Analyzing the supply chain sustainability of an internet service provider in Thailand

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Abstract. This paper aims to comprehensively analyze the supply chain activities of an Internet Service Provider company in Thailand, focusing on sustainability. The company utilizes the SCOR model and IDEF0 methodology to analyze the supply chain and offer rental equipment services. The major issues identified include inventory management, insufficient data in demand planning, supply chain planning, renewal contact planning, the role of suppliers, and last-minute changes during the installation process. To address these challenges, the paper suggests improvements such as optimizing equipment flow, improving communication with teams, implementing demand forecasting models, considering alternative suppliers, and clarifying technical requirements with customers. By implementing these recommendations, ISPs can enhance the sustainability of their supply chains, reducing environmental impacts, optimizing resource utilization, and meeting customer expectations for sustainable practices. This study highlights the importance of sustainable supply chain practices in the telecommunications industry and offers valuable insights for companies seeking to improve their operations in a more environmentally responsible manner.

1 Introduction

Nowadays, communication is an essential requirement, and with the onset of globalization, communication methods have evolved and continue to improve. Telecommunication technology and Information and Communication Technology (ICT) offer notable environmental advantages. The ability to work remotely facilitated by these technologies reduces carbon emissions associated with commuting to physical offices. Furthermore, ICT plays a crucial role in reducing information asymmetry by lowering the costs of accessing CO_2 emissions data and empowering individuals and organizations to make well-informed decisions regarding environmental sustainability. The adoption of cloud systems encourages resource sharing, eliminating the need for energy-intensive standalone private servers. Additionally, the utilization of electronic signatures (e-signatures) replaces traditional paper-based document signing, leading to waste reduction and the promotion of sustainability.

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These advancements not only contribute to environmental conservation but also align with consumers' preferences for environmentally friendly and sustainable practices [1-2]. Internet service providers (ISPs) not only need to focus on expanding coverage and capacity but also on maintaining spare parts for hardware to support their solutions.

This involves managing resources, network flexibility, and customizing network infrastructures to meet customer requirements. The ISPs industry has greatly benefited from this trend over the past five years, driven by rapid advances in digital infrastructure and services. In recent times, both consumers and businesses globally have come to view the Internet as a necessity rather than a luxury, a perception that is expected to become even more prevalent in the forecast period.

ASEAN's Internet market is rapidly growing, with 125,000 new users joining daily, projecting substantial expansion in the region's digital economy. Digital technology has revolutionized business models, surpassing traditional approaches and embracing modern advancements, representing a 20% increase compared to the previous year. The digital economy has transformed information and communication through innovative data utilization, sparking a renewed focus on digital business development and strategies. While digitization presents challenges and opportunities, the COVID-19 pandemic has further impacted consumer behavior, leading to increased reliance on digital commerce platforms for essential needs [3].

Thailand stands out with an impressive average download speed of 166.81 Mbps on fixed broadband in 2020, securing its second position among ASEAN member states. The country's operational infrastructure, including 10 international internet gateways, 11 internet exchange points, and over 200 ISPs, serves as the backbone of its internet connectivity. Thailand is also connected to 13 submarine cable networks, with three crucial landing stations contributing to its extensive network [4].

This research discusses a case study which is an ISP company with multiple service centers scattered across the country, where effective spare part inventory management is crucial to cost control. However, this aspect of supply chain management has been neglected in the past, leading to an inefficient solution for managing spare parts, resulting in transfer costs and inventory management problems. To address these challenges, this article proposes using the Supply Chain Operations Reference Model (SCOR model) and Integration Definition for Function Modeling (IDEF0) to enhance inventory management and minimize transfer costs. The IDEF0 model can help identify the shortcomings of the existing supply chain processes by mapping the input, output, control or constraint, and mechanism variables, as exemplified in Fig. 1.

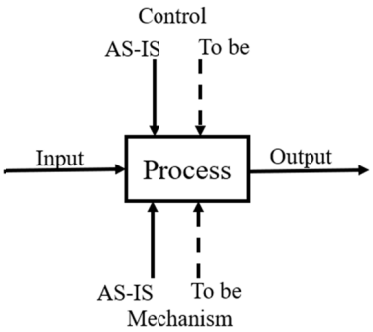

Fig. 1. The mapping of IDEF0.

2 Methodology

The study uses the IDEF0 and SCOR models to map the input, output, control or constraint, and mechanism of the targeted processes, to identify flaws and suggests improvements. The IDEF0 model is a supply chain analysis tool that finds use in several industries, including a container depot service provider in Thailand [5], a small-sized manufacturer's analysis of the blue crab supply chain during COVID-19 [6], Business Process Analysis and Improvement for a Third Party Logistics Provider in Indonesian Cold Chain Logistics [7], The study of a small-sized Thai chili paste supply chain [8], the analysis of a chilled beef supply chain for developing strategic improvement [9] and The analysis of a vertically integrated organic rice company: a case study in Thailand [10].

IDEF0 level 0 can describe the whole working process but cannot specific details of each process. So an author applies a deeper level to focus on the problem process. The process in question is layered, with Layer A_0 representing the top level and including all variables. To identify the precise process elements, Layer A_0 must be further subdivided based on specific industry details.

A_0 encompasses several processes, namely A_l to An, all of which are linked to more specific elements. These processes are sub-processes of A_0, with Al to An being further broken down into new sub-processes. For example, Value Process A comprises sub-processes A_l to A_{1n}, with each process linked to even more precise elements. A_{ij} can be further broken down into sub-processes A_{ijl} … A_{ijn}, and so on. It is necessary to break down every process in this model until sufficiently precise value process elements are identified [11]. In addition, the SCOR model helps to break down all processes of the supply chain and consists of 5 primary processes; Plan, Source, Make, Deliver, and Return [12].

1 Plan. Planning processes involve identifying resources, requirements, and communication channels necessary for a process to align with business objectives. This entails establishing optimal practices that enhance supply chain efficiency while factoring in compliance, transportation, inventory, and other essential aspects of supply chain management [13].

2 Source. Source processes encompass acquiring goods and services to fulfill anticipated or actual market demand. This entails activities such as procurement, receipt, evaluation, and supply of incoming materials, as well as managing supplier agreements.

3 Make. The company, being an ISP, does not engage in manufacturing activities. Rather, it concentrates on developing service offerings that align with customer requirements. This involves various tasks, such as creating a customer database by collecting relevant parameters and equipment specifications for each client, along with managing orders, transportation, and distribution.

4 Deliver. Under this category, any processes related to delivering final services to fulfill anticipated or actual demand are included. These may comprise configuration deployment into the network, equipment installation, and testing services to ensure service quality. The quality of network performance has a bearing on both attitudinal and behavioral loyalty. ISPs must effectively manage and regularly evaluate service quality. Higher service quality is associated with a greater customer inclination to maintain a positive attitude and remain loyal over time [14].

5 Return. Return processes refer to activities related to the return or receipt of products, whether from customers or suppliers. This may involve managing customer returns, processing supplier returns, and handling repair equipment. Additionally, it includes providing post-delivery customer support processes, which mark the end of the service.

3 Result and discussion

3.1 Background of the company

The company is a medium-sized organization with a workforce of over 300 employees across its headquarters and 19 provincial service centers. Its core services include dark fiber, private links, and direct internet links. The company has been a finalist in the "Asia-Pacific Carrier Ethernet Service Provider of the Year Contest" for four consecutive years, from 2007 to 2010, and was one of four finalists. In June 2009, the company received the MEF Certificate as an Ethernet provider from the Metro Ethernet Forum (MEF), in compliance with MEF9 and MEF14 standards. The company has received several awards and recognitions, including the "Quality Persons of the Year 2011" award from the Foundation of Science and Technology Council of Thailand (FSTT) in the Information and Communication Technology sector at the Chulabhorn Research Institute (CRI). In 2013, the company received an "Excellence" Corporate Governance Rating in the Corporate Governance Report of Thai Listed Companies 2013, which was surveyed and assessed by the Thai Institute of Directors Association (IOD), the Securities and Exchange Commission, and The Stock Exchange of Thailand. The company won the Best Investor Relations Award of SET Awards 2017 in 2017. In 2020, the company was certified as a member of CAC by the Council of Thai Collective Action Coalition against Corruption (CAC). Furthermore, the company has achieved ISO/IEC 27001:2013 and CSA STAR certifications, ensuring the provision of superior quality services [15].

The company's warehouse is located within the same building as its Bangkok headquarters, while the provincial service centers serve as both offices and warehouses. Providing comprehensive coverage is a critical factor, and to achieve this, the company has set up several provincial service centers that encompass all regions across Thailand. As enterprise customers require uninterrupted services, quick replacement of malfunctioning equipment is essential. To ensure the quality of service and the time taken to recover from potential issues, the company has put in place a SLA as a service condition.

3.2 Supply chain analysis of ISPs

In Fig. 3, the processes involving stakeholders are depicted, including inputs, outputs, controllers, and mechanisms. The first stakeholder is the supplier, whose input is limited to the order. In the sourcing team interview, it was revealed that the company reaches out to a minimum of three suppliers to obtain competitive pricing. Nevertheless, the company ultimately chooses to procure the entire order from a single supplier.

The equipment distribution process begins with the planning team utilizing historical data from the Enterprise Resource Planning (ERP) system to export data and determine the required quantity and location of equipment. The data is collected from the existing equipment at each customer site, as well as the total number of spare parts required for incidents and new links throughout the year. The planning team uses three components, namely the previous year's usage, the growth rate, and the spare parts allocated for replacement at customer sites, to arrive at the official numbers. Then, the company employs a blanket order to leverage quantity discounts and minimize stockouts, which enables large annual orders and small monthly orders. The sourcing team places orders for the necessary equipment, which the supplier delivers as planned every month. The equipment is then sent to the company's headquarters warehouse, following a pre-determined delivery plan. From there, the third-party logistics partners transport the equipment to the provincial service centers.

The equipment flow in the company is not limited to one direction, as the equipment is also returned to the warehouse. This occurs when customers terminate their services or when equipment fails and must be replaced to restore services, as depicted in Fig. 2.

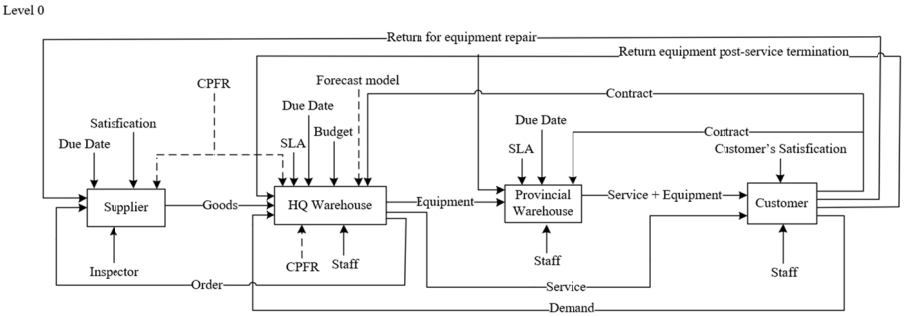

Fig. 2. The supply chain process of an Internet Service Provider (IDEF0 level 0).

The success of these processes is dependent on accurate data, and effective modeling to determine the appropriate amount and type of equipment at each location, and timely delivery from suppliers. The company's customer base consists of over 2,000 enterprise clients, ranging from hospitals and banks to universities, department stores, factories, industrial estates, government agencies, entertainment media, real estate businesses, and hotels. These customers are under contract and have the option to renew after the contract's expiration date.

3.3 Process analysis of the ISP company

In this section, an analysis was conducted on five major activities using the SCOR Model and IDEF0 level 1. Table 1 displays the current problems and proposed guidelines to improve the process, based on the process analysis of the ISP company shown in Fig. 3.

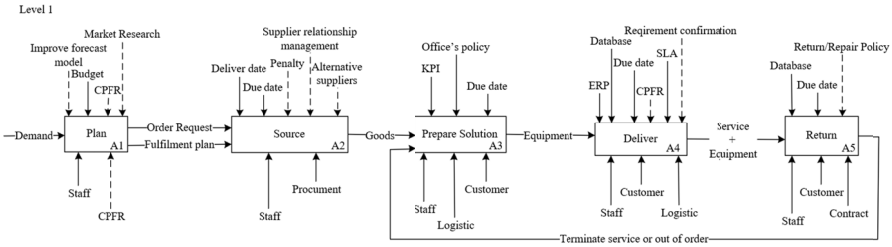

Fig. 3. The supply chain process of an Internet Service Provider (IDEF0 level 1).

The planning process for determining the appropriate quantity and type of equipment to purchase relies heavily on the staff's ability to create accurate forecast data from the ERP system. However, this process lacks support from other teams such as demand planning and no forecast demand, leading to no supply chain planning due to a lack of information sharing. Moreover, the budget is a crucial constraint that must be considered during the decision-making process. In the highly competitive ISP market, customers have many choices, and therefore, it is crucial to consider customer satisfaction. Finally, the lack of collaboration and problem-solving among teams can pose a challenge to the planning process. To improve the planning process, the company can take the following steps. First, conduct a study on consumer behavior to gain insights into their needs and preferences. Second, establish demand forecasting models based on historical data and market trends.

Then, set the forecasting models to fit the company's workflow, ensuring they are regularly updated with new data. Implement collaborative planning, forecasting, and replenishment (CPFR) with suppliers to improve supply chain management. Then, create a customer renewal service with the sales/marketing department to ensure customer retention. Finally, establish a cross-functional team from all departments involved in the planning process and schedule regular team meetings to facilitate communication and ensure all stakeholders are on the same page. During the sourcing process, the sourcing team relies on official data to place orders and commit to suppliers for the timely delivery of goods. The planning team assesses the availability of spare equipment parts at customer sites and requests a transfer to provincial service centers accordingly, ensuring that spare parts are readily available for use in case of equipment failures or new link orders. However, inaccurate demand forecasts can lead to ineffective equipment alignment with actual demand. The current monthly delivery process, which simply divides the yearly quantity by 12, may not effectively meet actual demand. Despite the company's efforts for timely deliveries, suppliers often fail to meet deadlines due to variations in their lead time, ranging from 1-3 weeks. Additionally, the limited number of suppliers and the absence of a supplier evaluation system pose challenges for the company.

Table 1. Summary of current problem and improvement plan

Activities	Problem	Improvement Guidelines
Plan	Insufficient demand planning and forecasting model, especially for renewals and terminations of customers	Conduct market research to understand consumers' behavior and preferences Develop and implement demand forecasting models based on historical data and market trends
	Absence of supply chain planning	Integrate demand forecasting models into the company's workflow and decision-making processes Implement collaborative planning, forecasting, and replenishment (CPFR) with suppliers and customers to improve supply chain efficiency
	Intense competition in the ISP market	Establish a customer renewal service to improve customer retention
	Limited collaboration in problem-solving	Establish a cross-functional team from all departments to work on process improvement and set up regular meetings for effective communication
Source	Equipment procurement lead time varies from 1-3 weeks	Identify alternative suppliers and establish penalty clauses in contracts to ensure timely delivery
	A limited number of suppliers and a lack of a supplier evaluation system	Develop an approved vendor list and supplier evaluation system to ensure reliable suppliers are selected
Deliver	Delivery delays due to equipment shortages	Improve demand planning by regularly reviewing and updating forecast models based on changing market trends and customer behavior Implement strategies to reduce procurement lead time
	Changes in requirements causing the need to change equipment	Ensure customer requirements are clearly defined and aligned with equipment used to prevent unexpected changes during installation
Return	Unanticipated repair lead time due to spare part shortages and obsolete spare parts, resulting in substitution effects for other customers.	Establish repair/return policies with suppliers to reduce repair lead time and ensure adequate spare parts availability to prevent substitution effects on other customers.

To improve the sourcing process, the following actions can be taken. Firstly, explore alternative suppliers to increase competition and reduce lead time. Secondly, implement a penalty system to ensure that suppliers meet delivery deadlines. Thirdly, establish a supplier relationship management program to build stronger partnerships with suppliers. Lastly, develop an approved vendor list and a supplier evaluation system to ensure that suppliers meet quality and service standards.

In the subsequent phase of the process, the solution, parameters, and equipment preparation are documented in a database. This phase is usually executed smoothly. In the equipment delivery process, a delayed delivery from the supplier may require staff to transfer available equipment from other service centers, leading to wasted time and additional costs. This can result in equipment shortages at provincial service centers, causing installation deadlines to be missed. To prevent such situations, it is essential to improve demand planning by regularly reviewing and updating forecast models based on changing market trends and customer behavior. Additionally, implementing strategies to reduce procurement lead time, and ensuring customer requirements are clearly defined and aligned with the equipment used can prevent unexpected changes during installation. Although the cost of transportation for each transfer is not high and the budget allows for urgent transfers to be made, this situation highlights the challenges in inventory management. During the installation process, the provisioning team deploys the configuration and parameters into the network, while the service team installs the equipment at the customer's site. However, it's not uncommon for customers to request changes to the solution during this process. These changes, if not accounted for in the planning phase, can lead to equipment availability issues. To avoid this, staff must ensure that customer requirements are clearly defined and aligned with the equipment used, to prevent unexpected changes during installation. The services are provided until the last day of the contract.

During the returning process, equipment is removed and sent back to either the headquarters' warehouse or provincial service centers, depending on its location, upon the termination of services. In the case of faulty equipment, it is replaced with a working one. However, suppliers do not commit to a specific timeline for repair, resulting in prolonged repair lead times. This can affect other customers who may face substitution effects due to the unavailability of equipment. To improve this process, it is essential to establish repair/return policies with suppliers, ensuring adequate spare parts availability, and reducing repair lead time.

4 Conclusions

The objective of this paper is to conduct a comprehensive analysis of ISPs' supply chain activities, with a particular focus on sustainability. Throughout the analysis, several critical issues have been identified. One of these challenges pertains to inventory management, necessitating the optimization of equipment flow and the reduction of urgent transfers. Insufficient data in demand planning, supply chain planning, and renew contact planning contribute to this problem. To address this issue, improved communication with involved teams and the implementation of demand forecasting models such as ABC analysis or the Pareto principle are recommended. These measures can prevent negative consequences in future processes and promote sustainability. Another notable concern is the role of suppliers within the supply chain. It is crucial to consider alternative suppliers and incentivize punctuality through penalties to enhance diversification and foster sustainability. Effective supplier management plays a vital role in maintaining a smooth and sustainable supply chain. Lastly, last-minute changes during the installation process can lead to additional time and resource consumption, impacting sustainability efforts. Thoroughly clarifying technical requirements with customers can help avoid unexpected changes and prevent disruptions. By addressing these challenges and implementing the suggested improvements, ISPs can enhance the sustainability of their supply chain activities. This will contribute to reducing environmental impacts, optimizing resource utilization, and meeting the expectations of customers who prioritize sustainable practices.

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