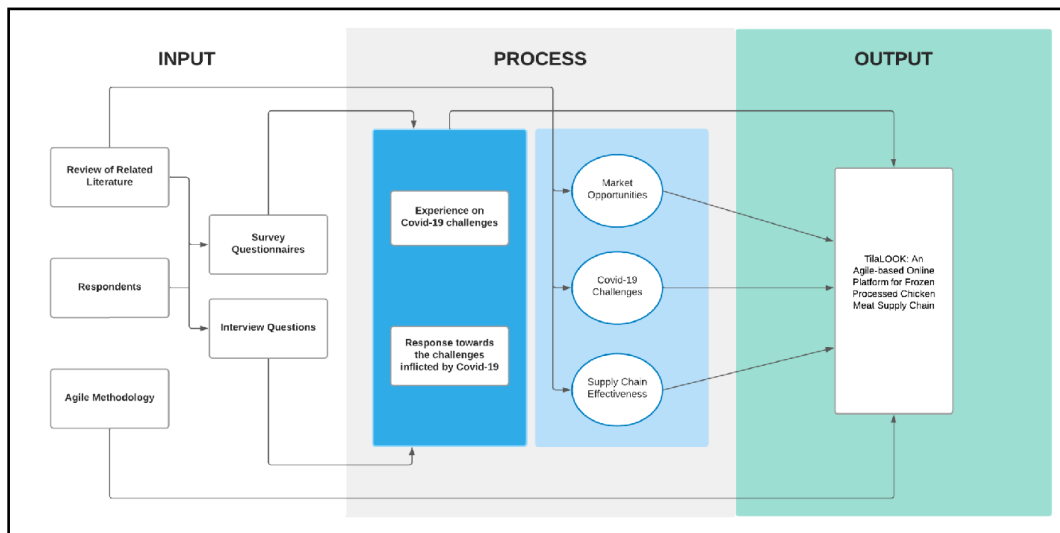

Figure 2. Conceptual Framework

The figure above illustrates the synchronization of the interrelated components and variables involved in the study. The researchers will have three (3) sources of data, specifically, their review of related literature, the agile methodology, the results of survey questionnaires, and interview questions from their chosen respondents. The acquired data will aid the researchers in gathering relevant information that would result in a more comprehensive understanding of the identified latent variables and an accurate evaluation of the respondent's experience and response to Covid-19 challenges. Once the relationships of each identified variable and component have been analyzed and interpreted by the researchers, it will enable them to develop an agile-based online platform for frozen processed chicken products.

3. Methods

This study employed a mixed-method design in order for the researchers to collect, analyze, and mix both quantitative and qualitative data to better comprehend their research problems (Creswell & Plano clark, 2011). The

integration of the two forms of data enabled the researchers to identify complex issues and relevant information by going through two phases in the study, specifically the qualitative phase (QUAL) and the quantitative phase (QUAN). In this research, the quantitative design is more dominant than the qualitative design, and each will be conducted simultaneously (QUAN + QUAL), signifying that each phase is independent of the other. This kind of research design aided the researchers in flexibly designing their study, enabling them to combine viewpoints of different studies to distinguish and classify the most informative results.

The researchers considered the quantitative research method more dominant in this study as it assisted them in generating accurate numerical results statistically analyzed to navigate the proceeding steps in their study. The data required for this study was acquired through conducting online surveys targeting frozen processed chicken meat consumers in the country focused on Region IV-A. On the other hand, the qualitative research was incorporated by interviewing different retailers and producers of frozen processed chicken meat within Region IV-A and National Capital Region (NCR), observing, and analysis of various credible online references. Furthermore, to provide a definite outline of the study, the researchers utilized the correlational research design which helped them further understand and evaluate the strength of each relationship identified in the study. This method aided the researchers in developing a structural equation model, which aided in creating an online platform for frozen processed chicken products supply chain flow.

3.1 Research Instrument

During the data collection process, the researchers conducted interviews with managers under the supply chain, operations, marketing, and similar departments in a company that produces frozen processed chicken meat products. In addition, the researchers also conducted interviews with retailers selling frozen processed chicken meat products. Moreover, both the producers and retailers interviewed by the researchers reside in Region IV-A and NCR due to the

limitation of securing interviews with such companies during the pandemic. Structured interviews were employed as a guide, consisting of a standardized set of questions that were asked to each interviewee. This method enabled the researchers to evaluate, compare, and analyze the gathered information and developed a coherent interpretation. The process was also documented using a patterned procedure to keep track of the interview results. The number of respondents was identified using purposeful sampling wherein the researchers will conduct an interview with someone (retailers and suppliers) who is particularly significant to the project. This method is commonly used in qualitative research (Moran, 2021).

Due to the limitations brought upon by the global Covid-19 pandemic, the researchers' main source of information used in the study were gathered from the web. Verified and reliable online references were used as a basis for validation, further understanding, and explanation of the study, as well as analysis and discussion of the gathered results.

The study's main source of data for analysis and discussion is gathered from the surveys that will be conducted virtually. In order to avoid possible exposure to the Covid-19 biological risk, the researchers opt to source respondents from social media platforms. The entire questionnaire was patterned through the study conducted by FAO (2021c) entitled "Rapid assessment of the impact of COVID-19 on food supply chains in the Philippines." The study has

available numerous survey guide questions that pertain to covid-19 impact on the Philippine food supply chain, which the researchers adopted and modified in order to fit this study's scope and goals.

As this study's initial and primary focus is developing an online platform specifically designed for the User-Interface (UI) of the customers, the targeted respondents are the consumers of frozen processed chicken meat products. The researchers have chosen to focus their study on Region IV-A as this region is said to be among the top producers of chicken meat in the country (Philippine Statistics Authority, 2016). This will also help the researchers gather respondents due to their proximity to the target population.

4. Data Collection

As mentioned above, the primary methods to collect the data for this study were online surveys and interviews. The platforms used were Google's well-renowned service Google Forms and video conferencing applications like Zoom Meeting. These are convenient to navigate and have been used by many researchers in conducting their studies

during this pandemic. The data collected was transferred to an online database called Google Sheets. These Google-based services were stored in a shared Google drive between the researchers, with a restricted access option for data protection. In dealing with the data, the software SPSS Statistics and SmartPLS 3 were used for data processing and analysis.

Other data relevant to the study, such as online references and related literature, were gathered using the internet, including different credible websites. Supporting historical information related to the collection of data, such as the total number of population in Region IV-A and other relevant demographics were gathered.

5. Results and Discussion

This chapter presents the gathered data from the research's three (3) types of respondents: consumers, retailers, and producers. The data were presented in a logical, sequential, and purposeful manner through texts, tables, and graphs to clearly categorize and classify the study's results. This section also analyzes the data through the use of different statistical tools to test its normality, correlation, significance, and reliability. Lastly, this chapter would also interpret the data and determine its importance and contribution to the advancement of the study.

As a means to verify the reliability of the 17-item Likert scale and determine that the instrument is free from measurement errors (APA, 1988), the researchers conducted a reliability test which is represented by the Cronbach's Alpha Coefficient. Values equal to or greater than 0.7 for Cronbach's Alpha are considered acceptable for a reliable instrument (Hair et al. 2017). The Cronbach's alpha coefficient for this study is .927 which is greater than 0.7. Hence, it could be concluded that the instrument's reliability is highly acceptable.

Table 1. Denotation of Variables

Indicators	Variable Code	Indicators	Variable Code
C19C	Covid-19 Challenges	MO_3	Onsite Purchase
CC_G	Lockdown Restrictions	MO_4	Online Purchase
CC_1	Closure of Markets	MO_5	Online Order Assistance
CC_2	Inter-city/Municipality Transportation Restrictions	SCE	Supply Chain Effectiveness
CC_3	Labor Shortage in the Markets	SC_G	Delivery Efficiency
CC_4	Purchase from Home	SC_1	Out-of-stock Issues
MO	Market Opportunities	SC_2	Quality of Online Products
MO_G	Product Availability and Price Difference	SC_3	Courier Availability
MO_1	Price Increase	SC_4	Sufficient number of Drivers
MO_2	Purchasing Frequency	SC_5	Price differences of Delivery Services

The table above is a helpful guide on the variables that will be used in discussing the paper's results.

5.1 Graphical Results

In order to validate the direct effect of the formulated structural model comprised of the three latent variables, specifically the Covid-19 Challenges (C19C), Market Opportunities (MO), and the Supply Chain Effectiveness (SCE), the path coefficients are to be observed. As reflected in Figure 3, the path coefficients of C19C -> MO has a value of 0.736 while C19C -> SCE has 0.709, indicating that both are directly influenced by the Covid-19 Challenges. According to a book by Moore et. al. (2013), the rule of thumb for interpreting the strength of a relationship based on its R-squared value has a strong, moderate, and weak effect size if its values are $R > 0.7$, $0.5 < R < 0.7$, and $0.3 < R < 0.5$ respectively. Hence, it can be concluded that Covid-19 Challenges have strong connectivity with market opportunities and supply chain effectiveness seeing that it has values greater than 0.7.
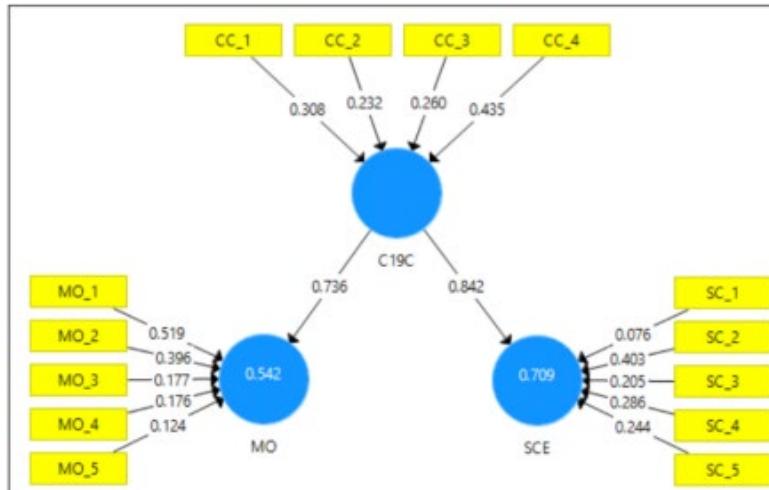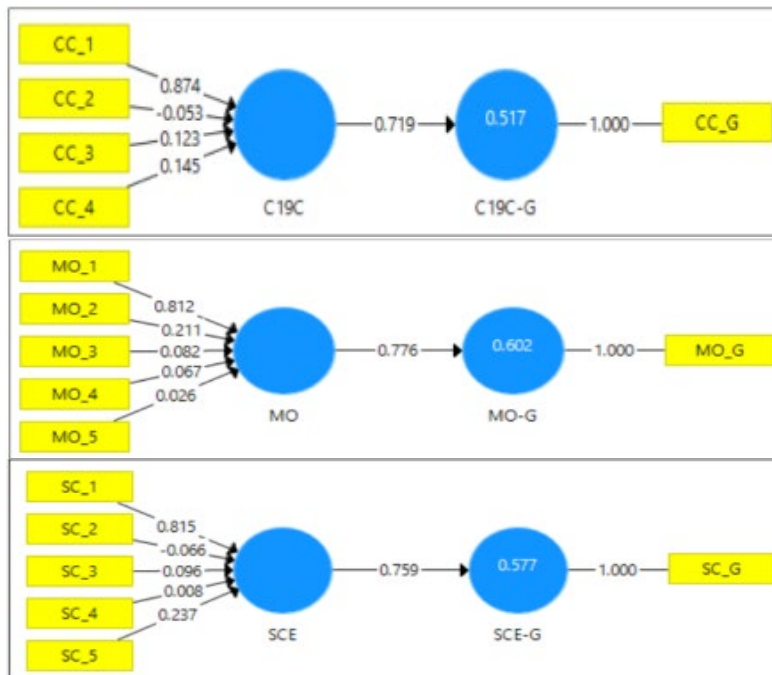
Figure 3. Hypothesized Model

Figure 4. Redundancy Analysis of latent variables to their single global items

Delving deeper into Figure 4 of the redundancy analysis of the respective latent variables, it can be observed that C19C, MO, and SCE have a correlation of 0.719, 0.776, and 0.759 to their corresponding global single unit (CC_G: Lockdown Restrictions, MO_G: Product Availability and Price Difference, SC_G: Delivery Efficiency). Danks et al. (2021), recommend that the correlation of the constructs with their global single unit should be 0.708 or higher, indicating that the construct explains more than the alternative measure's variance. In this study, the correlations of each latent variable are considered to be acceptable as they are all higher than 0.708, signifying that each construct correlates with the other measures of the same construct.

Numerical Results

Table 2. Collinearity Statistics

Indicators	Collinearity Statistics (VIF)	Indicators	Collinearity Statistics (VIF)
CC_1	1.489	MO_4	2.632
CC_2	2.09	MO_5	2.661
CC_3	1.645	SC_1	1.554
CC_4	2.166	SC_2	1.482
MO_1	1.551	SC_3	2.869
MO_2	1.397	SC_4	3.368
MO_3	1.088	SC_5	2.94

Under the same results of the PLS in SmartPLS 3, the collinearity statistics or the variance inflation factor (VIF) can also be calculated to aid in determining the collinearity of each construct. As observed, all formative constructs have values lower than 3 except SC_4, having a value of 3.368. This value does not signify that it has a collinearity issue, but it somehow has a higher chance of being collinear, which might affect the validity and reliability of the model. However, as stated by Hair et al. (2017), values ranging from 3 to 5 are still moderately acceptable and do not need to be removed from the indicators. Hence, it could be concluded that all constructs are acceptable, signifying low collinearity with other constructs.

Test of Significance (Bootstrapping)
The following values are used in doing the analysis of the results using Bootstrapping [Hair et al. (2017a)]:
- P-value < 0.05 for factors to be considered as significant
- T-statistics > 1.96 for factors that show a direct relationship to each latent variables

Table 3. Outer Weights of Variables

Indicators → Latent	T Statistics	P Values
CC_1 → C19C	6.252	0.00
CC_2 → C19C	3.785	0.00
CC_3 → C19C	4.842	0.00
CC_4 → C19C	7.204	0.00
MO_1 → MO	6.869	0.00
MO_2 → MO	5.069	0.00
MO_3 → MO	2.919	0.004
MO_4 → MO	1.841	0.066
MO_5 → MO	1.368	0.171
SC_1 → SCE	1.472	0.141
SC_2 → SCE	5.978	0.00
SC_3 → SCE	2.131	0.033
SC_4 → SCE	2.893	0.004
SC_5 → SCE	3.153	0.002

After conducting Bootstrapping with the use of SmartPLS 3, the Outer Weights show that 4 indicators used in measuring C19C (Covid-19 Challenges) have a significant value. This signifies that these indicators are significant factors that influence C19C. Looking at the values presented under the T-Statistics column under C19C, the values of the constructs also have acceptable values that denote direct relationships with the latent variable C19C.

For the latent variable MO (Market Opportunities), the values show that among the 5 indicators, 3 indicators show a significant value and direct relationship to it. Going through the T statistics, the values found on MO_4 and MO_5 indicate that they possess indirect relationships towards MO. Proceeding to SCE (Supply Chain Effectiveness), 4 observed constructs show a direct relationship towards their latent variable. The sole indirect factor is SC_1.

Table 4. Outer Loadings of Variables

Indicators	Original Sample	T Statistics	P Values
MO_4 → MO	0.569	8.42	0.00
MO_5 → MO	0.566	8.495	0.00
SC_1 → SCE	0.634	12.66	0.00

According to Hair et al. (2017b), the treatment of non-significant factors in formative models is usually evaluated first through their outer loadings. As shown in the table above, the P-values of MO_4, MO_5, and SC_1 are significant, making them acceptable. The final criteria to be considered is the original loading / sample of the non-significant indicators [Cheah et.al (2018)]. The same study also stated that the loading must be above 0.5 in order for non-significant factors to be retained. Looking at table 3, their respective values indicate that they can be retained. These factors are classified as relatively important but not as absolutely important compared to the others (Validating Formative Indicators Using SMART-PLS -, 2021).

Table 5. Top 4 Ways/Platforms (Customers)

Ways/Platforms in Purchasing Chicken Meat
Online
On-site
Flexible
Third-party

Table 5 summarizes the answers of the respondents who answered the open-ended question in the survey form. According to the results, 42.34% preferred using online platforms to purchase frozen processed chicken products. This is in contrast to the results of the direct factors found after executing the quantitative part of this study which labeled on-site purchase as a direct factor and online purchase as an indirect one. This qualitative result reflects the current state of the respondents, contrary to their dated experiences from the Likert-scale questions. The emergence of online platforms at the top shows the potential of this study's product in aiding to their preference. On-site followed at second with 35.4%, Flexible (both on-site and online) at 7.66%, and Third-party (reliance on delivery services or asking their friends/relatives to buy the products for them) at 4.01%.

Table 6. Inputs/Features Needed in the System

Inputs Needed in the System	
Retailer & Supplier	Customer
1. Product Description	1. Product Description
2. Expiration of Products	2. Price & Comparison with other brands
3. Order Visibility / Initial source of the products	3. Inventory Level
4. Delivery Information	4. Picture of the Product
5. Out-of-stock real-time updates	5. List of Available and Similar Products

The table above reveals the comprehensive responses of consumers, retailers, and suppliers as to what information and features they think are needed for developing an online platform for an integrated and effective system. Table 6 shows only the top 5 answers of the respondents, which reveals that Product Description came as the top 1 information needed, recording a total of 100% and 44.16% for both retailers & suppliers, and customers. This signifies that both groups see Product Description as helpful information/feature, enabling them to make informed purchasing decisions. On the other hand, the remaining key inputs mentioned by the retailers and suppliers were the expiration of products, order visibility, delivery information, and out-of-stock updates. While the essential features identified by the customers were price & comparison with other brands, inventory level, picture of the product, and the list of available and similar products. The responses gathered from this were the highlight of the interview and survey as they will be incorporated in designing and developing the online platform for frozen processed chicken products.

Assessing the responses from both the customers and the retailers and suppliers is a vital part in creating the design for the platform intended for frozen processed chicken products. The researchers also intend to make an agile-based design that can support various ends from the supplier, to the retailer, down to the customer. The answers of the customers regarding the features they wanted to see in an online platform included a detailed product description including expiration dates and manufacturing dates, updated price and price comparison with other brands, better inventory management through real-time stock level updates, order and delivery status, and accessible communication with stores. On the other hand, there were very similar answers with respect to the retailers and suppliers. Their responses included product description, expiration of products, delivery status, out-of-stock and surplus updates, inventory level, price, and product shelf life. Majority of these factors amount to what we call an agile system. According to Gilaninia et al. (2011a), the common characteristics of an agile system revolve around factors that focus on virtual means (shared information on real demand, collaborative, end-to-end visibility), market sensitivity (capturing emerging trends, feedback, customer-driven), process integration (synchronous inventory) and network based (focusing more on competencies). Proofhub (2019) also highlighted the importance of having great transparency and effective and fast communication in developing agile systems. In evaluating the factors that the researchers, the majority of the features can be attributed to an agile system. The list below shows how each feature was characterized by the researchers with accordance to agile definitions:

- Comprehensive product description (including expiration and manufacturing dates, shelf life and days spent on store, initial source before processing): order transparency
- Real-time inventory and stock-level update: shared information on real demand
- Order and delivery status: order visibility
- Easy communication (through instant messaging) with stores and customers: fast communication

6. Conclusion

This aspect of the study shows how each of the research problems was addressed upon the completion of this research.

1. What are the significant factors that contribute to the difficulties brought by Covid-19 in the supply chain of frozen processed chicken products?

The use of the quantitative methods has shown that the observed constructs under the Covid-19 challenges latent variable were all significantly affecting it. Closure of markets, Inter-city/municipality transportation restrictions, Labor shortage in the markets, and Purchases from home all had an acceptable significance value, indicating that they are significant factors to the latent variable being measured.

2. What are the direct and indirect relationships existing between covid-19 challenges, supply chain effectiveness, and market opportunities?

Covid-19 Challenges: The use of the quantitative methods has shown that the observed constructs under the Covid-19 challenges latent variable were all directly affecting it. Closure of markets, Inter-city/municipality transportation restrictions, Labor shortage in the markets, Purchases from home all have acceptable outer weights greater than the acceptable value of 1.96 - indicating the direct influence these factors have on Covid-19 challenges.

Market Opportunities: The structural equation model shows that Market Opportunities have a path coefficient of 0.736 which indicates that it is directly affected by Covid-19 challenges. Further going into the results, the factors that have a direct relationship under this latent variable are Price increases, Purchasing frequency, and On-site purchase having outer weights above 1.96. The indirect factors, which have a weight below the accepted value are Online purchase, and Online order assistance. These are considered relatively important constructs and are retained in the model as they have a generally accepted original loading (> 0.5). Although the results show that the majority still do on-site purchases, the researchers could see the potential of Online purchases as its assistance to current users of online platforms from the respondents show promising results amounting to 54.0%.

Supply Chain Effectiveness: Similar to the one above, Supply Chain Effectiveness is also directly affected by Covid-19 challenges. When dealing with the observed constructs, Quality of online ordered products, Courier availability, Sufficient number of drivers, and Price differences of delivery services are treated as the direct factors as they have acceptable outer weights. The sole indirect factor is Out-of-stock issues because its weight is < 1.96. Similar to Online purchase and Online order assistance above, it is retained in the model as its original loading is > 0.5.

As observed, the Out-of-stock issue came as the top among the seven (7) stated problems encountered by the respondents in the survey, yet it resulted as an indirect factor to Supply Chain Effectiveness. It only validated the survey result that 49.63% never and rarely encountered out-of-stock issues as they purchase chicken meat products.

3. What online supply chain platform for frozen processed chicken products can be developed using an agile system?

In accordance with the collective responses from the 274 consumers, 2 retailers, and 2 producers of frozen processed chicken products, it could be concluded that the social media platforms are the best online platforms to be used in marketing one's product while a mobile application or website is preferred when operational activities such as connecting with customers and receiving orders are done. As for the creation of the agile online supply chain platform, the researchers were able to extract and analyze data from all the respondents The following are the topmost features that were prioritized as part of the design of the product based on the analyzed answers: Product Transparency, Price Comparison (Mode of Payment, Store Distance, and Stock Level), Order Visibility, and Fast Communication.

6.1 Recommendation
With the aim of mapping out Covid-19 challenges and developing an agile-based online platform based on it, it is recommended that the future researchers, consumers, retailers, and producers of frozen processed chicken meat should consider the positive and negative implications of using an online platform in purchasing and selling such products. Analyzing each aspect of the mobile application and identifying what specific factors would have a significant impact as they buy and market frozen processed chicken meat. To that end, the researchers have enumerated specific actions that might be of help.

For future researchers and future studies:
- The researchers should consider including follow-up questions in this study's open-ended questions in the survey questionnaire. Specific time frames must also be set in studies that tackle cases like the pandemic.
- The researchers should develop a business plan if they have similar studies intended for a future business.
- The researchers should explore other software in constructing, analyzing, and interpreting their measurement models.
- The researchers should consider a reflective measurement model and compare and contrast, which models are more effective in topics concerning the food supply chain.
- The researchers should consider budgetary and time constraints in developing the mobile application and its user interface.
- The researchers are encouraged to continue developing the user interfaces of both retailers and producers for a better understanding of an integrated supply chain.

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Biographies

Abdullah M. Galo Jr. currently works as a Product Analyst at Transportify Philippines. He is a part of the Batch 2022 graduates of the Bachelor of Science in Industrial Engineering program of Adamson University. A consistent dean's lister since his freshman year, he was dedicated to always striving for excellence. During his sophomore year in college, he started to get exposed to leadership roles at the Philippine Institute of Industrial Engineers - Operations Research Society of the Philippines Adamson University Chapter, serving for 3 straight years: VP for Documentations (2019-2020), President (2020-2021), and AVP for Communications (2021-2022). One of his educational highlights was working as a Source-to-pay intern under the multinational company named Henkel (Henkel Asia Pacific Services Center - Henkel Philippines Inc.). He currently has two incubatee projects under the Adamson University Neo Science and Technology (AdU NEST) Altruinnovate program named CellaMed and TilaLOOK. He also has a Lean Six Sigma Yellow Belt certification.

Gwyneth Kate C. Panganiban is currently working in Analog Devices Inc. as an Associate Production Planner. She graduated with a Bachelor degree of Science in Industrial Engineering Batch 2022 in Adamson University. She has been affiliated with student organizations holding the position of Religious Directress of the Philippine Institute of Industrial Engineers - Operations Research Society of the Philippines Adamson Chapter A.Y. 2019-2020. She was a consistent Dean's Lister from her freshman year A.Y. 2018 to her senior year A.Y. 2022. She has gained her internship at TransProcure Corporation as a part of the Solutions and Services team, tasked to assess and source suppliers for the company's clients. She is currently part of two incubation projects under the Adamson University Neo Science and Technology (AdU NEST) Altruinnovate program named CellaMed and TilaLOOK. She is also a Lean Six Sigma Yellow Belt certified.

Venusmar C. Quevedo, Ph.D., is the Vice President for Administrative Affairs of Adamson University from 2012 to the present. She is the Chairman of the Industrial Engineering Certification Board (IECB). She serves the Commission on Higher Education (CHED) as a Quality Assurance Evaluator; Member of the Technical Panel for the BSIE Program; Program Evaluator for Centers of Excellence and Centers of Development in Engineering. She is a Full-time Professor of the Industrial Engineering Department of Adamson University. Her fields of specialization include educational research and evaluation, productivity and operational excellence, quality management systems, optimization techniques, operations research and project management.

Sheila Mae F. Carungay, PIE, is a Full-time Professor of the Industrial Engineering Department of Adamson University. She is an experienced Industrial Engineer with a demonstrated history of working in the production (Wistron Corp.), food (KFC Philippines) and retail (Watsons Personal Care Stores Philippines Inc.) industry. Skilled in Production Planning, Demand Planning, Supply Chain and Retail Operations. Strong sales professional with a Masters Degree in Engineering Management from Adamson University.