Simulating Supply Chain Dynamics at Camarines Norte Development Cooperatives: Optimizing Inventory Control and Demand Satisfaction

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***Abstract*— This research delves into the utilization of simulation-based methods to improve inventory management and demand satisfaction within the supply chain of Candevco, a company operating within the dynamic agricultural environment of the Bicol Region in the Philippines. The region's unique challenges include the volatility of crop yields, smaller farm sizes, and the decrease in agricultural land area due to urbanization. This study presents a discrete event simulation-based framework to model the dynamics of Candevco's supply chain, establishing appropriate inventory control policies. These policies are derived within an advanced computational framework so as to minimize costs in optimal ways, and enhance the operationally efficient supply chains that offer high demand satisfaction within available agricultural inputs. The results from the simulation lead to actionable knowledge about how to achieve inversions of desired inventory levels, lead times, and overall system robustness, while it also provides a scalable solution for similar supply chain systems.**

Keywords*— *Inventory management, Simulation, Supply chain optimization, Candevco

I. Introduction

Today, supply chain management in the global economy makes all the difference for a company that is trying to stay competitive and meet demand. The principal input into CANDEVCO's operations is agricultural products. Outputs of agricultural crops vary with seasons while demands in the market vary at different times. Such challenges are even more prevalent in regional areas, like Bicol Region of the Philippines, where agriculture constitutes the main economic input for this region. There has been a promising growth of late trends in agricultural production within the Bicol Region, most specifically on high-value crops. The region saw a 13% increase in the production of certain crops within the first half of the year 2020, and this progress reflects how the region is trying to modernize farming practices with improvements in crop yields against challenges in land availability and pressures of urbanization. However, the problem of decreased agricultural land and smaller farm sizes remains since urban development continues to eat away at the farmland in provinces like Camarines Norte and Camarines Sur .(Bicol's High Value Crops Grow by as High as 13% in the First Half of 2020 | DA Regional Field Office 5, 2020)

Agricultural dynamics in the Bicol Region bring unique complexities to business within the supply chain, including Candevco's, due to smaller farm sizes and lesser areas of farm land as the supply dynamics and availability time of input agricultural produce change. Greater demand in minimal resources dictate the optimization of supply chains. This study aims at developing a more responsive and resilient system through the implementation of the latest modeling and simulation techniques. Such a system will better be able to make forecasts on demand, optimize the level of inventory levels, and improve overall efficiency in supply chain management.

This research will address inefficiencies in inventory control and demand satisfaction, areas critical to Candevco's success. Through detail study on its supply chains procedures can be discovered with the possible ways to efficiency in handling inventories coupled with managing the demand of forecast supplies. Simulation facilitates strategy testing by putting the systems under consideration in a test framework so as not to halt actual movement. Findings of this study will prove crucial for Candevco and other companies as well which are involved with similar supply chain issues due to a changing agricultural scenario. In turn, results of this study will feed into supply chains that will be much more resilient and responsive in the face of sourcing raw materials in dynamic agricultural environments.

II. Literature Review

Over the past few decades, managing inventory effectively is something companies have come to use to cut costs and still ensure adequate stock so as not to run into stock-outs in increasingly complicated supply chains. Traditional techniques used in inventory optimization cannot frequently achieve these multiple goals all at once, more especially with an increase in supply chain size and complexity. To address these difficulties effectively, researchers have applied some advanced approaches, including frameworks with simulation and multi-objective optimization methods. These methods combine complex computational tools with statistical techniques to attain a better balance of key inventory objectives.

According to Gurinder, Kaur., Ronald, Kander. (2023), supply chain management (SCM), goods and services flow from the raw materials stage to the end user with complexities and uncertainty at each stage. Computer modeling and simulation is a particularly useful method to examine supply chain operational issues because it can solve operational complexities that are challenging and time consuming to analyze. Manufacturing companies fear losing valuable time and assets during the manufacturing process; the inaccurate estimation of raw materials, human capital, or physical infrastructure not only leads to monetary loss for the manufacturing unit, but also has a detrimental effect on the environment. The purpose of this paper is to demonstrate that system dynamics modeling (SDM) in sustainable supply chain management (SSCM) can be applied to apparel manufacturing to optimize materials, labor, and equipment usage. Utilizing system dynamics (SD), the manufacturing unit can improve sustainability by reducing materials, labor, and equipment usage, which in turn reduces energy use. In our literature review, we did not identify any study addressing supply chain simulation of the manufacturing of shirts using SDM. We chose shirt manufacturing to demonstrate the model because of its relatively simple manufacturing process. In our study, we conclude that SDM simulation is an efficient way to optimize materials, labor, and equipment in apparel manufacturing. This leads to a more sustainable manufacturing process, as the model simulates different manufacturing supply chain scenarios in a risk-free environment, thereby minimizing waste and resources. Further, the outputs from the STELLA® model can be used as inputs into a subsequent life cycle assessment (LCA) model to determine the quantitative environmental impacts.

According to (Wang & Hong, 2022), thousands of final products together with extensive types of raw materials and intermediates make large-scale production networks complicated. Traditional inventory models cannot manage the intricate decisions often needed to be made, while traditional simulation methods are too slow for handling the scale effectively. For solving these drawbacks, (Wang & Hong, 2022) proposed a simulation approach which is

RNN-inspired: it exploits the computational potential of recurrent neural networks for the purpose of production network structural layouts. This technique proved very fast: by orders, typically by thousands, more rapid compared to conventional simulations and yet will enable an efficient optimization even of the biggest inventory-related problems in the time constraint of real-world applications.

Parth, Sharma., Bidisha, Borkakakty. (2023) explains that supply chains more agile, adaptable, and responsive is a current trend in supply chain management (SCM). There are many different types of issues in a supply chain, including issues with transportation planning and inventory management. Each of these issues has a unique definition as an optimization problem, and solutions have been suggested. However, because the issue is considerably more complicated when approached collectively than the individual issues, it is challenging to create an algorithm for supply chain optimization concurrently. This paper presents a novel conceptual framework for multi-structural planning and management of adaptive supply chains considering structure dynamics. We develop an idea for adaptive supply chain management (A-SCM), as well as a dynamic model and using AnyLogic simulation environment as a tool for simulating the Supply Chain and assessing what-if scenarios. The modelling technique in this paper incorporates essential elements for hub shutdowns or demand pattern changes, with the goal of examining the effects of these scenarios on overall costs. This concept allows users to dynamically close hubs or adjust demand patterns through simple interactions, leveraging AnyLogic's inherent capabilities. These adjustments simulate real-world situations, such as supply disruptions or fluctuations in demand, enabling decision-makers to assess their potential impact on the cost structure of the supply chain.

According to Saeed, Kolahi-Randji., Mahdi, Yousefi, Nejad, Attari., Ali, Ala. (2023), effective supply chain management plays a pivotal role in the success of a business. The repercussions of a business strategy on the entire supply chain remain uncertain until it is implemented. Utilizing simulations offers the opportunity to gauge performance before implementing the strategy. The primary aim of employing supply chain simulation is to analyze the effects of different strategies on profit enhancement and cost reduction across all supply chain tiers. This research paper has formulated a discrete event simulation model using Arena software to evaluate and enhance the operational efficiency of the detergent supply chain. The problem involves multiple levels and commodities, encompassing four manufacturers, two intermediate storage warehouses, and four main distributors following an (s, S) inventory control approach. Shortages are permitted, leading to a partial loss or back-ordering of products. The overarching objective is to minimize the overall inventory costs within the system, accounting for holding costs at each tier, managing shortages, and the expense incurred due to lost sales. A range of scenarios are developed to set control parameters, with the evaluation of supply chain performance falling into two main categories: financial and operational considerations.

According to Perez et al. (2021), managing inventory in a make-to-order supply chain is challenging primarily in controlling both its production capacity and the inventory holding across numerous nodes with varying lead times and constraints. They addressed a system of uncertain, stale demand that a merchant has to deal with a period whereby there could be backlog or missed sales in terms of dealing with a single-product, multi-period system. Using literature research, this aim can be maximized by three approaches: deterministic linear programming, multi-stage stochastic linear programming, and reinforcement learning by maximizing the daily replenishment needs from immediate suppliers.

O., I., Kukartseva., A.S., Menshenin., Vadim, Tynchenko., Kseniya, Degtyareva. (2023) created a simulation model of a simple supply chain consisting of a single distribution center and several points of sale. Initially, a new model was created with the name "Supply Chain" and watches as units of model time. Next, a GIS (geographic information system) map was added to the diagram of the main object using the standard display settings. The distributor properties were defined and it marked the distribution point on the map. Next, retailers were added to the map: using the OpenStreetMap online server, to which AnyLogic sends addresses and receives coordinates and automatically arranges retailers. Manually added the properties of retailers. The next step was to create a model of trucks and their movement logic is set. To do this, a state diagram was used, with the help of which a diagram of the state of the logic of trucks was obtained. Using the New Agent Wizard, add a new agent type – order. It also changed the status chart to display order information. The created model was supplemented, where time was added for unloading and loading trucks from retailers. A basic simulation model of supply chains was built, and ideas for improving this model were considered.

Xu et al. (2019) argue that supply chain enterprises strategically focus on incurring inventory costs of fresh perishable agricultural products since the latter has a short shelf life and is susceptible. Since the shelf life is fairly short for the product, creating an effective multi-echelon policy for its inventory management at multiple supply chain stages is highly challenging because there is a need for a balance at each stage of the supply chain between the freshness of the product and cost reduction. Xu et al. (2019) discussed a mathematical analysis of inventory costs in a three-level inventory system for fresh agricultural products.

Xu et al. (2019) developed a simulation-based optimization model in this study through the use of an advanced particle swarm optimization method and Flexsim simulation software to overcome these challenges. This model, with a multilevel framework, addresses dynamic changes in inventory rules through incorporation of complex data on supply chain variations and product perishability. A large amount of survey data has been used for testing the model, and upon testing, the findings were that it could provide some insightful analysis and technical assistance for decision-making in the inventory control process (Xu et al., 2019).

A study by Navonil, Mustafee., Korina, Katsaliaki., Simon, J., E., Taylor. (2021), mentioned that the field of Supply Chain Management (SCM) is experiencing rapid strides in the use of Industry 4.0 technologies and the conceptualization of new supply chain configurations for online retail, sustainable and green supply chains, and the Circular Economy. Thus, there is an increasing impetus to use simulation techniques such as discrete-event simulation, agent-based simulation, and hybrid simulation in the context of SCM. In conventional supply chain simulation, the underlying constituents of the system like manufacturing, distribution, retail, and logistics processes are often modelled and executed as a single model. Unlike this conventional approach, a distributed supply chain simulation (DSCS) enables the coordinated execution of simulation models using specialist software. To understand the current state-of-the-art of DSCS, this paper presents a methodological review and categorization of literature in DSCS using a framework-based approach. Through a study of over 130 articles, we report on the motivation for using DSCS, the modelling techniques, the underlying distributed computing technologies and middleware, its advantages and a future agenda, and also limitations and trade-offs that may be associated with this approach. The increasing adoption of technologies like Internet-of-Things and Cloud Computing will ensure the availability of both data and models for distributed decision-making, which is likely to enable data-driven DSCS of the future. This review aims to inform organizational stakeholders, simulation researchers and practitioners, distributed systems developers and software vendors, as to the current state-of-the art of DSCS, and which will inform the development of future DSCS using new applied computing approaches.

Uwe, Clausen., Matthias, Brueggenolte., Marc, Kirberg., Christoph, Besenfelder., Moritz, Poeting., Mustafa, Gueller. (2019) explaines that In complex supply chains decision-makers strive to act quickly and effectively to ensure the efficient operation of their systems. Particularly, at the operational level immediate decision-making is required. In this context, simulation is becoming increasingly important for decision-making in logistics and supply chain. The classic event-discrete simulation paradigm is reaching its limits in the modelling of individual interacting system components of complex socio-technical systems due to a lack of flexibility and adaptability. The agent-based simulation (ABS) paradigm offers the capability to design heterogeneous individuals as agents that interact with each other as well as with the environment. This paper analyses the state-of-the-art of ABS in literature with a focus on operational logistics. We use a multi-level classification framework to provide a literature overview for publications of the operational logistics research field from in the recent years. On the basis of the literature review, categories are identified which may indicate research gaps.

A study by Imadeddine, Oubrahim., Naoufal, Sefiani., Ari, Happonen. (2022) explained that the structured literature review reveals the current state-of-the-art supply chain performance evaluation models (SCPEMs) from the last 21 years of research. Seventy related papers from the 2000 to 2021 time period were found to contribute by using ISI and SCOPUS databases. This paper has classified SCPEMs in terms of focus area and the perspective considered (financial and non-financial). With the analysis, these models' applicability in today's business environment pinpointed the most usable models and their current shortcomings. Findings disclose current SCPEMs limitations and misalignments with the emerging disruptive technologies observed in today's supply chains. Given the findings, this study has highlighted the lack of overall supply chain performance evaluation and the failure to underline the underperforming decision criteria in the SC network. Therefore, to tackle these gaps, the authors have suggested visibility, leagility, collaboration, digitalization, sustainability, and integration as SCM characteristics to be considered in the future when developing a novel SCPEM. Finally, this study can be used as guidance for future studies.

According to Yousef, Nooshiravani., Qasem, Ali, Bazai., Mansoureh, Aligholi. (2022) In the event of a crisis and epidemic of infectious disease, ensuring the proper and timely supply of necessary medicine is one of the main priorities of the health care system in any country. Therefore, the present study investigates the resilience of the Iranian medicine supply chain using the system dynamics simulation method in increasing the level of access to Remdesivir. Methods: This is a development-applied study to provide a model using the system dynamics approach, which first presents a rich image that is based on the model, and then cause-effect models appropriate to the observations made. It was structured on the behavior of the system and also inspired by valid theories. The effect of key factors affecting the supply chain resilience of the country's pharmaceutical industry was designed and analyzed using a system dynamics approach using decision support system (DSS) Vensim software. The time horizon considered for this research was 5 years, from 2019 to 2023. To predict and simulate the system dynamics model, the data collected from the questionnaires and the interviews with experts in this field were used. Results: Based on the result of this study, it can be expected that by reducing the schedule pressure by 1 and 3 % during the time of the study, the resilience of the supply chain of remedesvir in the country upgraded to about 32% and 47%. Conclusions: According to the complexity of health care systems, it is difficult to recognize the interaction of different variables, therefore, the effect of interventions is not immediately recognizable and requires the passage of time. In addition, the majority of the factors influencing health care outcomes are nonlinear. Therefore, the use of simulation models can help to clarify the indirect behavior of complex health care problems.

Ain, Kiisler., Olli-Pekka, Hilmola. (2020) explained Abstract Research is based on wholesale and distribution operations of real-life case company, and in this setting, the most critical part of company's supply chain is the inventory replenishment to warehouse (Distribution Center) as well as fulfilling and delivering customers' orders. Different Economic Order Quantity (EOQ)-based models have been considered (Reorder Point, Reorder Point with pipeline on order inventory, and "pulse train"). Simulation system evaluates annual total logistics costs. Results show that in an environment, where local warehouse inventory levels are rather high and replenishment order quantity is rather small, it is important to have frequent shipments divided in suitable intervals. In the simulation model, this could be done e.g. with the use of "pulse train" function or incorporating a pipeline on order inventory in order to decide. The research findings are valid for a small-scale supply chain servicing small and geographically limited markets with clients assuming high customer service levels (e.g. 24-hours lead time). For bigger markets, the cross-docking based supply chain models are worth considering in simulations.

According to Anna, Hartwick., Abdelgafar, Ismail., Beatriz, Kalil, Valladão, Novais., Mohammed, Zeeshan., Hans, Ehm. (2023), Due to the vitality of semiconductor products for other industries, the production of semiconductors and impact of external disruptions on the semiconductor supply chain should be well understood. As semiconductor manufacturing is accompanied with intrinsic long manufacturing cycle times ranging from 50 to 100 days where operations run 24/7, 365 days per year, correct understanding of potential disturbances should be considered.

Examples of these disturbances include pandemics, extreme weather events, geopolitical tensions and war. These hazards pose various risks for supply chains, for example, the bullwhip and ripple effect. To simulate the result of such risks, a simplified system dynamics model of a typical semiconductor manufacturing supply chain was constructed using the Anylogic Software. The model serves as a what-if scenario foundation to evaluate certain external circumstances dependent on current global situations to enhance supply chain resilience.

In combination, these studies highlight the role of simulation together with efficient optimization methods as a powerful tool for developing more robust, economical, and flexible solutions to inventory management problems. Such techniques are likely to play an increasingly important role in preserving service levels while reducing costs through effective management of uncertainty across an increasingly diversified operational spectrum of growing supply chain complexity.

III. METHODOLOGY

○ *A. Type of research*

This study adopted a quantitative research design using modeling and simulation techniques. The data collection process involves gathering supply chain-related information from Candevco, including supplier lead times, customer demand data, and inventory management practices.

The study relies on key personnel from Candevco, including supply chain managers, inventory controllers, and sales departments, to gather historical data related to demand fluctuations, supplier lead times, inventory levels, and customer orders from Candevco's historical data. The data is used to create a representative supply chain model.

Discrete event simulation is applied in modeling the dynamics of Candevco's supply chain in this study. This method models the sequential flow of events in the supply chain from the receipt of client orders, the start of production, replenishment of stocks, to order fulfillment. It examines the effects of a shift in demand, lead times, or inventory policies on the performance of a supply chain because each of these events will trigger certain processes and use resources. We use the DES model to allow scenario testing so that the best inventory control techniques can be found and stringent requirements for high demand satisfaction can be ensured under different operating conditions. It thus allows for the modeling of the impact of bigger safety stocks or of shorter lead times.

○ *B. Method of Analysis*

The use of quantitative methods enabled the collection of numerical data on several aspects of supply chains such as order fulfillment rates, inventory levels, lead times, variability of demand and the outcome of different inventory control strategies in simulation of supply chain dynamics at Candevco. Simulations and historical information are used to gather this data.

Quantitative analysis uses modeling models because it is through these that patterns and trends of supply chain performance will be measurable and evaluated to show impact, such as demand satisfaction and general efficiency of the supply chain. It can also measure the effectiveness of inventory policies and spatial distribution of stock among facilities.

Tools such as Python are used to build and simulate the supply chain model. A step-by-step approach is followed to validate the accuracy of the model based on historical data provided by Candevco.

○ *C. Data Gathering*

To obtain key information for the simulation process the researchers interviewed some of the most important personnel at Candevco. Transportation time and client demand trends were all well laid out within these interviews that revealed the firm's supply chain procedures and inventory control procedures. The information gathered in these conversations would form the basis for an accurate simulation of the supply chain dynamics.

Summary of Data Gathered Using Survey Questionnaires.

The survey gathers data related to the rice supply chain at Candevco, covering transportation, supply frequency, resupply processes, and challenges faced.

- Estimated travel time from producer to CANDEVCO.

It usually takes about an hour for a rice delivery from a supplier to CANDEVCO.

- Processing time for rice (from Receiving to Restocking/Supplying).

It takes about an average of 1 to 3 hours for the rice to be processed for it to be available for restock.

- Delivery time from CANDEVCO to Customer locations.

It takes about 2 hours or less for rice to be delivered from CANDEVCO to Customer locations.

- Frequency of Supply by Producers.

CANDEVCO typically resupplies from producers weekly.

- Frequency of Restocking Inventory at CANDEVCO.

The Inventory of rice at CANDEVCO is restocked daily.

- Patterns in Customer Demand.

It has been observed by CANDEVCO that customer demand varies by month/week.

- Challenges in Supply Chain.

CANDEVO have had shortages of supply from producers.

- Type of Transportation Used by Suppliers.

Producers typically use Small or Big trucks to transport rice to CANDEVCO.

- Number of Vehicles used for Resupplying.

Producers approximately uses about 4 to 5 vehicles to resupply products to CANDEVCO.

- Type of Transportation CANDEVCO uses for delivering products to customers.

CANDEVCO typically use 2 to 3 Small or Big trucks to transport rice to customers.

NAME	ADDRESS
Supplier 1	AWITAN, LABO
Supplier 2	MAMBALITE, DCN
Supplier 3	PAMORANGON, DCN
Supplier 4	SAN ISIDRO, DCN
Supplier 5	ALAWIHAO, DCN
Supplier 6	TALISAY, DCN
Supplier 7	COBANGBANG, DCN
Supplier 8	TALISAY, DCN
Supplier 9	P2 MAMBALITE, DCN
Supplier 10	
Supplier 11	DIPDIPON, VCN
Supplier 12	P2 MAMBALITE
Supplier 13	P2 MAMBALITE
Supplier 14	ALAWIHAO
Supplier 15	
Supplier 16	P6 MAMBALITE
Supplier 17	P2 MAMBALITE
Supplier 18	P2 MAMBALITE
Supplier 19	
Supplier 20	GAHONON, DCN
Supplier 21	P2 MAMBALITE
Supplier 22	TALISAY, DCN
Supplier 23	P2 MAMBALITE
Supplier 24	P2 MAMBALITE
Supplier 25	P5 COBANGBANG
Supplier 26	P2 MAMBALITE
Supplier 27	P2 MAMBALITE
Supplier 28	GAHONON, DCN
Supplier 29	P5 COBANGBANG
Supplier 30	VINZONS, CN
Supplier 31	VINZONS, CN

Table 1. Suppliers Associated With CANDEVCO.

Destinations for CANDEVCO Product Shipments

- San Pascual, Basud
- San Lorenzo Ruiz (Gutierrez Store)
- Canoreco (Daet)
- Brgy. Pagsangahan, Basud
- Provincial Capitol of Daet
- JPNHS - MPC
- Jose Panganiban Municipal

Interviewing and using a survey questionnaire was utilized to collect data essential for the simulation. The gathered information played a crucial role in successfully completing the simulation process.

A. Simulation Model

While building a simulation model of CANDEVCO's supply chain, some critical issues must focus on to maximize control over inventory as well as demand fulfillment. Paramount among these is the knowledge of primary players in the supply chain including agricultural suppliers whose seasonal fluctuations have an immense influence on dynamics in the inventory. These features of the supplier provide a basis for exactly simulating the movement of agricultural products. No less important is the specification of setting parameters for each defined attribute related to variations of supply and demand.

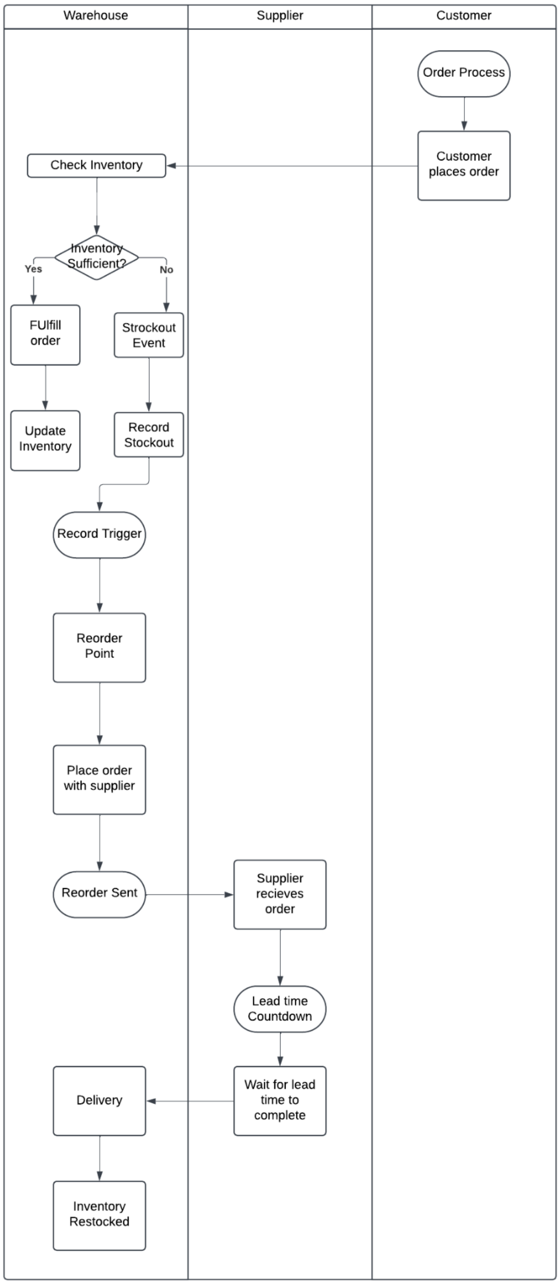


Fig. 1. Swimlane Diagram of Supply Chain of CANDEVO

This swimlane diagram explains a process where three main entities are involved: the Warehouse, the Supplier, and the Customer. The "Order Process" is triggered when a customer places an order. This prompts the warehouse to check its inventory to ascertain whether the items are available for the order. If the items are available, the order is fulfilled and the inventory updated. In the event that there were no sufficient items, a stockout event is recorded and the reorder point noted. This triggers the system that prompts the warehouse to place an order with the supplier. The supplier acknowledges receipt of the reorder and begins counting lead time, during which the warehouse will have to wait until the supplier prepares and delivers the order. Upon delivery of the goods by the supplier, it too restocks them. This process makes inventory management easy because it eliminates stockouts and makes it possible to fulfill customer orders on time.

B. Formula

These formulas were applied to the research cycle, in which lead times, costs, and reorder levels whichl help detect key points of the supply chain. This computation helps in cost analysis and optimizing the inventory as well.

1. Reorder Point (R) Formula:

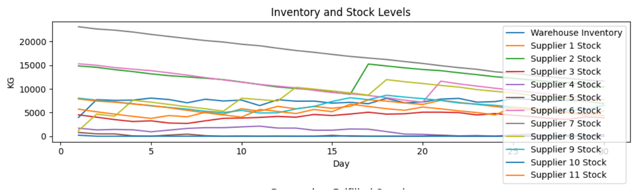
$$R = d \times L + SS$$

where:

- *d = daily average demand*
- *L = lead time (in days) for replenishment*
- *SS* = safety stock to buffer against demand variability

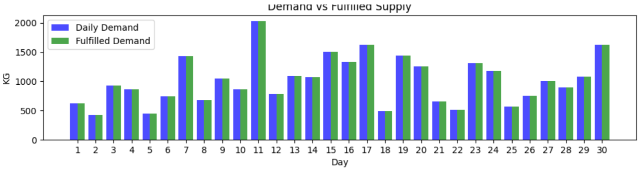
The Reorder Point (R) Formula is the formula used in this simulation model, which enables businesses to calculate when they should place a new order for stock before running out. This ensures there is always enough stock on hand to cater for demand over the lead time between ordering and receiving inventory replenishments. Reorder point(RR) R=d×L+SS, Where, RR= Reorder Point, or inventory level at which a new order is placed d = daily demand, average number of units sold (or used) per day (usually based on historical data and/or forecasts) L = lead time, the number of days required for an order to be received from a supplier after being placed SS = safety stock; an additional amount of inventory held as buffer stock to shy away from anticipated forecast error(s) in demand or delivery lags and thus help avoid stockouts. This formula, which guarantees optimal inventory, was derived from the information provided by MRPeasy *(Mattias Turovski, 2023*).

IV. Results and Discussion



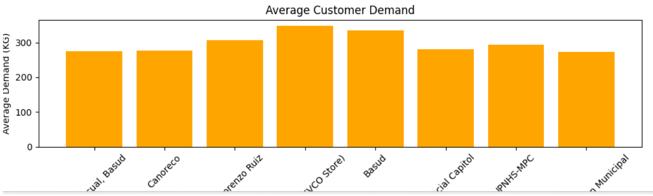
Graph 1. Inventory and Stock levels of CANDEVCO

This graph illustrates the inventory and stock levels of CANDEVCO and associated stakeholders over a 30-day period. A visual comparison can be done to see the trends of supply and demand. The variation in stock levels between the warehouse and the individual stockholders can be seen, and the "Warehouse Inventory" shows the significant fluctuations due to the dynamic nature of inventory management to meet demand. The remaining stockholders maintain more stable stocks. This pattern may represent a more consistent supply chain chain. The pattern between demand on a day-to-day basis and supply fulfilled, emphasizes the strategic practices of the inventory to have stability throughout the supply chain network.



Graph 2. Demand VS Fulfilled Supply of CANDEVCO

This graph provides a comparison of daily demand and fulfilled supply of CANDEVCO over 30 days. The green bars are fulfilled demands, indicating the capacity in which the supply chain fulfils daily demands. Here, despite fluctuations in daily demands, the system maintains fairly consistent fulfillment rates, illustrating the efficiency of supply chain strategies. It reveals peaks and troughs of data that show variability in the needs of customers and responsiveness in the supply chain towards changes in those needs. The analysis thus highlights demand forecasting and adaptive inventory management to maintain a balanced relationship of supply and demand.



Graph 3. Average Customer Demand of CANDEVCO

The graph shows the average customer demand in kilograms for various customers of CANDEVCO. From the data, the demand levels are relatively consistent across the listed entities with only slight variations. Customers like "San Lorenzo Ruiz," "Candevco Store," and "Basud" have similar demand patterns, indicating balanced consumption requirements. The chart gives much emphasis to each customer contributing to the overall demand, as shown by the steady distribution.

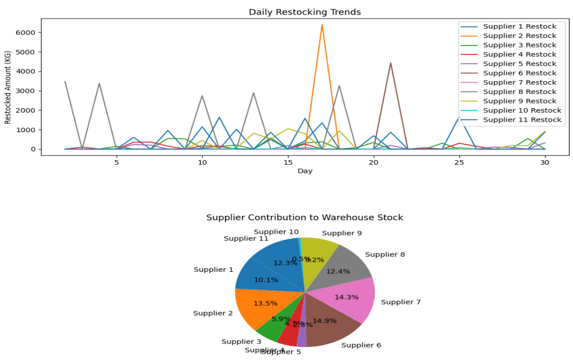


Fig. 2. Restocking trends and Supplier Contribution to Warehouse Stock.

This figure highlights which suppliers are the most beneficial in restocking the warehouse or have available supply to fulfill demand. The top graph illustrates the daily restocking trends over a 30-day period, where Supplier 2 is significantly different with a spike around Day 17, adding more than 6,000 KG, and Supplier 5 and Supplier 10 exhibit more consistent but lower levels of restocking. The pie chart gives the percentage-based breakdown of how much each supplier contributes to warehouse stock as a whole. Supplier 6 takes the lead at 14.9%, with Supplier 7 taking a close second at 14.3%. Suppliers 8 and 11 are also significant, contributing 12.4% and 12.3%, respectively, and Supplier 10 is the smallest, at 0.5%. This aggregated analysis helps show key contributors and restocking trends in suppliers who maintain supply levels and who always meet demand.

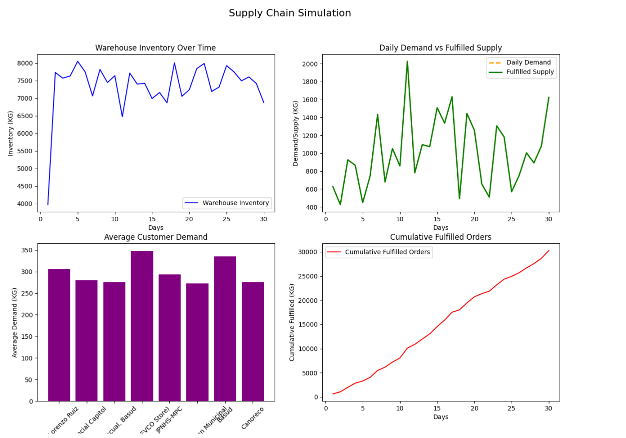


Fig. 3.Visualization of Supply Chain Simulation of Candevco.

This figure depicts an overview of Candevco's supply chain performance through four key visualizations. First, the graph is showing the warehouse inventory over time where the curve starts at about 4,000 KG, stabilizing between 7,000–8,000 KG, and the curve falls slightly toward the end of the month. The Daily demand vs Fulfilled supply shows the fluctuations in the amount of fulfilled supply in comparison with the daily demand, which are marked with significant peaks on Days 12 and 28, which shows the instances of mismatch. The bar chart for Average Customer Demand shows that "CANDEVCO Store" and "Brgy. Pagsanghan, Basud" have a maximum average demand above 330 KG, whereas all other customers keep it relatively moderate. Finally, the Cumulative Fulfilled Orders graph is a steady upward curve that indicates consistent fulfillment of supply orders over the entire 30-day period. In summary, these charts reveal the general stability in the supply chain but show points where demand volatility could necessitate closer monitoring.

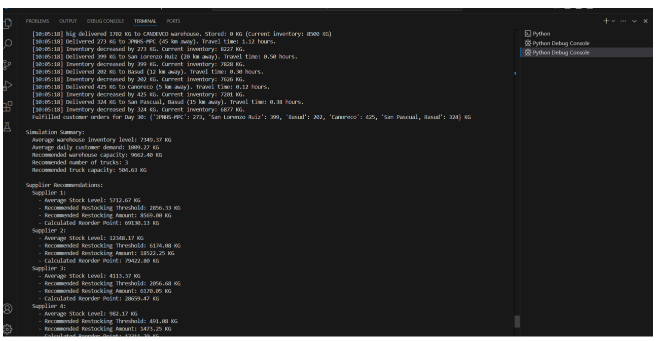


Fig. 4. CANDEVO Simulation Conducted in a Span of 30 days.

The supply chain simulation of CANDEVCO was able to demonstrate the supplier's stock replenishment, customer satisfaction, and warehouse inventory management. It showed the variation in warehouse inventory levels that has been a result of the supplier's delivery and the fulfillment of customer needs. The standard level of the inventory was counted that helped us to find out where we can reduce the warehouse size. Changes in supplier behavior were also studied, as they affect warehouse inventory levels through replenishment frequency, express amounts, and wait intervals that need to be adjusted. The customer's order fulfillment operations were under close supervision, thus showing the lack of satisfied customers caused by the non-availability of stock and suggesting a need for better synchronization between inventory and demand trends.

The simulation brought to light the difficulties in the management of the supply chain for CANDEVCO in an agri-business setup and also showed areas of improvement. It proposed such strategic changes as increasing or decreasing the warehouse space, the number of trucks used or the parameters of the supplier rotation reservoir. Model that featured dynamic supply chain aspects allowed the management of the CANDEVCO company to foresee small fluctuations in consumer demand and supply and therefore be more active and information based in their decision making. Further the flexibility of the model makes it possible to extend the model through adding new factors such as, seasonal changes in demand, changes in transportation costs and disruptions in supply of products.

V. Conclusion

As a whole, the simulation met the objectives of the study efficiently, which were to raise inventory efficiency and demand satisfaction. It gave a dependable basis for the trial of supply chain strategies without making any trouble in the line of action for the CANDEVCO. It made the company not only increase the amount of goods it was made and reduced the costs but also supported and met the demand of the customers. In fact, These discoveries supported the simulation model approach as one of the challenges of supply chain solving and the strategic direction for successful management.

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