A Lean Service Conceptual Model for Digital Transformation in the Competitive Service Industry

Nur Niswah Hasina Mohammad Amin[1]*, Amelia Natasya Abdul Wahab[2], Nur Fazidah Elias[3], Ruzzakiah Jenal[4], Muhammad Ihsan Jambak[5]*, Nur Afini Natrah Mohd Ashril[6]
Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia, Selangor, Malaysia[1, 2, 3, 4, 6]
Faculty of Computer Science, Universitas Sriwijaya, Palembang, Indonesia[5]

***Abstract*—In today's competitive service industry, the pressure to boost productivity, cut costs, and improve service quality is immense. By integrating lean principles and digital transformation, organizations can streamline processes and reduce waste. Although various lean models have been developed for different service industry, there is no universal standard. Hence, this study aims to address this gap by proposing a Lean Service Conceptual Model through qualitative research by identifying nine types of waste and seven lean dimensions. Interviews, observations, and audio-visual materials are the data collection methods used in this study. The model aligns seamlessly with modern digital technologies such as big data, the Internet of Things, blockchain, cloud computing, and artificial intelligence, making it adaptable for service organizations to excel in the digital age. The model focuses on enhancing efficiency and effectiveness while primarily reducing waste in service operations. Due to restrictions during the pandemic and the interest expressed by the informants in participating in this study, the focus is thus made on a single case study, which may lead to biased findings. However, future studies will be performed on multiple case studies to enhance the findings. Exploring and reviewing an array of best practices, techniques, and tools available for waste reduction within organizational operations is paramount.**

***Keywords*—Lean principles; digital transformation; model conceptual; service industry; waste; dimension; qualitative research**

I. Introduction

In the evolving environment of contemporary companies, two fundamental paradigms have emerged as transformative forces that shape the way organizations operate and deliver value, which is known as lean and digital transformation. The term "lean" refers to the principles and procedures of the Toyota Production System (TPS) [1]. Nowadays, lean is no longer limited to the manufacturing industry; it is all about doing more with less. Over time, the service industry has also effectively adopted the lean idea [2]. Without doubt, lean is successfully implemented in the service industry.

In today's competitive world, service organizations are faced with enormous pressure to raise productivity, cut costs, and enhance the quality of their service. Lean is a practice used in overcoming such issues, and in creating more value for the customers. Studies on the implementation of lean service have indicated interesting trends that began in 2005, with an increase in the number of studies in the service industry such as healthcare, education, public services, hotels, banking, and information technology [3]. The modern economy is dependent on the service industry, which is very tightly tied to our daily life [4]. Lean implementation in the service industry has difficulty in assessing efficiency because the service industry focuses non-value-added activities on intangible assets [5]. Lean is necessary in improving performance [6]. Thus lean implementation approaches are used in identifying and reducing wastes [7].

In addition, the era of digital transformation has brought about uncommon technological progress and advancement. To keep up with the current opportunities and trends, organizations must therefore constantly innovate through a process known as digital transformation [8]; which is a process of building dynamic capabilities for the continuous strategic regeneration of organizations [9]. Digital transformation is the adoption of digital technology into all aspects of an organization's operations that lead to a significant change in the way the organization operates and gives value for its customers [10]. The approaches towards digital transformation would adopt a different viewpoint that is aimed at accomplishing multiple goals [11]; impacting all aspects of the organizational process, activities, and structures [12].

Despite the growing acknowledgment of the significance of lean principles and digital transformation within the service industry, a discernible gap persists in the existing body of knowledge. While previous studies have delved into either lean practices or digital transformation individually, there remains a shortage of comprehensive research exploring the synergistic effects arising from the integration of lean principles with digital transformation in service organizations [13] . This study endeavours to address this gap by providing a holistic examination of how the convergence of lean principles and digital transformation can contribute to waste reduction in the operational service industry [14].

Our research aims to fill this void by offering valuable insights that not only tackle the current challenges faced by service organizations but also furnish a nuanced understanding of the potential benefits and challenges associated with this integration. Through this endeavour, we seek to provide practical guidance for practitioners, researchers, and policymakers in navigating the intricacies of contemporary service environments, with the goal of facilitating operational efficiency and waste reduction.

The integration of both lean principles and digital transformation has the potential to change the service industry

*Corresponding Author.

by enabling organizations to simplify processes, and thus reduce wastes. However, this integration is challenging due to the complexity of the technological requirements, culture, behavioural challenges and also the size of the organization [8]. Over the years, several lean models have been developed for different service industries. However, there is no standardized lean model that can be used for all service industries that have type of waste and dimension all together. Thus, the crucial need for future research to develop a standardized model for lean services [15]. Developing a standardized model is crucial because it ensures uniformity and comparability across studies, allowing for greater validation and reproducibility. Hence, rather than developing a completely new model, this study attempts to examine and employ appropriate models that are currently available for the implementation of lean services.

This paper aims to explore how lean principles and digital transformation may reduce waste in service organizations. We want to propose a conceptual model that enables service organizations to successfully navigate changes in this era of digital transformation, thus maximising their operational efficiency by reducing waste in the operation. Besides that, the scope of this study is to find the answers to the following research question.

RQ: How can the integration of lean principles and digital transformation lead to waste reduction in service organizations?

The organization of this article is as follows. Section II discusses the related works on lean service and data transformation. Section III presents the research method and activities and discusses the approach taken in conducting this study. Section IV presents the results, and Section V presents the discussion. Finally, the conclusion of this study is made in Section VI.

II. Related Works

A. Definition and Principles of Lean

Lean is a philosophy, a collection of lean techniques or tools, and the concept of waste elimination [16]. Lean is the most important word in any organization [17]. The goal of implementing lean in the service industry is the same as the manufacturing industry: to reduce waste and to enhance resource efficiency. Lean defines as the continuous elimination of waste in all areas of operation [18]. To stay ahead of their competitors, the service industry must address the needs of every consumer. Lean service operation must provide what the consumer wants, where he wants it [19].

The manufacturing industry is differentiated from the service industry in terms of waste and dimension. The manufacturing industry is involved in transforming goods or raw materials into new products such as machinery, computers, electronics, furniture, chemicals, food, and plastics [20]. On the other hand, the service industry creates value, particularly intangible values such as management, guidance, information, advice, design, data, and experience.

The two industries have different outputs, demands, customer-specific production, labour requirements, automated processes, and the location of physical production [21]. Table I illustrates the differences between the manufacturing and the service industry:

TABLE I. The Difference Between the Manufacturing Industry and the Service Industry

Differences	Manufacturing	Service
Output	Physical products that is observable and touchable by the customer.	Intangible.
Demand	Produces product stocks with inventory level that are parallel to the forecast of customer demand.	Does not keep inventories; service is provided as per customer request
Customer-specific production	Production can be performed without customer orders or customer demand forecast.	Service is provided only upon customer request.
Labour requirements and automated processes	Automating production process to reduce labour needs.	Need to recruit people with specific knowledge and skills.
Physical production locations	Must be physically found for production operation and stock keeping.	Does not require physical site for production.

Source: [21]

The difference in operation makes the service industry unique. It is important in generating economic growth [22]. With a contribution of more than half of a country's gross domestic product, the service industry is indispensable to the global economy [4], [11]. The service industry plays an important role in the global economy [23]. Many services industry try to distinguish themselves from their competitors by making improvements in their operation. Considering the current economic situation, the successful implementation of lean is expected to contribute to cost reduction and improvement of the service operation, [2]; which is achieved through the identification and elimination of waste [24].

Although lean in the service industry began in the 21st century and is continuously expanding [25], it is still a relatively new concept and has not been thoroughly researched [26]. The advantages of lean include reduced inventory, increased process understanding, operational cost reduction, less re-work, reduced lead-time, and less process waste [27]. Although the implementation of lean in the service industry offers numerous advantages, it is nonetheless challenge-free [28]. The main challenge is the lack of awareness regarding its advantages [15].

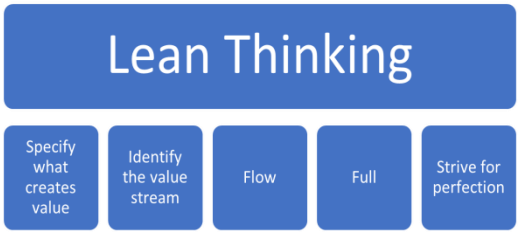

Fig. 1. Five principles of lean thinking.

Lean Thinking is a principle that could improve the efficiency of the service industry, reduce its operating costs, and increase operations capability [29], [30]]. Over time, Lean Thinking has expanded tremendously in the service industry, providing excellent benefits [31]. Lean becomes a way of

thinking, whereas practices or tools are ways to put these beliefs into reality [15]. Fig. 1 show the five principles of Lean Thinking are; specify what creates value, identify the value stream, flow, pull, and strive for perfection [23].

B. Models of Lean

This section examines several models of lean based on the review of the literature made between the years 2004 to 2022.

A model for lean production is explained and translated into service industry [32]. The Ahlstrom model is the earliest model designed to assess the level of lean implementation in an organization. The model indicates; (1) lean development, (2) lean procurement, (3) lean manufacturing, (4) lean distribution form, and (5) lean enterprise or organization that is competitive at the global level. However, this model does not indicate the wastes that may exist in an organization.

Vadivel & Sequeira [3] developed a model to investigate lean service activities and their impact on operational performance in the Indian postal service. However, the development of the model is restricted to their consideration for and selection of methods, tools, and techniques that were only put out in the empirical literature review. Other than that, neither the types of waste nor the way that lean should be implemented in an organization's operations are discussed in their model.

In a study by Sreedharan V et al. [33], a focus group and a structured literature review are used in constructing the Green Lean Six Sigma (GLSS) model for the public industry. This model consists of three different stages; procurement, production, and distribution, whereby the flow of activities starting from the procurement to distribution are depicted in the model. Bajjou et al. [34] developed an input-output model for the construction industry. This input-output model consists of three processes; the input, transformation process, and the output, whereby each process has its own principles. However, no mention of the types of waste is made in these models.

Iranmanesh et al. [35] proposed a model to investigate the effects of lean practices involving the aspects of process and equipment, manufacturing planning and control, human resources, product design, supplier relationship, and customer relationship. However, no discussion is made on the effects of waste on the sustainable performance of the manufacturing firms. A product-service system (PSS) leanness assessment model is developed by Elnadi & Shehab [31]. This assessment model consists of three levels; the enablers, criteria, and attributes that are used in proposing an index to assess the leanness of PSS in a United Kingdom manufacturing company. However, this model does not involve the assessment of any type of waste.

In addition to that, in a study conducted by Abdul Wahab et al. [36], a model of lean production dimensions and its relation to waste has been developed. This model serves as a guideline for management team in examining the types and places that waste can occur in the manufacturing industry. The model consists of seven dimensions that are the functional areas in the manufacturing industry. It also states eight types of waste that might exist in each dimension. These seven dimensions are Supplier Relationship, Customer Relationship, Product Development and Technology, Manufacturing Process and Equipment, Manufacturing Planning and Scheduling, Customer Relationship, and Visual Information System. The eight types of waste are waiting, defect, overproduction, transportation, motion, inventory, extra processing, and underutilized people. However, the dimensions and types of waste presented in this model are specified for the manufacturing industry, hence this model is not applicable for the service industry.

A model is therefore required in providing the right guidance and directions for industries, specifically those in the service industry, to enhance their operations. Although the process of becoming a lean service organization takes time and effort, the development of a model for guiding and tracking the results of such effort is of paramount importance to speed up the process.

C. Types of Waste

Lean is the outcome of Taichii Ohno's invention of the Toyota Production System that aims to reduce waste. To identify the "*Muda*" or waste in lean service, a review of the literature of previous studies is performed. Waste is defined as any activity that increases the cost, but does not add any value from the customers' perspective [26], [37], [38]. Besides that, lean is about improving quality to eliminate waste [15]. Lean is also an approach of eliminating waste in a process and creates value for the customers [39].

Identifying waste in a service industry can be complex because the operations are intangible [23]. Several types of waste identified by Ohno [40] in the manufacturing industry also exist in the service industry: over-production, inventory, waiting, motion, transportation, defects, and over-processing. Waste in the form of underutilized resources and a manager's resistance to change are also mentioned in the service industry [1], [23].

The discussion on lean service by Mohammad Amin et al. [24] examines nine types of waste; over-production, inventory, waiting, motion, transportation, defect, over-processing, underutilized resources, and manager's resistance to change, which is depicted in Fig. 2.

In this work, the types of waste are identified based on their definition. Table II shown the definition of waste based on the service perspective.

Fig. 2. Waste in lean service.

TABLE II. THE DEFINITION OF WASTE FROM THE PERSPECTIVE OF SERVICE INDUSTRY

Waste(s)	Definition
Inventory	Any work in process (Work-in-Progress) that exceeds what needs to be produced for the customer, inventory accumulation that causes the overuse of storage space, and reduced worker productivity due to the surplus of inventory [23], [41].
Transportation	Unnecessary movement of materials, products, information, workers and forklift operators [23], [41].
Waiting	Waiting whereby the employees or customers must wait for information or service delivery. Waiting is also involved when employees are ready to resume work, yet are unable to do so due to product, machine, or system unavailability [1], [23].
Motion	Unnecessary movement of resources or workers that need to bend over to choose items [1], [23].
Over-production	The completion of more work than required or before customer demand, which can lead to overcrowding [1], [23].
Over-processing	Adding unnecessary value to a service or product that is not requested by the customer, or will pay for, including unnecessary inspection and packaging [1], [41].
Defect	Any aspect of the service that does not suit the customer's needs, such as selecting incorrect items or incorrect quantity of an item [1], [23].
Underutilized resources	Waste of resources, especially human potential, not utilizing the talent and potential of employees, underutilizing their skills, creative abilities, and knowledge [1], [23], [42].
Manager's resistance to change	The attitude of "saying no" by the management, does not encourage all employees to be involved in the continuous process of improvement [23].

D. Dimension

The understanding of the dimension of lean implementation is an important aspect in improving operational performance. Lean implementation dimension does not only serve as a strategic guide in identifying and overcoming waste in the service process; it also acts as a guide for the formation of an organizational culture that focuses on efficiency, quality, and customer satisfaction.

Several variations of the functional domains or operational dimensions used in assessing the level of organizational implementation have been identified in the previous studies. However, most studies would focus on the dimensions without discussing the situations where waste could occur. Table III below depicts the definition of the dimensions of lean in the service industry.

E. Digital Transformation

Digital transformation has become one of the most discussed topics, and many industries have embraced digital transformation to acquire a competitive edge and maintain their sustainability [49]. Service industry operate their businesses, provide customer service and support by changing their way of operating through digital transformation [50].

Amidst the dynamic business landscape changes, service organizations are adopting digital transformation. Digital transformation enables service organizations to manage their operations more efficiently and effectively through the reduction of operational waste. At present, the term digital transformation does not have any recognized definition [51] since the scholarly literature lacks specific definitions [52]. Table IV illustrates some of the definitions of digital transformation [52].

There are new technologies that have become the trend in digital transformation, for example big data [52]–[54], the Internet of Things [9], [52]–[54], blockchain [9], [52], cloud computing [9], [53], [54], and artificial intelligence [52], [54]. These technologies offer new uses based on innovation and focus on the needs of the consumers [52]. Fig. 3 shows the technologies for digital transformation.

TABLE III. DEFINITION OF LEAN DIMENSION

Dimension	Definition
Lean Supplier	A supplier is a person or company that provides goods or services to another person or entity. The seller is referred to as the supplier. The basic function of supplier management is to control cost, quality, delivery performance, and billing accuracy. Adapted from [43], [44].
Lean Workforce Management	Workforce management is the process of strategically optimizing employee productivity to ensure all resources are in the right place at the right time. Workforce management strategies include scheduling, forecasting, skills management, punctuality and attendance, daily management, and employee empowerment. Adapted from [45].
Lean Operations Development and Technology	Lean Operations Development and Technology refers to the choice of operational structure, materials, and technical solutions in adopting service methods in line with the latest technology or innovative practices to increase operational capability. Technology is used to increase the autonomy of result-oriented groups and the distribution of responsibilities in operations. Adapted from [32], [46].
Lean Service Provision Process	Lean Service Provision Process refers to all activities required in producing services by using the collection of methods and materials or techniques in service operations that emphasize service quality standards, workplace layout, productive use of equipment and maintenance, material handling, safety, hygiene, and ergonomic aspects to reduce service preparation time. Adapted from [46].
Lean Service Planning and Scheduling	Lean Service Planning and Scheduling refers to all activities required to coordinate services and market demand, and thus increase the ability to meet customer orders. This minimizes variation in service operations, which can be achieved by optimizing resource use into a seamless service flow and by maximizing productivity through usage of appropriate service scheduling methods, and tools or techniques. Adapted from [46].
Customer Relationship	Customers are people or organization who receives, use, or purchase products or services, and they can choose different goods and suppliers. Customer relationship refers to the establishment of a relationship with the customers by obtaining information about their needs and wants customers for better understanding of their preferences. This relationship is also important in deciding the value and quality of service from their perspective, and all worthless activities can be targeted for elimination. Adapted from [46]–[48].
Visual Information System	Visual information system refers to an information system that delivers prompt and useful flow of information to relevant decision-makers to obtain quick feedback and corrective actions. This is achieved by using certain visual tools for different purposes in the workplace, such as visual boards, operational status, and performance information that enable the specific personnel to perform tasks appropriately according to company goals. Adapted from [32], [46], [47]

TABLE IV. CURRENT DEFINITIONS OF DIGITAL TRANSFORMATION

Author (s)	Definition
Matt et al. (2015)	Digital transformation strategy is a blueprint that supports organization in governing the transformations that arise owing to the integration of digital technologies, as well as in their operations after a transformation.
Hess et al. (2016)	Digital transformation is concerned with the changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or the automation of processes. These changes can be seen in the rising demand for Internet-based media, which has led to changes in the entire business models (for example, in the music industry).
Liere-Netheler et al. (2018)	The use of new digital technologies (social media, mobile, analytics, or embedded devices) to enable significant business improvements (such as enhancing customer experience, streamlining operations, or creating new business models).
Horlach et al. (2017)	Digital transformation as encompassing the digitization of sales and communication channels, and the digitization of a firm's offerings (products and services), which replaces or augments physical offerings. Furthermore, digital transformation entails tactical and strategic business moves that are triggered by data-driven insights and the launch of digital business models that allow new ways of capturing value.
Westerman et al. (2011) Westerman et al. (2014) Karagiannaki et al. (2017)	The use of technology to radically improve performance or reach of enterprises.

Source: [52]

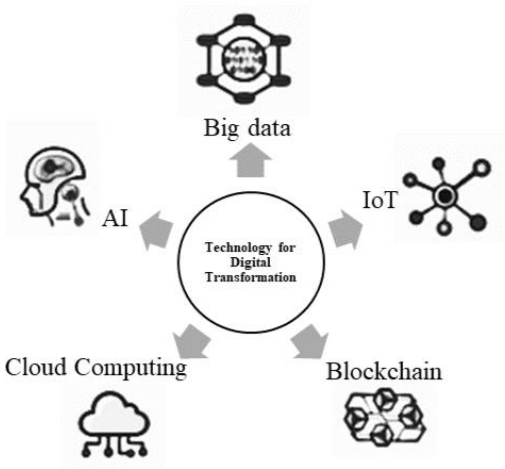

Fig. 3. Technology for digital transformation.

1) Big data. Big data is a method and technique to retrieve, collect, manage, and analyse large and complex data in which traditional methods of processing data are difficult [52], [55]. The utilization of big data is also on the rise within the waste management and recycling sector [54]. On the other hand, the use of big data requires for careful planning and implementation [56].

2) Internet of Things (IoT). This is one of the technologies essential in the evolution of services, and in increasing customer value [57]. IoT involves the connectivity of physical objects to the Internet or other interconnected systems using sensors and actuators [52]. The communication and exchange of data among physical objects can be performed using IoT. The progress in IoT is not restricted solely to Industry 4.0, as it is also concurrent with the evolution of the service transformation [57].

3) Blockchain. Currently, several study fields are paying attention to a new technology known as blockchain [58]. which has become a top technology layer for financial applications [59]. It is practical and appropriate for network providers to trade processing and networking resources using a blockchain-based solution [60]. Blockchain has generated interests as an innovative technology that has the potential to provide substantial cost reductions by allowing transactions to be carried out as peer-to-peer operations directly between users [61]. Using blockchain platforms for service institutions is crucial for specific purposes [62].

4) Cloud computing. Cloud computing makes it possible for information to be distributed effectively, regardless of the location [53]. This technology plays a significant role in the service industry; customers want to reduce costs, whilst cloud computing service providers provide their customers with services that maximize their earnings [63]. It refers to the delivery of various computing services, and builds on well-established trends for reducing the cost of service delivery [64].

5) Artificial Intelligence (AI). Artificial intelligence allows for precise decision-making that offers significant time and cost savings through data collection, forecasting, and trend analysis [65]. For the last two decades, AI has greatly improved the performance of the manufacturing and service industries [66]. AI can also be used for a wide range of tasks, such as identifying data trends to reduce market risks, improving customer service with the help of virtual assistants, and analysing large document repositories spread across numerous servers within an organization to find instances of compliance violations [65].

Digital transformation is reshaping the service industry in profound ways. The integration of technologies such as big data, IoT, blockchain, cloud computing, and AI is driving a fundamental shift in the way service organizations operate and engage with their customers. This transformation enhances operational efficiency, and enables for personalized customer experiences. By using these digital technologies, service providers may go beyond the customers' expectations.

III. METHOD

A. Research Design

During the research design phase, we meticulously reviewed current methodologies employed in studying lean methods within the service industry. Our investigation entailed a comprehensive examination of a variety of qualitative and quantitative approaches. Table V shows the quantitative versus qualitative approaches.

The quantitative approach involves statistical analysis to analyse trends and relationships, comparing results with

predictions and past research, while the qualitative approach focuses on descriptive data analysis, identifying themes through text analysis, and interpreting findings within the study's context [68]. The case study approach encompasses a set of methods that emphasize the choice between a qualitative or quantitative approach [69].

TABLE V. QUANTITATIVE VERSUS QUALITATIVE APPROACHES

Quantitative approach	Qualitative approach
Measure objective facts	Construct social reality, cultural meaning
Focus on variable	Focus on interactive processes, events
Reliability the key factor	Authenticity the key factor
Value free	Values present and explicit
Separate theory and data	Theory and data fused
Independent of context	Situationally constrained
Many cases, subjects	Few cases, subjects
Statistical analysis	Thematic analysis
Researcher detached	Researcher involved

Source: [67]

A qualitative method was used in this study to achieve the aim of gaining understanding about lean in the service industry. The decision to adopt a qualitative approach is based on its capability to thoroughly explore the detailed complexities and subjective aspects of implementing lean principles within the service industry.

A qualitative method is an approach that requires the researcher to approach the study subject directly; to observe, listen, ask, and verify [70]. This method explores the informants' perspectives in order to comprehend a group or phenomena [71]. The purpose of qualitative data collection is to determine the types of data that will answer the research questions [68]. As shown in Fig. 4, this study was conducted in three phases, which included (1) Data collection, (2) Analysis, and (3) Result.

Fig. 4. Research design.

B. Phase 1: Data Collection

Data collection for this study was performed through focus group interview, observation, and audio-visual materials.

1) Interview protocol: An interview protocol was developed to validate the conceptual model. Questions on the interview protocol were used to collect data for model validation. The goal of a study is outlined in its interview protocol [72]. The interview protocol used in this study is a semi-structured interview; the interview is performed based on the questions and sequence of questions pre-determined by the interviewer, and the important content is recorded during the interview session [71].

The interview protocol was constructed by designing questions based on the components in the conceptual model. There are thirty-nine questions that are divided into five parts; Part A: Demographics, Part B: Dimension of Lean in Services, Part C: Relationship among the Dimensions of Lean, Part D: Relationship between the Dimension of Lean and Waste, and Part E: Role of Information Technology in Lean Implementation. Table VI shows the number of questions for each section in the interview protocol for model validation.

The content of the interview protocol has been validated prior to the interview session. The experts in lean commented on every question of the protocol. Four experts took part in validating this protocol; two are academicians actively engaged in lean research, and the other two are from the industry with knowledge of lean. These four experts were approached and invited by e-mail; they were given the protocol interview and one week to complete the evaluation.

A document having the interview questions was given to each informant prior to the interview so that they are familiar with the questions to be posed during the interview session. The interview began with an explanation of the lean conceptual model for the service industry before moving on to the structured questions.

2) Focus group interview: The purpose of the focus group interview is to validate the conceptual model. Focus group interview can be used to discuss issues at a more strategic level [73]. Focus group interview allows for multiple informants to be simultaneously interviewed [72]. A purposive sampling procedure was used to choose the sample for this study. However, as purposive sampling is a frequent case study methodology strategy and will yield the most information about the subject under study, snowball sampling was used [74].

Focus group interview usually consists of four to six informants [68]. Thus, four informants were identified from the researcher's initial contact with workers from the case study companies, and were then selected for the interview. A network was later created by asking41 the first group of informants to refer more informants for the focus group interview. Table VII is four informants who expressed their interest in taking part in this study.

TABLE VI. NUMBER OF INTERVIEW PROTOCOL QUESTIONS

Part	Total
Part A: Demographics	8
Part B: Dimension of Lean in Services	8
Part C: Relationship Among Dimensions of Lean	4
Part D: Relationship between Dimension of Lean and Waste	17
Part E: Role of Information Technology in Lean Implementation	2
Total question(s)	39

TABLE VII. LIST OF INFORMANTS FOR INTERVIEW

Informant number	Role	Years of experience
IN1	Warehouse Executive	16
IN2	Cargo Operation Executive	3
IN3	Cargo Operation Officer	1
IN4	Cargo Operation Officer	1 1/2

Focus group interview informants were contacted to obtain their consent to take part in the interview session. A total of four informants were contacted, to whom the interview protocol was sent via email prior to the interview session in preparation for the interview.

The focus group interview session lasted for 73 minutes involving a conversation between the researcher and the informants to obtain relevant data and information. The data and information include; types of dimensions in services, the relationship among the dimensions, the relationship between waste and the dimensions, and the role of information technology in the implementation of lean.

The interview session was physically conducted at the meeting room of the case study company on September 1, 2022. Prior to the session, permission was sought from the informants for the conversation to be recorded [75] using a voice recorder. Although the researcher controlled the discussion by asking questions based on the interview protocol questions, the informants were given the opportunity to speak and share their views freely.

3) Observation: The purpose of the observation is to validate the conceptual model. Observation is one of the processes of gathering information openly, directly by observing people and places at the site of the study [68]. The data obtained from the observation in this study are in the form of audio-visual materials and field notes. Since permission to observe the interview was granted for only 60 minutes, it was conducted on September 1, 2022, at the case study company. The researcher was accompanied by three employees from the case study company who understand the operational processes of their company. They consist of a warehouse executive, a cargo operation executive, and a cargo operation officer.

The role of the researcher was only as an observer, not a participant. Non-participant observers are observers who visit the site and record data without being involved in the activities of the participants [68]. Observation of the operational process was performed with the guidance from the three workers who explained the activities that take place in each process.

4) Audio-visual material: Data collection was audio-visual materials that made up of photos or sounds of people or locations captured by the researcher or another person to assist the researcher in comprehending the core phenomenon under investigation [68]. During the observation, audio-visual materials such as pictures and videos of the process were taken.

C. Phase 2: Analysis

Qualitative data analysis involves the systematic process of identifying meaningful information from the data obtained. In this study, qualitative data was obtained from focus group interview, observation, and audio-visual materials. Fig. 5 is a guideline used in analysing the qualitative data [68]. Prior to the data analysis process, focus group interview data and observations were collected and organized into file folders on the computer. Then the interview data was transcribed by the researcher as data preparation for analysis. The collected data were read repeatedly to comprehend the coding of the data. Encoding the data is conducted for analytical reports.

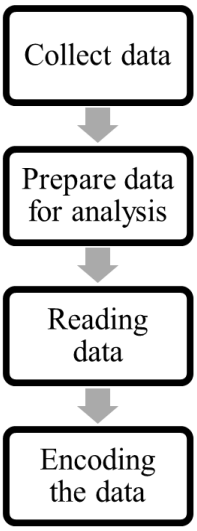

Fig. 5. Qualitative data analysis process.

1) Data transcription: Transcription is frequently used in qualitative research [76]. Transcribing an interview involves converting audiotape recordings into text data [68]. There are no common guidelines or procedures for transcription [77]. Hence, below are four steps used in transcribing the interview of this study:

- Prepare data during interview by recording the conversation.
- Listen to the recording multiple times when transcribing.
- Identify the informants and label them accordingly while transcribing.
- Use timestamps to show when an informant starts or stops speaking.

2) Themes and code: Analysis of the data was conducted using a computer software program for qualitative data, such as interview transcripts and pictures, using Atlas.ti. The data was explored and coded by reading all data collection and then employing the codes. Codes were also collected to create themes that were used as the main findings of the study [68]. Before the data were coded, code themes were decided based on the type of waste and dimension of lean service.

3) Validation and reliability: Triangulation is the use of different sources of information to help confirm and improve the clarity or accuracy of research findings [73]. Triangulation is also seen as a qualitative research strategy to test validity through the convergence of information from different sources [78]. The same interview protocol was used for all case study informants during triangulation to increase reliability [79]. This study has chosen a combination of data from focus group interviews and observations to provide triangulation results [80]. Triangulation is used to support the principle in case studies that phenomena are seen and explored from multiple perspectives [81].

D. Phase 3: Result

A conceptual model was developed and revised through a case study after the analysis of the data collection was performed. A case study is an intense description and analysis of an experience, social unit, or system related to time or place [82]. A qualitative case study is an ideal method for understanding and interpreting experience. The qualitative case study methodology enables researchers to carry out a thorough investigation of complex phenomena within a particular setting [83].

IV. RESULTS

To answer the research question "How can the integration of lean principles and digital transformation lead to waste reduction in service organizations?", the qualitative data approach has been carried out. The qualitative method has been successful in gathering feedback from the informants about the dimensions of lean in services, relationship among the dimensions of lean, relationship between the dimension of lean and waste, and the role of information technology in lean implementation. Fig. 6 shows the lean conceptual model that has been developed for the service industry.

In this study, dimensions are defined as functional areas that carry out specific activities and roles in an organization in achieving the organizational goals. There are seven dimensions of lean that exist in the service industry, namely:

- Lean Supplier
- Lean Workforce Management
- Lean Operations and Technology Development
- Lean Service Provision Process
- Lean Service Planning and Scheduling
- Customer Relations
- Visual Information System

Next, in the manufacturing industry, the product production process can be represented as an input-output model, where resources in the form of raw materials will be transformed into finished products due to the output of the system. All informants agreed that all seven dimensions stated can also be represented as input-output processes in the service industry. All the phases in the lean conceptual model will be created based on user or consumer demand.

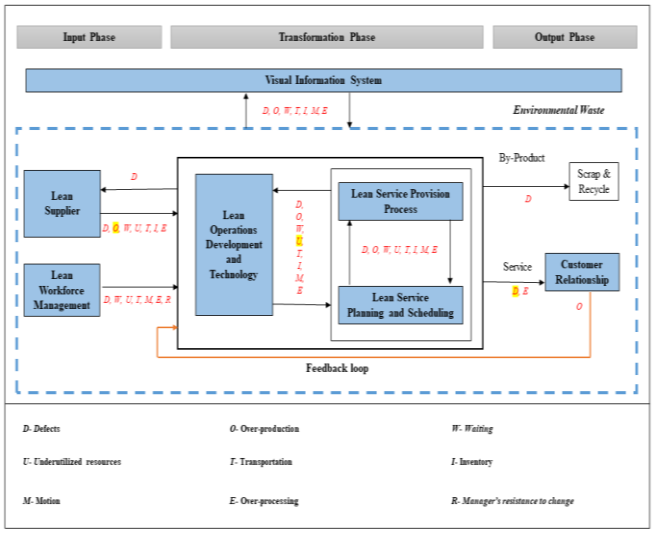

Fig. 6. Lean service conceptual model (Adapted from [46]).

According to the informants, the lean conceptual model reflects the detailed service operations of the informants' company; business activity must be conducted when there is a demand. All dimensions and their relationships cannot be less than one since the dimensions are interrelated, as specified by the researcher in the initial conceptual model.

Analysis of the data revealed that the informants' organization has nine types of wastes, namely over-production, inventory, waiting, motion, transportation, defect, over-processing, underutilized resources, and manager's resistance to change. According to the informants, the types and examples of wastes are easy to be figured out because they are visible to the naked eyes. Identified waste and its types are particularly important in implement lean service; waste must be identified so that the cause of the problem can be addressed.

TABLE VIII. EXAMPLES OF WASTE IN LEAN DIMENSIONS

Dimension	Waste(s)
Lean Supplier	Defect, Over-production, Waiting, Underutilized resources, Transportation, Inventory, Over-processing.
Lean Workforce Management	Defect, Waiting, Underutilized resources, Transportation, Over-processing, Manager's resistance to change.
Lean Operations Development and Technology	Defect, Over-production, Waiting, Underutilized resources, Transportation, Inventory, Over-processing.
Lean Service Provision Process	Defect, Over-production, Waiting, Underutilized resources, Transportation, Inventory, Over-processing.
Lean Service Planning and Scheduling	Defect, Over-production, Waiting, Underutilized resources, Transportation, Inventory, Over-processing.
Customer Relationship	Defect, Over-processing.
Visual Information System	Defect, Over-production, Waiting, Transportation, Inventory, Over-processing.

The informants agreed with the proposed dimensions and wastes of the initial conceptual model. However, after analysis, additional waste on several dimensions was discovered as highlighted in the lean conceptual model shown in Fig. 6; over-

production waste is added to the lean supplier dimension, underutilized resources waste is added to the lean operations and technology development dimension, lean service provision process dimension, and lean service planning and scheduling dimension, and defect waste is added in the customer relations dimension. Waste in the seven dimension of the lean conceptual model is illustrated in Table VIII.

According to two informants, IT plays a critical role in assisting with the implementation of lean in the organization. To aid in the application of lean in the service industry, a system must be established. Knowing where waste occurs is a required system feature. However, according one of the informants, they do not require a system to figure out waste because they are more comfortable executing the work manually.

V. Discussion

This research was carried out to provide a preliminary overview of the validation of a conceptual model for lean service in the service industry. Initially, lean conceptual models are developed based on the literature review and preliminary research where types of waste and dimensions in lean service are identified. However, in this study, we limit the development of our conceptual model by focusing on the types of waste and dimensions in lean service using a qualitative method. The data for this study were gathered via focus group interview, observation, and audio-visual sources [68].

The results of this study revealed that the proposed Lean Conceptual Model for the service industry is applicable. This is because the service operation in the case study company shares the same dimensions of lean, relationships among the dimensions of lean, and relationships between dimensions of lean and waste. Thus, this study has found nine types of waste with seven lean dimensions.

The types of waste identified are over-production, inventory, waiting, motion, transportation, defects, over-processing, underutilized resources, and manager's resistance to change. The seven lean dimensions identified are Lean Supplier, Lean Workforce Management, Lean Operations and Technology Development, Lean Service Provision Process, Lean Service Planning and Scheduling, Customer Relationship, and Visual Information Systems.

The Lean Service Conceptual Model for the service industry can be aligned with the existing digital transformation technologies such as big data, IoT, blockchain, cloud computing, and AI. By harnessing the capabilities of these technologies, organizations will not only embrace lean principles but also propel their service operations into a new era of efficiency and effectiveness [84].

Across all the Lean Service Conceptual Model's dimensions, big data analytics is crucial for reducing waste [85]. Organizations develop the ability to identify and reduce distinct types of waste through the analysis of significant data produced throughout its service operations. As an example, within the Lean Supplier dimension, data analytics can optimize inventory management, leading to a decrease in excess inventory waste. These analytics can help with resource allocation in the context of lean service planning and scheduling [56] and reduce waste [86].

IoT devices emerge as pivotal assets in the alignment of dimensions within the Lean Service Conceptual Model. These devices assume a crucial role in capturing real-time operational data, seamlessly harmonizing with various dimensions of lean service. They play a crucial role in the efficient use of resources, namely taking care of the Lean Workforce Management component. Moreover, IoT devices effectively monitor the intricacies of service provision processes [87], thereby closely aligning with the Lean Service Provision Process dimension. Furthermore, these tools improve customer experience interaction [88] by encouraging mutually beneficial relationship through the Customer Relationship dimension. The result is a decrease in waste brought on by the ability to make informed decisions made possible by these IoT devices.

Blockchain technology serves as a robust pillar in upholding the core principles of lean service, primarily by instilling trust and transparency, with a particular focus on the Lean Supplier dimension. This technology successfully reduces waste in the supply chain by serving as a strong barrier against flaws and dangerous goods [59]. Moreover, blockchain's capabilities extend to the enhancement of transparency in Customer Relationship dimension, where it securely records interactions and transactions. In addition to fostering more trust, this careful documentation also helps to cut down on processing waste. In summary, the integration of blockchain strengthens lean service by promoting waste reduction, transparency, and trust across the service ecosystem.

In the context of lean service, cloud computing appears as a catalyst for facilitating collaboration [89]. Due to its innate abilities, several lean dimensions can be seamlessly coordinated. TCloud computing transforms into an essential channel for the exchange of real-time information by facilitating improved communication and cooperation across multiple functional areas. Through coordinated efforts and real-time information sharing, this collective method enables organizations to jointly detect and manage waste, strengthening the lean service concepts of efficiency and waste reduction.

Within the context of lean service, AI emerges as a powerful force for automation and greater efficiency. AI proves to be a crucial tool for optimizing operations across all dimensions of lean service thanks to its comprehensive range of automation and predictive analytics capabilities. The Lean Operations Development and Technology dimensions are successfully improved because of how well it performs everyday chores. Additionally, AI is crucial to optimizing resource allocation and integrates perfectly with the Lean Service Planning and Scheduling dimension component. Most significantly, AI helps the Customer Relationship Dimension to offer excellent client experiences [90]. In the process, it simultaneously decreases waste by improving overall process effectiveness, reiterating its function as a major enabler of lean service concept.

VI. Conclusion

This research is aimed at providing a conceptual model that enables service organization to successfully navigate changes

in the environment of the digital era while maximising their operational efficiency by reducing waste in their operation. This research contributes to the types of waste in lean service. Nine types of waste have been identified; over-production, inventory, waiting, motion, transportation, defects, over-processing, underutilized resources, and manager's resistance to change. Seven lean dimensions identified are Lean Supplier, Lean Workforce Management, Lean Operations and Technology Development, Lean Service Provision Process, Lean Service Planning and Scheduling, Customer Relationship, and Visual Information Systems.

This study has successfully validated a Lean Service Conceptual Model for the service industry through the qualitative method by identifying nine types of waste and seven lean dimensions. This research is significant because it proves how well this paradigm aligns with modern digital transformation technologies like big data analytics, IoT, blockchain, cloud computing, and AI. These technologies are essential for reducing waste, optimizing resources, encouraging collaboration, and automating all aspects of lean service. This integration highlights the model's adaptability, positioning it as a catalyst for service organizations to thrive in a digitally transformed landscape characterized by enhanced efficiency and effectiveness, with a primary focus on waste reduction within service operations.

Thus, the contribution of this study provides a solid foundation to ensure efficient achievement or performance in the service industry. The constraint of this study is in the limitation of the number of companies for the case study. The pandemic that hit when the study was conducted has caused the ability to interact with various organizations in the service industry to be limited; only one company was ready to take part as a case study company for this study.

In the realm of future research endeavours, it is recommended for the inclusion of case study companies to be expanded, with a deliberate focus on diverse sectors within the service industry. This approach aims to mitigate potential bias in research outcomes and offers a more comprehensive understanding of how the Lean Service Conceptual Model aligns with digital transformation technologies across different service contexts.

Additionally, exploring and reviewing the array of best practices, techniques, and tools available for waste reduction within organizational operations is paramount. Such investigations can unveil effective measures that organizations can readily implement to enhance operational efficiency and minimize waste, contributing to a more sustainable and lean service ecosystem. These research directions hold the potential to further advance our knowledge and practical insights in the pursuit of lean service excellence.

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